Main Criteria: Mississippi Standards and Frameworks
Secondary Criteria: JoVE
Subject: Science
Grade: 9-12
Correlation Options: Show Correlated
Adopted: 2010

COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
INDICATOR	1.a.1.	Safety symbols and safety rules in all laboratory activities JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Common Lab Glassware and Uses • Conducting Reactions Below Room Temperature • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Making Solutions in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Understanding Concentration and Measuring Volumes
INDICATOR	1.a.2.	Proper use and care of the compound light microscope JoVE • Common Lab Glassware and Uses
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers JoVE • Common Lab Glassware and Uses
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.

NUMBERED ITEMS	**1.c.**	**Identify and apply components of scientific methods in classroom investigations. (DOK 3)**
INDICATOR	**1.c.2.**	**Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)** **<u>JoVE</u>** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Chromatography-Based Biomolecule Purification Methods** **• Column Chromatography** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Cyclic Voltammetry (CV)** **• Determining Rate Laws and the Order of Reaction** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Fractional Distillation** **• Förster Resonance Energy Transfer (FRET)** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Growing Crystals for X-ray Diffraction Analysis** **• High-Performance Liquid Chromatography (HPLC)** **• Ideal Gas Law** **• Internal Standards** **• Introduction to Catalysis** **• Introduction to Mass Spectrometry** **• Introduction to Titration** **• Introduction to the Microplate Reader** **• Ion-Exchange Chromatography** **• Le Châtelier's Principle** **• MALDI-TOF Mass Spectrometry** **• Making Solutions in the Laboratory** **• Metabolic Labeling** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Performing 1D Thin Layer Chromatography** **• Photometric Protein Determination** **• Protein Crystallization** **• Purifying Compounds by Recrystallization** **• Raman Spectroscopy for Chemical Analysis** **• Separation of Mixtures via Precipitation** **• Solid-Liquid Extraction** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant** **• Surface Plasmon Resonance (SPR)** **• Tandem Mass Spectrometry** **• The Ideal Gas Law**

		• Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes
COMPETENCY	**MS.PS.**	**Physical Science**
OBJECTIVE	**PS.1.**	**Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
NUMBERED ITEMS	**1.d.**	**Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs.) (DOK 2)** **JoVE** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Chromatography-Based Biomolecule Purification Methods** **• Column Chromatography** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Cyclic Voltammetry (CV)** **• Determining Rate Laws and the Order of Reaction** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Fractional Distillation** **• Förster Resonance Energy Transfer (FRET)** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Growing Crystals for X-ray Diffraction Analysis** **• High-Performance Liquid Chromatography (HPLC)** **• Ideal Gas Law** **• Internal Standards** **• Introduction to Catalysis** **• Introduction to Mass Spectrometry** **• Introduction to Titration** **• Introduction to the Microplate Reader** **• Ion-Exchange Chromatography** **• Le Châtelier's Principle** **• MALDI-TOF Mass Spectrometry** **• Making Solutions in the Laboratory** **• Metabolic Labeling** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Performing 1D Thin Layer Chromatography** **• Photometric Protein Determination** **• Protein Crystallization** **• Purifying Compounds by Recrystallization** **• Raman Spectroscopy for Chemical Analysis** **• Separation of Mixtures via Precipitation** **• Solid-Liquid Extraction** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant**

		• Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The Ideal Gas Law • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
NUMBERED ITEMS	1.e.	Analyze procedures and data to draw conclusions about the validity of research. (DOK 3) JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Cyclic Voltammetry (CV) • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • Method of Standard Addition • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Raman Spectroscopy for Chemical Analysis • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Two-Dimensional Gel Electrophoresis • X-ray Fluorescence (XRF)
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.2.	Physical Science: Describe and explain how forces affect motion.
NUMBERED ITEMS	2.d.	Draw and assess conclusions about charges and electric current. (DOK 2)
INDICATOR	2.d.1.	Static/current electricity and direct current/alternating current JoVE • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Nuclear Magnetic Resonance (NMR) Spectroscopy • Testing For Genetically Modified Foods
INDICATOR	2.d.3.	Conductors and insulators JoVE

		• Assembly of a Reflux System for Heated Chemical Reactions • Surface Plasmon Resonance (SPR)
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.2.	Physical Science: Describe and explain how forces affect motion.
NUMBERED ITEMS	2.e.	Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's Law). (DOK 2) JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy • Object Substitution Masking • Tandem Mass Spectrometry • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.3.	Physical Science: Demonstrate an understanding of general properties and characteristics of waves.
NUMBERED ITEMS	3.a.	Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1) JoVE • Raman Spectroscopy for Chemical Analysis
NUMBERED ITEMS	3.b.	Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler Effect) and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2) JoVE • Abdominal Exam II: Percussion • Auscultation • Color Afterimages • Crowding • Finding Your Blind Spot and Perceptual Filling-in • Histological Sample Preparation for Light Microscopy • Inattentional Blindness • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Just-noticeable Differences • Motion-induced Blindness • Nuclear Magnetic Resonance (NMR) Spectroscopy

		• Object Substitution Masking • Percussion • Peripheral Vascular Exam Using a Continuous Wave Doppler • Raman Spectroscopy for Chemical Analysis • Spatial Cueing • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • The Ames Room • The Attentional Blink • The Inverted-face Effect
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.3.	Physical Science: Demonstrate an understanding of general properties and characteristics of waves.
NUMBERED ITEMS	3.c.	Classify the electromagnetic spectrum's regions according to frequency and/or wavelength and draw conclusions about their impact on life. (DOK 2)
INDICATOR	3.c.1.	The emission of light by electrons when moving from higher to lower levels JoVE • Coordination Chemistry Complexes • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Introduction to Fluorescence Microscopy • Introduction to the Microplate Reader • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • MALDI-TOF Mass Spectrometry • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Tandem Mass Spectrometry • X-ray Fluorescence (XRF)
INDICATOR	3.c.2.	Energy (photons as quanta of light) JoVE • Förster Resonance Energy Transfer (FRET) • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	3.c.3.	Additive and subtractive properties of colors JoVE • Color Afterimages

INDICATOR	3.c.4.	Relationship of visible light to the color spectrum JoVE • Color Afterimages
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.3.	Physical Science: Demonstrate an understanding of general properties and characteristics of waves.
NUMBERED ITEMS	3.d.	Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1) JoVE • Auscultation • Percussion • The Staircase Procedure for Finding a Perceptual Threshold
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.4.	Physical Science: Develop an understanding of the atom.
NUMBERED ITEMS	4.a.	Cite evidence to summarize the atomic theory. (DOK 1)
INDICATOR	4.a.3.	Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.) JoVE • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Scanning Electron Microscopy (SEM) • X-ray Fluorescence (XRF)
INDICATOR	4.a.4.	Atomic orbitals (s, p, d, f) and their basic shapes JoVE • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.4.	Physical Science: Develop an understanding of the atom.
NUMBERED ITEMS	4.b.	Explain the difference between chemical and physical changes and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2) JoVE • An Introduction to Cell Metabolism • An Introduction to the Centrifuge • Assembly of a Reflux System for Heated Chemical Reactions

		• Calibration Curves • Capillary Electrophoresis (CE) • Carbon and Nitrogen Analysis of Environmental Samples • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Dialysis: Diffusion Based Separation • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Titration • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Tandem Mass Spectrometry • The ATP Bioluminescence Assay • The ELISA Method • Two-Dimensional Gel Electrophoresis • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.4.	Physical Science: Develop an understanding of the atom.

NUMBERED ITEMS	**4.c.**	**Research the history of the periodic table of the elements and summarize the contributions which led to the atomic theory. (DOK 2)**
INDICATOR	**4.c.1.**	**Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrodinger, etc.)** **JoVE** **• Ideal Gas Law** **• Rotary Evaporation to Remove Solvent** **• The Ideal Gas Law**
INDICATOR	**4.c.2.**	**Technology (e.g., x-rays, cathode-ray tubes, spectroscopes)** **JoVE** **• An Introduction to the Micropipettor** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Chromatography-Based Biomolecule Purification Methods** **• Co-Immunoprecipitation and Pull-Down Assays** **• Column Chromatography** **• Common Lab Glassware and Uses** **• Community DNA Extraction from Bacterial Colonies** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Cyclic Voltammetry (CV)** **• Degassing Liquids with Freeze-Pump-Thaw Cycling** **• Density Gradient Ultracentrifugation** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Determining Rate Laws and the Order of Reaction** **• Determining the Density of a Solid and Liquid** **• Determining the Empirical Formula** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Determining the Solubility Rules of Ionic Compounds** **• Dialysis: Diffusion Based Separation** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Electrophoretic Mobility Shift Assay (EMSA)** **• Enzyme Assays and Kinetics** **• Fractional Distillation** **• Freezing-Point Depression to Determine an Unknown Compound** **• Förster Resonance Energy Transfer (FRET)** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Growing Crystals for X-ray Diffraction Analysis**

		• High-Performance Liquid Chromatography (HPLC) • Ideal Gas Law • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Measuring Mass in the Laboratory • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Nutrients in Aquatic Ecosystems • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Plasmid Purification • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Reconstitution of Membrane Proteins • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The Ideal Gas Law • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter • X-ray Fluorescence (XRF) • Yeast Maintenance

COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.4.	Physical Science: Develop an understanding of the atom.
NUMBERED ITEMS	4.d.	Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
INDICATOR	4.d.1.	Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions) JoVE • Coordination Chemistry Complexes • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry
INDICATOR	4.d.2.	Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius) JoVE • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Determining the Solubility Rules of Ionic Compounds • Introduction to Mass Spectrometry • Surface Plasmon Resonance (SPR) • X-ray Fluorescence (XRF)
INDICATOR	4.d.3.	Average atomic mass from isotopic abundance JoVE • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry
INDICATOR	4.d.4.	Solids, liquids, and gases JoVE • Degassing Liquids with Freeze-Pump-Thaw Cycling • Fractional Distillation • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • Ideal Gas Law • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Protein Crystallization • Purifying Compounds by Recrystallization • Schlenk Lines Transfer of Solvents

		• Separation of Mixtures via Precipitation • Solid-Liquid Extraction • The Ideal Gas Law
INDICATOR	4.d.5.	Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table JoVE • Coordination Chemistry Complexes
COMPETENCY	MS.PS.	Physical Science
OBJECTIVE	PS.5.	Physical Science: Investigate and apply principles of physical and chemical changes in matter.
NUMBERED ITEMS	5.a.	Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1) JoVE • Determining the Empirical Formula
NUMBERED ITEMS	5.b.	Balance chemical equations. (DOK 2) JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determining Rate Laws and the Order of Reaction • Determining the Empirical Formula • Determining the Solubility Rules of Ionic Compounds • Introduction to Catalysis • Introduction to Titration • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
NUMBERED ITEMS	5.c.	Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2) JoVE • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Determining Rate Laws and the Order of Reaction • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat

		• Enzyme Assays and Kinetics • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Introduction to Titration • Le Châtelier's Principle • Photometric Protein Determination • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Separation of Mixtures via Precipitation • Spectrophotometric Determination of an Equilibrium Constant • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs) draw conclusions and make inferences. (DOK 3) JoVE • Introduction to the Microplate Reader
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.2.	Physical Science: Develop an understanding of concepts related to forces and motion.
NUMBERED ITEMS	2.a.	Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
INDICATOR	2.a.4.	Relations among mass, inertia, and weight JoVE • Determining the Density of a Solid and Liquid • Measuring Mass in the Laboratory
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.2.	Physical Science: Develop an understanding of concepts related to forces and motion.
NUMBERED ITEMS	2.d.	Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
INDICATOR	2.d.2.	Concept of centripetal acceleration undergoing uniform circular motion

		JoVE • An Introduction to the Centrifuge
INDICATOR	2.d.4.	Oscillatory motion and the mechanics of waves JoVE • Determining the Empirical Formula • Raman Spectroscopy for Chemical Analysis
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.3.	Physical Science: Develop an understanding of concepts related to work and energy.
NUMBERED ITEMS	3.a.	Explain and apply the conservation of energy and momentum. (DOK 2)
INDICATOR	3.a.5.	Principles of impulse in inelastic and elastic collisions JoVE • Raman Spectroscopy for Chemical Analysis
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.3.	Physical Science: Develop an understanding of concepts related to work and energy.
NUMBERED ITEMS	3.c.	Apply the principles of impulse and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1) JoVE • Raman Spectroscopy for Chemical Analysis
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.3.	Physical Science: Develop an understanding of concepts related to work and energy.
NUMBERED ITEMS	3.d.	Investigate and summarize the principles of thermodynamics. (DOK 2)
INDICATOR	3.d.1.	How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached JoVE • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	3.d.2.	Temperature and thermal energy as related to molecular motion and states of matter JoVE • Fractional Distillation • Ideal Gas Law • The Ideal Gas Law
INDICATOR	3.d.3.	Problems involving specific heat and heat capacity JoVE

		• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.3.	Physical Science: Develop an understanding of concepts related to work and energy.
NUMBERED ITEMS	3.e.	Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2) JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.4.	Physical Science: Discuss the characteristics and properties of light and sound.
NUMBERED ITEMS	4.a.	Describe and model the characteristics and properties of mechanical waves. (DOK 2)
INDICATOR	4.a.2.	Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength JoVE • Auscultation • Percussion • The Staircase Procedure for Finding a Perceptual Threshold
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.4.	Physical Science: Discuss the characteristics and properties of light and sound.
NUMBERED ITEMS	4.b.	Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1) JoVE • Peripheral Vascular Exam Using a Continuous Wave Doppler
NUMBERED ITEMS	4.e.	Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2) JoVE • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.5.	Physical Science: Apply an understanding of magnetism, electric fields, and electricity.
NUMBERED ITEMS	5.a.	Analyze and explain the relationship between electricity and magnetism. (DOK 2)

INDICATOR	5.a.3.	Magnetic poles, magnetic flux and field, Ampere's law and Faraday's law JoVE • Gas Chromatography (GC) with Flame-Ionization Detection
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.5.	Physical Science: Apply an understanding of magnetism, electric fields, and electricity.
NUMBERED ITEMS	5.c.	Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2) JoVE • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.6.	Physical Science: Analyze and explain concepts of nuclear physics.
NUMBERED ITEMS	6.a.	Analyze and explain the principles of nuclear physics. (DOK 1)
INDICATOR	6.a.1.	The mass number and atomic number of the nucleus of an isotope of a given chemical element JoVE • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Tandem Mass Spectrometry
COMPETENCY	MS.PH.	Physics
OBJECTIVE	PH.6.	Physical Science: Analyze and explain concepts of nuclear physics.
NUMBERED ITEMS	6.b.	Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
INDICATOR	6.b.1.	Quantum energy and emission spectra JoVE • Coordination Chemistry Complexes • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Introduction to Fluorescence Microscopy • Introduction to the Microplate Reader • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • MALDI-TOF Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy

		• Protein Crystallization • Raman Spectroscopy for Chemical Analysis • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	**MS.C.**	**Chemistry**
OBJECTIVE	**C.1.**	**Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
NUMBERED ITEMS	**1.d.**	**Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)** **JoVE** • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Fractional Distillation • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ideal Gas Law • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Le Châtelier's Principle • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Protein Crystallization • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Separation of Mixtures via Precipitation • Solid-Liquid Extraction

		• Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The Ideal Gas Law • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Cyclic Voltammetry (CV) • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • Method of Standard Addition • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Raman Spectroscopy for Chemical Analysis • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Two-Dimensional Gel Electrophoresis • X-ray Fluorescence (XRF)
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.2.	Physical Science: Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
NUMBERED ITEMS	2.a.	Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
INDICATOR	2.a.1.	Physical properties (e.g., melting points, densities, boiling points)of a variety of substances JoVE • Common Lab Glassware and Uses • Determining the Density of a Solid and Liquid

		• Determining the Mass Percent Composition in an Aqueous Solution • Freezing-Point Depression to Determine an Unknown Compound
INDICATOR	2.a.2.	Substances and mixtures <u>JoVE</u> • An Introduction to Cell Metabolism • An Introduction to the Centrifuge • An Introduction to the Micropipettor • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Calibration Curves • Capillary Electrophoresis (CE) • Carbon and Nitrogen Analysis of Environmental Samples • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Common Lab Glassware and Uses • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Dialysis: Diffusion Based Separation • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC)

		• Internal Standards • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Method of Standard Addition • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • The ATP Bioluminescence Assay • The ELISA Method • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
INDICATOR	2.a.3.	Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Conducting Reactions Below Room Temperature • Degassing Liquids with Freeze-Pump-Thaw Cycling • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization

		Detection • Growing Crystals for X-ray Diffraction Analysis • Ideal Gas Law • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • The Ideal Gas Law • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.2.	Physical Science: Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
NUMBERED ITEMS	2.c.	Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
INDICATOR	2.c.1.	Properties and interactions of the three fundamental particles of the atom JoVE • Coordination Chemistry Complexes • Scanning Electron Microscopy (SEM) • X-ray Fluorescence (XRF)
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.2.	Physical Science: Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
NUMBERED ITEMS	2.d.	Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
INDICATOR	2.d.1.	Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power) JoVE • Analysis of Earthworm Populations in Soil • Carbon and Nitrogen Analysis of Environmental Samples • Dissolved Oxygen in Surface Water • Filamentous Fungi

		• Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR
INDICATOR	2.d.2.	The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process JoVE • Determining Rate Laws and the Order of Reaction
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.2.	Physical Science: Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
NUMBERED ITEMS	2.e.	Compare the properties of compounds according to their type of bonding. (DOK 1)
INDICATOR	2.e.1.	Covalent, ionic, and metallic bonding JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Determining the Solubility Rules of Ionic Compounds • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
INDICATOR	2.e.2.	Polar and non-polar covalent bonding JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis

		• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ion-Exchange Chromatography • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	2.e.3.	Valence electrons and bonding atoms JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Raman Spectroscopy for Chemical Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.2.	Physical Science: Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

NUMBERED ITEMS	2.f.	Compare different types of intermolecular forces and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1) JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Column Chromatography • Determining the Density of a Solid and Liquid • Determining the Mass Percent Composition in an Aqueous Solution • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ideal Gas Law • Performing 1D Thin Layer Chromatography • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Separation of Mixtures via Precipitation • The Ideal Gas Law
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.3.	Physical Science: Develop an understanding of the periodic table.
NUMBERED ITEMS	3.a.	Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1) JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determining Rate Laws and the Order of Reaction • Determining the Empirical Formula • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration

		• Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.3.	Physical Science: Develop an understanding of the periodic table.
NUMBERED ITEMS	3.b.	Analyze patterns and trends in the organization of elements in the periodic table and compare their relationship to position in the periodic table. (DOK 2)
INDICATOR	3.b.1.	Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements JoVE • Coordination Chemistry Complexes • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Tandem Mass Spectrometry
INDICATOR	3.b.2.	Average atomic mass calculations JoVE • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry
INDICATOR	3.b.3.	Chemical characteristics of each region JoVE • Coordination Chemistry Complexes • Surface Plasmon Resonance (SPR)
INDICATOR	3.b.4.	Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)

		JoVE • Coordination Chemistry Complexes
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.3.	Physical Science: Develop an understanding of the periodic table.
NUMBERED ITEMS	3.c.	Classify chemical reactions by type. (DOK 2)
INDICATOR	3.c.1.	Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation. JoVE • Co-Immunoprecipitation and Pull-Down Assays • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Determining Rate Laws and the Order of Reaction • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Introduction to Titration • Le Châtelier's Principle • Photometric Protein Determination • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Separation of Mixtures via Precipitation • Spectrophotometric Determination of an Equilibrium Constant • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
INDICATOR	3.c.2.	Products (given reactants) or reactants (given products) for each reaction type JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Biofuels: Producing Ethanol from Cellulosic Material • Calibration Curves • Capillary Electrophoresis (CE) • Co-Immunoprecipitation and Pull-Down Assays • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • DNA Gel Electrophoresis • Determining Rate Laws and the Order of Reaction

		• Determining the Empirical Formula • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Gel Purification • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Introduction to Titration • Ion-Exchange Chromatography • Le Châtelier's Principle • Photometric Protein Determination • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • The Western Blot • Two-Dimensional Gel Electrophoresis • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
INDICATOR	3.c.3.	Solubility rules for precipitation reactions and the activity series for single and double displacement reactions JoVE • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determining Rate Laws and the Order of Reaction • Le Châtelier's Principle • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.3.	Physical Science: Develop an understanding of the periodic table.
NUMBERED ITEMS	3.d.	Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
INDICATOR	3.d.1.	Difference between chemical reactions and chemical equations JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes

		• Determining Rate Laws and the Order of Reaction • Determining the Empirical Formula • Determining the Solubility Rules of Ionic Compounds • Introduction to Catalysis • Introduction to Titration • Le Châtelier's Principle • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	3.d.2.	Formulas and calculations of the molecular (molar) masses JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Determining Rate Laws and the Order of Reaction • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Le Châtelier's Principle • Making Solutions in the Laboratory • Photometric Protein Determination • Sample Preparation for Analytical Preparation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Understanding Concentration and Measuring Volumes
INDICATOR	3.d.3.	Empirical formula given the percent composition of elements JoVE • Density Gradient Ultracentrifugation • Determining the Empirical Formula
INDICATOR	3.d.4.	Molecular formula given the empirical formula and molar mass JoVE

		• Density Gradient Ultracentrifugation • Determining the Empirical Formula
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.4.	Physical Science: Analyze the relationship between microscopic and macroscopic models of matter.
NUMBERED ITEMS	4.a.	Analyze the nature and behavior of gaseous, liquid, and solid substances using the kinetic molecular theory. (DOK 3) JoVE • Fractional Distillation • Ideal Gas Law • The Ideal Gas Law
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.4.	Physical Science: Analyze the relationship between microscopic and macroscopic models of matter.
NUMBERED ITEMS	4.b.	Use the ideal gas laws to explain the relationships between volume, temperature, pressure, and quantity in moles. (DOK 2)
INDICATOR	4.b.1.	Difference between ideal and real gas JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
INDICATOR	4.b.2.	Assumptions made about an ideal gas JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
INDICATOR	4.b.3.	Conditions that favor an ideal gas JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.4.	Physical Science: Analyze the relationship between microscopic and macroscopic models of matter.
NUMBERED ITEMS	4.c.	Use the gas laws of Boyles, Charles, Gay-Lussac, and Dalton to solve problems based on the laws. (DOK 2) JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
COMPETENCY	MS.C.	Chemistry

OBJECTIVE	**C.4.**	**Physical Science: Analyze the relationship between microscopic and macroscopic models of matter.**
NUMBERED ITEMS	**4.d.**	**Explain the thermodynamics associated with physical and chemical concepts related to temperature, entropy, enthalpy, and heat energy. (DOK 2)**
INDICATOR	**4.d.1.**	**Specific heat as it relates to the conservation of energy** **JoVE** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy**
INDICATOR	**4.d.2.**	**Amount of heat absorbed or released in a process, given mass, specific heat, and temperature change** **JoVE** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy**
INDICATOR	**4.d.3.**	**Energy (in calories and joules) required to change the state of a sample of a given substance, using its mass and its heat of vaporization or heat of fusion.** **JoVE** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy**
INDICATOR	**4.d.4.**	**Endothermic or exothermic changes** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Conducting Reactions Below Room Temperature** **• Degassing Liquids with Freeze-Pump-Thaw Cycling** **• Determining Rate Laws and the Order of Reaction** **• Fractional Distillation** **• Freezing-Point Depression to Determine an Unknown Compound** **• Growing Crystals for X-ray Diffraction Analysis** **• Le Châtelier's Principle** **• Preparing Anhydrous Reagents and Equipment** **• Purifying Compounds by Recrystallization** **• Rotary Evaporation to Remove Solvent** **• Schlenk Lines Transfer of Solvents** **• Separation of Mixtures via Precipitation** **• Solid-Liquid Extraction** **• Solutions and Concentrations** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy**
COMPETENCY	**MS.C.**	**Chemistry**
OBJECTIVE	**C.4.**	**Physical Science: Analyze the relationship between microscopic and macroscopic models of matter.**

NUMBERED ITEMS	**4.e.**	**Describe and identify factors affecting the solution process, rates of reaction, and equilibrium. (DOK 2)**
INDICATOR	**4.e.1.**	**Concentration of a solution in terms of its molarity, using stoichiometry to perform specified dilutions** **JoVE** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Determining Rate Laws and the Order of Reaction** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Freezing-Point Depression to Determine an Unknown Compound** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• High-Performance Liquid Chromatography (HPLC)** **• Internal Standards** **• Introduction to Titration** **• Introduction to the Microplate Reader** **• Introduction to the Spectrophotometer** **• Le Châtelier's Principle** **• Making Solutions in the Laboratory** **• Photometric Protein Determination** **• Sample Preparation for Analytical Preparation** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant** **• Understanding Concentration and Measuring Volumes**
INDICATOR	**4.e.2.**	**Chemical reaction rates affected by temperature, concentration, surface area, pressure, mixing, and the presence of a catalyst** **JoVE** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Determining Rate Laws and the Order of Reaction** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Introduction to Catalysis**
INDICATOR	**4.e.3.**	**Relationship of solute character** **JoVE** **• An Introduction to the Micropipettor** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Calibration Curves**

		• Capillary Electrophoresis (CE) • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Determining the Mass Percent Composition in an Aqueous Solution • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Growing Crystals for X-ray Diffraction Analysis • Internal Standards • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Making Solutions in the Laboratory • Method of Standard Addition • Performing 1D Thin Layer Chromatography • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Schlenk Lines Transfer of Solvents • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Understanding Concentration and Measuring Volumes
INDICATOR	4.e.4.	LeChatelier's Principle JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Le Châtelier's Principle • Separation of Mixtures via Precipitation • Spectrophotometric Determination of an Equilibrium Constant
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.5.	Physical Science: Compare factors associated with acid/base and oxidation/reduction reactions.
NUMBERED ITEMS	5.a.	Analyze and explain acid/base reactions. (DOK 2)

INDICATOR	**5.a.1.**	**Properties of acids and bases, including how they affect indicators and the relative pH of the solution** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• High-Performance Liquid Chromatography (HPLC)** **• Introduction to Titration** **• Ion-Exchange Chromatography** **• Le Châtelier's Principle** **• Passaging Cells** **• Two-Dimensional Gel Electrophoresis** **• Using a pH Meter**
INDICATOR	**5.a.2.**	**Formation of acidic and basic solutions** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Determining the Empirical Formula** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Introduction to Titration** **• Ion-Exchange Chromatography** **• Le Châtelier's Principle** **• Two-Dimensional Gel Electrophoresis** **• Using a pH Meter**
INDICATOR	**5.a.3.**	**Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration** **JoVE** **• High-Performance Liquid Chromatography (HPLC)** **• Introduction to Titration** **• Le Châtelier's Principle** **• Passaging Cells** **• Using a pH Meter**
INDICATOR	**5.a.4.**	**The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution** **JoVE** **• Introduction to Titration** **• Using a pH Meter**
INDICATOR	**5.a.5.**	**How a buffer works and examples of buffer solutions** **JoVE** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Dialysis: Diffusion Based Separation**

		• Le Châtelier's Principle • Using a pH Meter
COMPETENCY	MS.C.	Chemistry
OBJECTIVE	C.5.	Physical Science: Compare factors associated with acid/base and oxidation/reduction reactions.
NUMBERED ITEMS	5.b.	Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions, respectively and predict products for aqueous neutralization reactions. (DOK 2) JoVE • Using a pH Meter
NUMBERED ITEMS	5.c.	Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2) JoVE • Cyclic Voltammetry (CV) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Introduction to Titration • Photometric Protein Determination • Proton Exchange Membrane Fuel Cells
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
INDICATOR	1.a.2.	Proper use and care of the compound light microscope, slides, chemicals, etc. JoVE • An Introduction to the Micropipettor • Common Lab Glassware and Uses • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Making Solutions in the Laboratory • Measuring Mass in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Understanding Concentration and Measuring Volumes
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers JoVE

		• An Introduction to the Micropipettor • Common Lab Glassware and Uses • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Making Solutions in the Laboratory • Measuring Mass in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Understanding Concentration and Measuring Volumes
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3) JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Fractional Distillation • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ideal Gas Law • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Le Châtelier's Principle • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy

		• Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Protein Crystallization • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The Ideal Gas Law • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes
NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Cyclic Voltammetry (CV) • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • Method of Standard Addition • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Raman Spectroscopy for Chemical Analysis • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Two-Dimensional Gel Electrophoresis • X-ray Fluorescence (XRF)
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.2.	Physical Science: Demonstrate an understanding of the properties, structure and function of organic compounds.
NUMBERED ITEMS	2.a.	Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)

INDICATOR	2.a.1.	Structures of hydrocarbon compounds JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.2.	Physical Science: Demonstrate an understanding of the properties, structure and function of organic compounds.
NUMBERED ITEMS	2.b.	Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)

		JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.2.	Physical Science: Demonstrate an understanding of the properties, structure and function of organic compounds.
NUMBERED ITEMS	2.c.	Apply principles of geometry and hybridization to organic molecules. (DOK 2)
INDICATOR	2.c.1.	Lewis structures for organic molecules

		JoVE • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
INDICATOR	2.c.2.	Bond angles JoVE • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
INDICATOR	2.c.3.	Hybridization (as it applies to organic molecules) JoVE • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.2.	Physical Science: Demonstrate an understanding of the properties, structure and function of organic compounds.
NUMBERED ITEMS	2.d.	Write, complete and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1) JoVE • Coordination Chemistry Complexes • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
NUMBERED ITEMS	2.e.	Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2) JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Degassing Liquids with Freeze-Pump-Thaw Cycling • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis

		• MALDI-TOF Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	**MS.OC.**	**Organic Chemistry**
OBJECTIVE	**OC.2.**	**Physical Science: Demonstrate an understanding of the properties, structure and function of organic compounds.**
NUMBERED ITEMS	**2.f.**	**Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitrides) by their structure and properties. (DOK 2)**
INDICATOR	**2.f.1.**	**Structural formulas from functional group names and vice-versa** **JoVE** • Coordination Chemistry Complexes • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	**2.f.2.**	**Chemical and physical properties of compounds containing functional groups** **JoVE** • Coordination Chemistry Complexes • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy

INDICATOR	2.f.3.	Equations representing the transformation of one functional group into another JoVE • Coordination Chemistry Complexes • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.3	Physical Science: Discuss the versatility of polymers and the diverse application of organic chemicals.
NUMBERED ITEMS	3.a.	Describe and classify the synthesis, properties, and uses of polymers.(DOK 2)
INDICATOR	3.a.1.	Common polymers JoVE • Introduction to Catalysis • Le Châtelier's Principle
INDICATOR	3.a.2.	Synthesis of polymers from monomers by addition or condensation JoVE • Introduction to Catalysis • Le Châtelier's Principle
INDICATOR	3.a.3.	Condensations of plastics according to their commercial types JoVE • Degassing Liquids with Freeze-Pump-Thaw Cycling • Introduction to Catalysis • Schlenk Lines Transfer of Solvents • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	3.a.4.	Elasticity and other polymer properties JoVE • Introduction to Catalysis • Le Châtelier's Principle
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.3	Physical Science: Discuss the versatility of polymers and the diverse application of organic chemicals.
NUMBERED ITEMS	3.b.	Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)

INDICATOR	3.b.1.	Common uses of polymers and organic compounds in medicine, drugs, and personal care products JoVE • Degassing Liquids with Freeze-Pump-Thaw Cycling • Fractional Distillation • Introduction to Catalysis • Schlenk Lines Transfer of Solvents • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	3.b.2.	Compounds which have the property to dye materials JoVE • Fractional Distillation
INDICATOR	3.b.3.	Petrochemical production JoVE • Fractional Distillation
INDICATOR	3.b.4.	Biologically active compounds in terms of functional group substrate interaction JoVE • Coordination Chemistry Complexes • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.OC.	Organic Chemistry
OBJECTIVE	OC.3	Physical Science: Discuss the versatility of polymers and the diverse application of organic chemicals.
NUMBERED ITEMS	3.c.	Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.) (DOK 3) JoVE • Fractional Distillation
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
INDICATOR	1.a.1.	Safety rules and symbols JoVE

		• An Introduction to the Centrifuge • An Introduction to the Micropipettor • Aseptic Technique in Environmental Science • Histological Sample Preparation for Light Microscopy • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.2.	Proper use and care of the compound light microscope, slides, chemicals, etc. JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Measuring Mass in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Identify questions that can be answered through scientific investigations. (DOK 3)

		JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.c.	Identify and apply components of scientific methods in classroom investigations. (DOK 3)
INDICATOR	1.c.1.	Predicting, gathering data, drawing conclusions JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
INDICATOR	1.c.2.	Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance

		• Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain

		• Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self

		• The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	**MS.IB.**	**Introduction to Biology**
OBJECTIVE	**IB.1.**	**Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
NUMBERED ITEMS	**1.d.**	**Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs. (DOK 2)** **JoVE** • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil

		• Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding

		• Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes

		• The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Analyze procedures and data to draw conclusions about the validity of research. (DOK 3) <u>JoVE</u> • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.IB.	Introduction to Biology

OBJECTIVE	IB.2.	Physical Science: Investigate and summarize the chemical basis of life.
NUMBERED ITEMS	2.a.	Compare and contrast atoms, ions, elements, molecules, and compounds in terms of the relationship of the bond types (e.g., ionic, covalent, and hydrogen bonds) to chemical activity and explain how this is relevant to biological activity. (DOK 2) <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Maintenance • Carbon and Nitrogen Analysis of Environmental Samples • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions

		• DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Fractional Distillation • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • Nuclear Magnetic Resonance (NMR) Spectroscopy • Nutrients in Aquatic Ecosystems • PCR: The Polymerase Chain Reaction • Passaging Cells • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Plasmid Purification • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Purification of a Total Lipid Extract with Column

		Chromatography **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• RNA-Seq** **• RNAi in C. elegans** **• Recombineering and Gene Targeting** **• Reconstitution of Membrane Proteins** **• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry** **• Restriction Enzyme Digests** **• SNP Genotyping** **• Sample Preparation for Analytical Preparation** **• Separating Protein with SDS-PAGE** **• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium** **• Sonication Extraction of Lipid Biomarkers from Sediment** **• Soxhlet Extraction of Lipid Biomarkers from Sediment** **• Spectrophotometric Determination of an Equilibrium Constant** **• Surface Plasmon Resonance (SPR)** **• Tandem Mass Spectrometry** **• Testing For Genetically Modified Foods** **• The ATP Bioluminescence Assay** **• The ELISA Method** **• The TUNEL Assay** **• The Transwell Migration Assay** **• The Western Blot** **• Two-Dimensional Gel Electrophoresis** **• Ultraviolet-Visible (UV-Vis) Spectroscopy** **• Whole-Mount In Situ Hybridization** **• Yeast Maintenance** **• Yeast Transformation and Cloning** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Microinjection Techniques** **• Zebrafish Reproduction and Development**
NUMBERED ITEMS	**2.b.**	**Classify pH solutions (e.g., acids, bases, neutrals) and explain the importance of pH in living systems. (DOK 2)** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• High-Performance Liquid Chromatography (HPLC)** **• Introduction to Titration** **• Ion-Exchange Chromatography** **• Le Châtelier's Principle** **• Passaging Cells**

		• Two-Dimensional Gel Electrophoresis • Using a pH Meter
NUMBERED ITEMS	2.c.	Compare the composition and primary properties of carbohydrates, proteins, lipids, and nucleic acids and relate these to their functions in living organisms. (DOK 2) <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation

		• Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning

		• Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	2.d.	Compare and contrast the basic processes of photosynthesis and cellular respiration. (DOK 2) JoVE • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.3.	Life Science: Investigate and explain how organisms interact with their environment.
NUMBERED ITEMS	3.b.	Analyze and explain the interactions among organisms for each level of biological organization. (DOK 2)
INDICATOR	3.b.1.	Biotic and abiotic JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
INDICATOR	3.b.2.	Predation, competition, symbiosis, mutualism, commensalism, parasitism, etc. JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Recombineering and Gene Targeting • Tree Survey: Point-Centered Quarter Sampling Method

		• Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
COMPETENCY	**MS.IB.**	**Introduction to Biology**
OBJECTIVE	**IB.3.**	**Life Science: Investigate and explain how organisms interact with their environment.**
NUMBERED ITEMS	3.c.	Analyze energy flow through an ecosystem by assessing the roles of carnivores, omnivores, herbivores, producers, and decomposers and determine their effects on an ecosystem. (DOK 2) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Basic Care Procedures • Basic Mouse Care and Maintenance • C. elegans Maintenance • Carbon and Nitrogen Analysis of Environmental Samples • Culturing and Enumerating Bacteria from Soil Samples • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Drosophila Maintenance • Filamentous Fungi • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Zebrafish Maintenance and Husbandry • Zebrafish Reproduction and Development
NUMBERED ITEMS	3.d.	Predict the impact of human activities (e.g., recycling, pollution, overpopulation) on the environment. (DOK 3) JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Isolation of Fecal Bacteria from Water Samples by Filtration • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Self-report vs. Behavioral Measures of Recycling

		• Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.4.	Life Science: Investigate, compare, and contrast cell structures, functions, and methods of reproduction.
NUMBERED ITEMS	4.a.	Compare and contrast cell structures, functions, and methods of reproduction to analyze the similarities and differences among cell types. (DOK 2)
INDICATOR	4.a.1.	Prokaryotic/eukaryotic JoVE • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Culturing and Enumerating Bacteria from Soil Samples • Electrophoretic Mobility Shift Assay (EMSA) • Plasmid Purification • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	4.a.2.	Unicellular/multicellular JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Motility and Migration • An Introduction to Drosophila melanogaster • An Introduction to Saccharomyces cerevisiae • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Genetic Crosses • Isolating Nucleic Acids from Yeast • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	4.a.3.	Plant/animal/bacterial/protist/fungal JoVE • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Genetic Engineering

		• Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Culturing and Enumerating Bacteria from Soil Samples • Density Gradient Ultracentrifugation • Electrophoretic Mobility Shift Assay (EMSA) • Genetic Engineering of Model Organisms • Invasion Assay Using 3D Matrices • Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • The Transwell Migration Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
COMPETENCY	**MS.IB.**	**Introduction to Biology**
OBJECTIVE	**IB.4.**	**Life Science: Investigate, compare, and contrast cell structures, functions, and methods of reproduction.**
NUMBERED ITEMS	**4.b.**	Describe and explain the relationships between structures and functions of major eukaryotic organelles (e.g., cell wall, cell membrane, chromosomes, mitochondrion, nucleus, chloroplast, vacuole, endoplasmic reticulum, ribosomes, centrioles, cytoplasm/cytosol, Golgi apparatus, vesicles, lysosomes, microtubules, microfilaments, cytoskeleton, nucleolus, nuclear membrane.) (DOK 2) JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Calcium Imaging in Neurons

		• Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Cytogenetics • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Electro-encephalography (EEG) • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • FM Dyes in Vesicle Recycling • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Murine In Utero Electroporation • Neuronal Transfection Methods • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • RNA-Seq • Reconstitution of Membrane Proteins • SNP Genotyping • The ATP Bioluminescence Assay • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Yeast Maintenance • Yeast Transformation and Cloning
NUMBERED ITEMS	4.c.	Describe how active, passive, and facilitated transports relate to the maintenance of homeostasis. (DOK 1) JoVE • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • Calcium Imaging in Neurons • Cell-surface Biotinylation Assay • Detecting Reactive Oxygen Species • FM Dyes in Vesicle Recycling • In ovo Electroporation of Chicken Embryos • Patch Clamp Electrophysiology • Reconstitution of Membrane Proteins • The TUNEL Assay • Using Diffusion Tensor Imaging in Traumatic Brain

		Injury • Yeast Transformation and Cloning
NUMBERED ITEMS	4.d.	Compare and contrast the processes and results of mitosis and meiosis. (DOK 2) JoVE • An Introduction to Cell Division • An Introduction to Saccharomyces cerevisiae • Cell Cycle Analysis • Genetic Crosses • Live Cell Imaging of Mitosis • Recombineering and Gene Targeting • Yeast Reproduction • Yeast Transformation and Cloning
COMPETENCY	MS.IB.	Introduction to Biology
OBJECTIVE	IB.5.	Life Science: Analyze the roles DNA and RNA play on the mechanism of inheritance.
NUMBERED ITEMS	5.a.	Utilize genetic terminology and principles to solve monohybrid crosses involving dominant and recessive traits. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Overview of Epigenetics • An Overview of Genetic Analysis • An Overview of Genetics and Disease • C. elegans Development and Reproduction • Drosophila Development and Reproduction • Fundamentals of Breeding and Weaning • Genetic Crosses • Genetic Screens • Mouse Genotyping
NUMBERED ITEMS	5.b.	Identify inheritance patterns using pedigrees and karyotypes. (DOK 2) JoVE • An Overview of Genetics and Disease • Cytogenetics
NUMBERED ITEMS	5.c.	Explain and distinguish among the roles of DNA and RNA in replication, transcription, and translation. (DOK 1) JoVE • An Introduction to Cell Division • An Overview of Epigenetics • An Overview of Gene Expression • Cell Cycle Analysis • Chromatin Immunoprecipitation • DNA Ligation Reactions

		• DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genetic Screens • Genome Editing • Live Cell Imaging of Mitosis • Method of Standard Addition • Molecular Cloning • PCR: The Polymerase Chain Reaction • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Restriction Enzyme Digests • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning
COMPETENCY	**MS.IB.**	**Introduction to Biology**
OBJECTIVE	**IB.6.**	**Life Science: Apply the concept of evolution to the diversity of organisms.**
NUMBERED ITEMS	**6.a.**	Classify organisms into groups based on their unique characteristics (e.g., cell type, nutrition, reproductive methods, organism examples, etc.) and trace the evolutionary relationships among the groups. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Chick ex ovo Culture • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation

		• Filamentous Fungi • In ovo Electroporation of Chicken Embryos • Introducing Experimental Agents into the Mouse • Isolating Nucleic Acids from Yeast • Mouse Genotyping • RNAi in C. elegans • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	6.b.	Describe how natural selection relates to adaptation, survival, and speciation. (DOK 1) JoVE • An Overview of Genetic Analysis
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
INDICATOR	1.a.1.	Safety rules and symbols JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Aseptic Technique in Environmental Science • Histological Sample Preparation for Light Microscopy • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.2.	Proper use and care of the compound light microscope, slides, chemicals, etc. JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy

		• Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Measuring Mass in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Formulate questions that can be answered through research and experimental design. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
NUMBERED ITEMS	1.c.	Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism

		• An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis

		• Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave

		Doppler **• Perspectives on Cognitive Psychology** **• Perspectives on Neuropsychology** **• Physiological Correlates of Emotion Recognition** **• Piaget's Conservation Task and the Influence of Task Demands** **• Plasmid Purification** **• Positive Reinforcement Studies** **• Prospect Theory** **• Purification of a Total Lipid Extract with Column Chromatography** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• RNAi in C. elegans** **• SNP Genotyping** **• Self-administration Studies** **• Spatial Cueing** **• Spatial Memory Testing Using Mazes** **• The ATP Bioluminescence Assay** **• The Attentional Blink** **• The Costs and Benefits of Natural Pedagogy** **• The ELISA Method** **• The Inverted-face Effect** **• The Morris Water Maze** **• The Precision of Visual Working Memory with Delayed Estimation** **• The Rouge Test: Searching for a Sense of Self** **• The Split Brain** **• The Staircase Procedure for Finding a Perceptual Threshold** **• The TUNEL Assay** **• The Transwell Migration Assay** **• The Western Blot** **• Using Diffusion Tensor Imaging in Traumatic Brain Injury** **• Using TMS to Measure Motor Excitability During Action Observation** **• Using Your Head: Measuring Infants' Rational Imitation of Actions** **• Verbal Priming** **• Visual Attention: fMRI Investigation of Object-based Attentional Control** **• Visual Search for Features and Conjunctions** **• Visual Statistical Learning** **• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy** **• Water Quality Analysis via Indicator Organisms** **• Yeast Maintenance** **• fMRI: Functional Magnetic Resonance Imaging**

NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.f.	Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.2.	Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.
NUMBERED ITEMS	2.a.	Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
INDICATOR	2.a.1.	Subatomic particles and arrangement in atoms JoVE • Coordination Chemistry Complexes • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Scanning Electron Microscopy (SEM) • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
INDICATOR	2.a.2.	Importance of ions in biological processes

		JoVE • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.2.	Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.
NUMBERED ITEMS	2.b.	Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2) JoVE • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • High-Performance Liquid Chromatography (HPLC) • Nutrients in Aquatic Ecosystems • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
NUMBERED ITEMS	2.c.	Classify solutions as acidic, basic, or neutral and relate the significance of the pH scale on an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2) JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • High-Performance Liquid Chromatography (HPLC) • Introduction to Titration • Ion-Exchange Chromatography • Le Châtelier's Principle • Passaging Cells • Two-Dimensional Gel Electrophoresis • Using a pH Meter
COMPETENCY	MS.BI.	Biology I

OBJECTIVE	**BI.2.**	**Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.**
NUMBERED ITEMS	**2.d.**	**Compare and contrast the structure, properties, and principal functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)**
INDICATOR	**2.d.1.**	**Basic chemical composition of each group** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cell Motility and Migration** **• An Introduction to Developmental Genetics** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Transfection** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Annexin V and Propidium Iodide Labeling** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• C. elegans Maintenance** **• Cell Cycle Analysis** **• Cell-surface Biotinylation Assay** **• Chromatin Immunoprecipitation** **• Chromatography-Based Biomolecule Purification Methods** **• Co-Immunoprecipitation and Pull-Down Assays** **• Column Chromatography** **• Community DNA Extraction from Bacterial Colonies** **• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry** **• Cytogenetics** **• DNA Gel Electrophoresis** **• DNA Ligation Reactions** **• DNA Methylation Analysis** **• Density Gradient Ultracentrifugation** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Detecting Reactive Oxygen Species** **• Development and Reproduction of the Laboratory Mouse**

		• Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation

		• Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	2.d.2.	Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation

		• Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction

		• Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	2.d.3.	Basic functions (e.g., energy, storage, cellular, heredity) of each group <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae

		• An Introduction to Transfection • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses

		• Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization

		• Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.2.	Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.
NUMBERED ITEMS	2.e.	Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
INDICATOR	2.e.1.	Enzyme structure JoVE • An Introduction to Cell Death • Biofuels: Producing Ethanol from Cellulosic Material • Co-Immunoprecipitation and Pull-Down Assays • DNA Ligation Reactions • Enzyme Assays and Kinetics • Introduction to Catalysis • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • The ELISA Method • The TUNEL Assay
INDICATOR	2.e.2.	Enzyme function, including enzyme-substrate specificity and factors that effect enzyme function (pH and temperature) JoVE • An Introduction to Cell Death • Biofuels: Producing Ethanol from Cellulosic Material • Co-Immunoprecipitation and Pull-Down Assays • DNA Ligation Reactions • Enzyme Assays and Kinetics • Introduction to Catalysis • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • The ELISA Method • The TUNEL Assay
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.2.	Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.
NUMBERED ITEMS	2.f.	Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)

INDICATOR	2.f.1.	ATP structure JoVE • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • Detecting Reactive Oxygen Species • Invasion Assay Using 3D Matrices • The ATP Bioluminescence Assay • The Transwell Migration Assay
INDICATOR	2.f.2.	ATP function JoVE • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • Detecting Reactive Oxygen Species • Invasion Assay Using 3D Matrices • The ATP Bioluminescence Assay • The Transwell Migration Assay
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.2.	Physical Science: Describe the biochemical basis of life and explain how energy flows within and between the living systems.
NUMBERED ITEMS	2.g.	Analyze and explain the biochemical process of photosynthesis and cellular respiration and draw conclusions about the roles of the reactant and products in each. (DOK 3)
INDICATOR	2.g.1.	Photosynthesis and respiration (reactants and products) JoVE • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
INDICATOR	2.g.2.	Light-dependent reactions and light-independent reactions in photosynthesis, including requirements and products of each JoVE • An Introduction to Cell Metabolism
INDICATOR	2.g.3.	Aerobic and anaerobic processes in cellular respiration, including products of each and energy differences JoVE • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
COMPETENCY	MS.BI.	Biology I

OBJECTIVE	**BI.3.**	**Life Science: Investigate and evaluate the interaction between living organisms and their environment.**
NUMBERED ITEMS	**3.a.**	**Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)**
INDICATOR	**3.a.1.**	**Plant and animal species** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Drosophila melanogaster** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Chick ex ovo Culture** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• In ovo Electroporation of Chicken Embryos** **• Introducing Experimental Agents into the Mouse** **• Mouse Genotyping** **• RNAi in C. elegans** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Maintenance and Husbandry** **• Zebrafish Microinjection Techniques** **• Zebrafish Reproduction and Development**
INDICATOR	**3.a.2.**	**Climate (temperature and rainfall)** **JoVE** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry**
INDICATOR	**3.a.3.**	**Adaptations of organisms** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cognition**

		• An Introduction to Drosophila melanogaster • An Introduction to Learning and Memory • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Basic Care Procedures • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • Development of the Chick • Drosophila Development and Reproduction • Drosophila Maintenance • Fear Conditioning • Positive Reinforcement Studies • Spatial Memory Testing Using Mazes • Tree Identification: How To Use a Dichotomous Key • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Yeast Maintenance • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.BI.**	**Biology I**
OBJECTIVE	**BI.3.**	**Life Science: Investigate and evaluate the interaction between living organisms and their environment.**
NUMBERED ITEMS	**3.b.**	**Provide examples to justify the interdependence among environmental elements. (DOK 2)**
INDICATOR	**3.b.1.**	**Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)** **JoVE** • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy

INDICATOR	**3.b.2.**	**Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)** **JoVE** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Drosophila melanogaster** **• An Introduction to the Chick: Gallus gallus domesticus** **• Analysis of Earthworm Populations in Soil** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Basic Care Procedures** **• Basic Mouse Care and Maintenance** **• C. elegans Maintenance** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Culturing and Enumerating Bacteria from Soil Samples** **• Dissolved Oxygen in Surface Water** **• Drosophila Development and Reproduction** **• Drosophila Maintenance** **• Filamentous Fungi** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• Zebrafish Maintenance and Husbandry** **• Zebrafish Reproduction and Development**
INDICATOR	**3.b.3.**	**Roles of beneficial bacteria** **JoVE** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Transfection** **• An Overview of Genetic Engineering** **• Aseptic Technique in Environmental Science** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Community DNA Extraction from Bacterial Colonies** **• Culturing and Enumerating Bacteria from Soil Samples** **• Cyclic Voltammetry (CV)** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Filamentous Fungi** **• Genetic Engineering of Model Organisms** **• Genetic Screens** **• Gram Staining of Bacteria from Environmental Sources**

		• Isolation of Fecal Bacteria from Water Samples by Filtration • Metabolic Labeling • Molecular Cloning • Nutrients in Aquatic Ecosystems • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
INDICATOR	3.b.4.	Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism) JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Recombineering and Gene Targeting • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.3.	Life Science: Investigate and evaluate the interaction between living organisms and their environment.
NUMBERED ITEMS	3.c.	Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2) JoVE • Analysis of Earthworm Populations in Soil • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Lead Analysis of Soil Using Atomic Absorption

		Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.4.	Life Science: Analyze and explain the structures and function of the levels of biological organization.
NUMBERED ITEMS	4.a.	Differentiate among plant and animal cells and eukaryotic and prokaryotic cells.
INDICATOR	4.a.1.	Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfiliaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Balance and Coordination Testing • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Development and Reproduction • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Cytogenetics • DNA Ligation Reactions • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species

		• Electro-encephalography (EEG) • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gene Silencing with Morpholinos • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Surface Plasmon Resonance (SPR) • The ATP Bioluminescence Assay • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	4.a.2.	Components of mobility (e.g., cilia, flagella, pseudopodia) JoVE • An Introduction to Cell Motility and Migration • Invasion Assay Using 3D Matrices • The Transwell Migration Assay
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.4.	Life Science: Analyze and explain the structures and function of the levels of biological organization.
NUMBERED ITEMS	4.b.	Differentiate between types of cellular reproduction. (DOK 1)
INDICATOR	4.b.1.	Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions

		JoVE **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Developmental Neurobiology** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• Annexin V and Propidium Iodide Labeling** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• C. elegans Development and Reproduction** **• Cell Cycle Analysis** **• Detecting Reactive Oxygen Species** **• Embryonic Stem Cell Culture and Differentiation** **• Explant Culture of Neural Tissue** **• Induced Pluripotency** **• Live Cell Imaging of Mitosis** **• Murine In Utero Electroporation** **• Neuronal Transfection Methods** **• Primary Neuronal Cultures** **• The TUNEL Assay** **• Yeast Maintenance** **• Yeast Reproduction** **• Yeast Transformation and Cloning**
INDICATOR	**4.b.2.**	**Binary fission (e.g., budding, vegetative propagation, etc.)** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Zebrafish: Danio rerio** **• C. elegans Development and Reproduction** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Fundamentals of Breeding and Weaning** **• Genetic Crosses** **• Genetic Screens** **• Yeast Maintenance** **• Yeast Reproduction** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Reproduction and Development**
INDICATOR	**4.b.3.**	**Significance of meiosis in sexual reproduction** **JoVE** **• An Introduction to Cell Division**

		• C. elegans Development and Reproduction • Cytogenetics • DNA Methylation Analysis • Embryonic Stem Cell Culture and Differentiation • Genetic Crosses • Recombineering and Gene Targeting • Yeast Reproduction
INDICATOR	4.b.4.	Significance of crossing over JoVE • An Introduction to Cell Division • An Overview of Genetic Analysis • Cell Cycle Analysis • DNA Ligation Reactions • Drosophila Development and Reproduction • Genetic Crosses • Genetic Screens • Live Cell Imaging of Mitosis • Method of Standard Addition • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • Yeast Maintenance • Yeast Transformation and Cloning
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.4.	Life Science: Analyze and explain the structures and function of the levels of biological organization.
NUMBERED ITEMS	4.c.	Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1) JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Learning and Memory • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • C. elegans Development and Reproduction • Chick ex ovo Culture • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Drosophila Development and Reproduction • Drosophila Larval IHC • Embryonic Stem Cell Culture and Differentiation

		• Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Genetic Engineering of Model Organisms • Histological Sample Preparation for Light Microscopy • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Murine In Utero Electroporation • Sterile Tissue Harvest • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Reproduction and Development
NUMBERED ITEMS	4.d.	Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1) JoVE • An Introduction to Cell Metabolism • Density Gradient Ultracentrifugation • Reconstitution of Membrane Proteins • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.5.	Life Science: Demonstrate an understanding of the molecular basis of heredity.
NUMBERED ITEMS	5.a.	Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
INDICATOR	5.a.1.	Structures of DNA and RNA JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling

		• Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery

		• SNP Genotyping • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The TUNEL Assay • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	5.a.2.	Processes of replication, transcription, and translation JoVE • An Introduction to Cell Division • An Overview of Epigenetics • An Overview of Gene Expression • Cell Cycle Analysis • Chromatin Immunoprecipitation • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genetic Screens • Genome Editing • Live Cell Imaging of Mitosis • Method of Standard Addition • Molecular Cloning • PCR: The Polymerase Chain Reaction • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Restriction Enzyme Digests • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning
INDICATOR	5.a.3.	Messenger RNA codon charts JoVE • An Overview of Epigenetics • An Overview of Gene Expression • Chromatin Immunoprecipitation • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos

		• Genome Editing • Molecular Cloning • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Whole-Mount In Situ Hybridization
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.5.	Life Science: Demonstrate an understanding of the molecular basis of heredity.
NUMBERED ITEMS	5.b.	Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes.) (DOK 2) JoVE • Fundamentals of Breeding and Weaning • Genetic Crosses
NUMBERED ITEMS	5.c.	Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2) JoVE • An Overview of Genetics and Disease • Capillary Electrophoresis (CE) • Cytogenetics • DNA Gel Electrophoresis • Electrophoretic Mobility Shift Assay (EMSA) • Gel Purification • Making Solutions in the Laboratory • PCR: The Polymerase Chain Reaction • Plasmid Purification • RNA-Seq • SNP Genotyping • Testing For Genetically Modified Foods • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.5.	Life Science: Demonstrate an understanding of the molecular basis of heredity.
NUMBERED ITEMS	5.d.	Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
INDICATOR	5.d.1.	Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death

		• An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The TUNEL Assay
INDICATOR	5.d.2.	Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Downs Syndrome, color blindness JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Endocytosis and Exocytosis • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Chromatography-Based Biomolecule Purification Methods • Cytogenetics • Embryonic Stem Cell Culture and Differentiation • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • SNP Genotyping • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.6.	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.
NUMBERED ITEMS	6.a.	Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on

		similarities that reflect their evolutionary relationships. (DOK 2)
INDICATOR	**6.a.1.**	**Characteristics of the six kingdoms** **<u>JoVE</u>** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Drosophila melanogaster** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• Aseptic Technique in Environmental Science** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• Biofuels: Producing Ethanol from Cellulosic Material** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Chick ex ovo Culture** **• Culturing and Enumerating Bacteria from Soil Samples** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Detection of Bacteriophages in Environmental Samples** **• Determination of Moisture Content in Soil** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Filamentous Fungi** **• Genetic Crosses** **• Genetic Engineering of Model Organisms** **• Gram Staining of Bacteria from Environmental Sources** **• In ovo Electroporation of Chicken Embryos** **• Introducing Experimental Agents into the Mouse** **• Isolating Nucleic Acids from Yeast** **• Mouse Genotyping** **• RNAi in C. elegans** **• Recombineering and Gene Targeting** **• Sonication Extraction of Lipid Biomarkers from Sediment** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method**

		• Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	6.a.2.	Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species) <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Analysis of Earthworm Populations in Soil • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Chick ex ovo Culture • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Filamentous Fungi • In ovo Electroporation of Chicken Embryos • Introducing Experimental Agents into the Mouse • Isolating Nucleic Acids from Yeast • Mouse Genotyping • RNAi in C. elegans • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling

		• Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	6.a.3.	Body plans (symmetry) JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Motor Exam I • Motor Exam II • Rodent Stereotaxic Surgery
INDICATOR	6.a.4.	Methods of sexual reproduction (e.g., conjugation, fertilization, pollination) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • C. elegans Development and Reproduction • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Fundamentals of Breeding and Weaning • Genetic Crosses • Genetic Screens • Yeast Maintenance • Yeast Reproduction • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
INDICATOR	6.a.5.	Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • C. elegans Development and Reproduction • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting

		and Preparation • Fundamentals of Breeding and Weaning • Genetic Crosses • Genetic Screens • Yeast Maintenance • Yeast Reproduction • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
COMPETENCY	MS.BI.	Biology I
OBJECTIVE	BI.6.	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.
NUMBERED ITEMS	6.b.	Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3) JoVE • An Overview of Genetic Analysis • High-Performance Liquid Chromatography (HPLC)
NUMBERED ITEMS	6.c.	Research and summarize the contributions of scientists, (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	6.d.	Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	6.e.	Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs.(DOK 2) JoVE • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated

		Solvent Extraction • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Clarify research questions and design laboratory investigations. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.c.	Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design

NUMBERED ITEMS	**1.d.**	**Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)** **<u>JoVE</u>** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Genetic Analysis** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Analysis of Earthworm Populations in Soil** **• Annexin V and Propidium Iodide Labeling** **• Anterograde Amnesia** **• Anxiety Testing** **• Approximate Number Sense Test** **• Are You Smart or Hardworking? How Praise Influences Children's Motivation** **• Assessing Dexterity with Reaching Tasks** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Balance and Coordination Testing** **• Basic Mouse Care and Maintenance** **• Binocular Rivalry** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Blood Pressure Measurement** **• C. elegans Chemotaxis Assay** **• Calcium Imaging in Neurons** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Categories and Inductive Inferences** **• Cell Cycle Analysis** **• Cell-surface Biotinylation Assay** **• Children's Reliance on Artist Intentions When Identifying Pictures** **• Chromatin Immunoprecipitation**

		• Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps

		• Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming

		• Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.2.	Life Science: Describe and contrast the structures, functions, and chemical processes of the cell.
NUMBERED ITEMS	2.a.	Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2) JoVE • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Detecting Reactive Oxygen Species

		• Dialysis: Diffusion Based Separation • Electro-encephalography (EEG) • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • Neuronal Transfection Methods • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Reconstitution of Membrane Proteins • The TUNEL Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Yeast Maintenance • Yeast Transformation and Cloning
NUMBERED ITEMS	2.b.	Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2) JoVE • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Neurobiology • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Cell Cycle Analysis • Detecting Reactive Oxygen Species • Embryonic Stem Cell Culture and Differentiation • Explant Culture of Neural Tissue • Induced Pluripotency • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • The TUNEL Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.2.	Life Science: Describe and contrast the structures, functions, and chemical processes of the cell.

NUMBERED ITEMS	2.c.	Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
INDICATOR	2.c.1.	The impact of enzymatic reactions on biochemical processes JoVE • An Introduction to Cell Death • Biofuels: Producing Ethanol from Cellulosic Material • Co-Immunoprecipitation and Pull-Down Assays • DNA Ligation Reactions • Enzyme Assays and Kinetics • Introduction to Catalysis • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • The ELISA Method • The TUNEL Assay
INDICATOR	2.c.2.	Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.) JoVE • An Introduction to Cell Death • Biofuels: Producing Ethanol from Cellulosic Material • Co-Immunoprecipitation and Pull-Down Assays • DNA Ligation Reactions • Enzyme Assays and Kinetics • Introduction to Catalysis • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • The ELISA Method • The TUNEL Assay
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.2.	Life Science: Describe and contrast the structures, functions, and chemical processes of the cell.
NUMBERED ITEMS	2.d.	Life Science: Differentiate between photosynthesis and cellular respiration. (DOK 2)
INDICATOR	2.d.1.	Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide) JoVE • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • Invasion Assay Using 3D Matrices

		• The ATP Bioluminescence Assay • The Transwell Migration Assay
INDICATOR	2.d.2.	Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain) JoVE • An Introduction to Cell Metabolism • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • Biofuels: Producing Ethanol from Cellulosic Material • Calcium Imaging in Neurons • Cell-surface Biotinylation Assay • Detecting Reactive Oxygen Species • FM Dyes in Vesicle Recycling • Patch Clamp Electrophysiology • Reconstitution of Membrane Proteins • The ATP Bioluminescence Assay • The TUNEL Assay • Yeast Transformation and Cloning
INDICATOR	2.d.3.	Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis JoVE • An Introduction to Cell Metabolism • Reconstitution of Membrane Proteins
INDICATOR	2.d.4.	Oxidation and reduction reactions JoVE • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.3.	Life Science: Investigate and discuss the molecular basis of heredity.
NUMBERED ITEMS	3.a.	Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1) JoVE • An Introduction to Cell Division • Genetic Crosses • Recombineering and Gene Targeting • Yeast Reproduction

NUMBERED ITEMS	3.b.	Research and explain how major discoveries led to the determination of DNA structure. (DOK 2) JoVE • An Introduction to Developmental Genetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.3.	Life Science: Investigate and discuss the molecular basis of heredity.
NUMBERED ITEMS	3.c.	Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
INDICATOR	3.c.1.	Translation of a messenger RNA strand into a protein JoVE • Chromatin Immunoprecipitation • Electrophoretic Mobility Shift Assay (EMSA)
INDICATOR	3.c.2.	Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell JoVE • An Overview of Epigenetics • An Overview of Gene Expression • Chromatin Immunoprecipitation • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genome Editing • Molecular Cloning • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Whole-Mount In Situ Hybridization
INDICATOR	3.c.3.	Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation) JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration

		• An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Cell Cycle Analysis • Chick ex ovo Culture • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Cytogenetics • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Ear Exam • Embryonic Stem Cell Culture and Differentiation • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • Introducing Experimental Agents into the Mouse • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Lymph Node Exam • Male Rectal Exam • Mouse Genotyping • Passaging Cells • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • SNP Genotyping • The TUNEL Assay • The Transwell Migration Assay • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization
INDICATOR	3.c.4.	Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)

		JoVE **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Motility and Migration** **• An Introduction to Cellular and Molecular Neuroscience** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Organogenesis** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• Annexin V and Propidium Iodide Labeling** **• C. elegans Development and Reproduction** **• Chick ex ovo Culture** **• Chromatin Immunoprecipitation** **• DNA Methylation Analysis** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Embryonic Stem Cell Culture and Differentiation** **• Explant Culture for Developmental Studies** **• Explant Culture of Neural Tissue** **• Expression Profiling with Microarrays** **• Fate Mapping** **• Gene Silencing with Morpholinos** **• Genetic Crosses** **• Genetic Engineering of Model Organisms** **• Genetic Screens** **• Histological Staining of Neural Tissue** **• In ovo Electroporation of Chicken Embryos** **• Induced Pluripotency** **• Introduction to the Microplate Reader** **• Isolating Nucleic Acids from Yeast** **• Mouse Genotyping** **• Murine In Utero Electroporation** **• PCR: The Polymerase Chain Reaction** **• Protein Crystallization** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR**

		• RNA-Seq • RNAi in C. elegans • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.BII.**	**Biology II**
OBJECTIVE	**BII.3.**	**Life Science: Investigate and discuss the molecular basis of heredity.**
NUMBERED ITEMS	**3.d.**	**Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)**
INDICATOR	**3.d.1.**	**Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine and forensics** **JoVE** • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Capillary Electrophoresis (CE) • Chick ex ovo Culture • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis

		• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Making Solutions in the Laboratory • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development

COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.3.	Life Science: Investigate and discuss the molecular basis of heredity.
NUMBERED ITEMS	3.e.	Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Capillary Electrophoresis (CE) • Chick ex ovo Culture • DNA Ligation Reactions • DNA Methylation Analysis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Molecular Cloning

		• Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Plasmid Purification • Primary Neuronal Cultures • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.BII.**	**Biology II**
OBJECTIVE	**BII.4.**	**Life Science: Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
NUMBERED ITEMS	**4.a.**	**Explain the history of life on Earth and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)**
INDICATOR	**4.a.1.**	**Main periods of the geologic timetable of Earth's history** **JoVE** • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry
INDICATOR	**4.a.2.**	**Roles of catastrophic and gradualistic processes in shaping planet Earth** **JoVE** • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section

		• Using Topographic Maps to Generate Topographic Profiles
COMPETENCY	**MS.BII.**	**Biology II**
OBJECTIVE	**BII.4.**	**Life Science: Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
NUMBERED ITEMS	4.b.	Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Genetic Analysis • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • High-Performance Liquid Chromatography (HPLC)
NUMBERED ITEMS	4.c.	Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2) JoVE • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio
NUMBERED ITEMS	4.d.	Formulate a scientific explanation based on fossil records of ancient life-forms and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	4.e.	Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.) (DOK 2) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	4.f.	Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.) (DOK 1) JoVE • An Overview of Genetic Analysis

NUMBERED ITEMS	4.g.	Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, Darwin) on the formulation of ideas about evolution. (DOK 2) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	4.h.	Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3) JoVE • An Overview of Genetic Analysis
NUMBERED ITEMS	4.i.	Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of non-native species. (DOK 2) JoVE • Analysis of Earthworm Populations in Soil • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.BII.	Biology II
OBJECTIVE	BII.5.	Life Science: Develop an understanding of organism classification.
NUMBERED ITEMS	5.a.	Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus

		• An Introduction to the Zebrafish: Danio rerio • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Chick ex ovo Culture • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Filamentous Fungi • In ovo Electroporation of Chicken Embryos • Introducing Experimental Agents into the Mouse • Isolating Nucleic Acids from Yeast • Mouse Genotyping • RNAi in C. elegans • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.BII.**	**Biology II**
OBJECTIVE	**BII.5.**	**Life Science: Develop an understanding of organism classification.**
NUMBERED ITEMS	**5.b.**	**Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)**
INDICATOR	**5.b.1.**	**Bacteria, fungi, and protists** **JoVE** • Algae Enumeration via Culturable Methodology • An Introduction to Cell Motility and Migration • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications

		• Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Culturing and Enumerating Bacteria from Soil Samples • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Filamentous Fungi • Genetic Crosses • Genetic Engineering of Model Organisms • Gram Staining of Bacteria from Environmental Sources • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • Sonication Extraction of Lipid Biomarkers from Sediment • The Transwell Migration Assay • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	5.b.2.	Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata) JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • Analysis of Earthworm Populations in Soil • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Genetic Screens • Invertebrate Lifespan Quantification • RNAi in C. elegans • Whole-Mount In Situ Hybridization
INDICATOR	5.b.3.	Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)

		JoVE **• An Introduction to Aging and Regeneration** **• An Introduction to Transfection** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• Anesthesia Induction and Maintenance** **• Basic Care Procedures** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• Blood Withdrawal I** **• Blood Withdrawal II** **• Chick ex ovo Culture** **• Compound Administration I** **• Compound Administration II** **• Compound Administration III** **• Compound Administration IV** **• Considerations for Rodent Surgery** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Diagnostic Necropsy and Tissue Harvest** **• Explant Culture for Developmental Studies** **• Fate Mapping** **• Fundamentals of Breeding and Weaning** **• Gene Silencing with Morpholinos** **• In ovo Electroporation of Chicken Embryos** **• Introducing Experimental Agents into the Mouse** **• Mouse Genotyping** **• Rodent Handling and Restraint Techniques** **• Rodent Identification I** **• Rodent Identification II** **• Sterile Tissue Harvest** **• Transplantation Studies** **• Whole-Mount In Situ Hybridization** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Maintenance and Husbandry** **• Zebrafish Microinjection Techniques** **• Zebrafish Reproduction and Development**
INDICATOR	**5.b.4.**	**Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants).** **JoVE** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry**
COMPETENCY	**MS.G.**	**Genetics**

OBJECTIVE	G.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Clarify research questions and design laboratory investigations. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.c.	Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans

		• An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis

		• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology

		• Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms

		• Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.2.	Life Science: Analyze the structure and function of the cell and cellular organelles.
NUMBERED ITEMS	2.a.	Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2) JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Balance and Coordination Testing • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Development and Reproduction • Calcium Imaging in Neurons

		• Cell Cycle Analysis • Cell-surface Biotinylation Assay • Cytogenetics • DNA Ligation Reactions • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Electro-encephalography (EEG) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gene Silencing with Morpholinos • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Surface Plasmon Resonance (SPR) • The ATP Bioluminescence Assay • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
NUMBERED ITEMS	2.b.	Describe how organic components are integral to biochemical processes. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration

		• An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos

		• Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • Nuclear Magnetic Resonance (NMR) Spectroscopy • PCR: The Polymerase Chain Reaction • Passaging Cells • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • SNP Genotyping • Sample Preparation for Analytical Preparation • Separating Protein with SDS-PAGE • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.G.**	**Genetics**
OBJECTIVE	**G.2.**	**Life Science: Analyze the structure and function of the cell and cellular organelles.**

NUMBERED ITEMS	**2.c.**	**Differentiate among the processes by which plants and animals reproduce. (DOK 1)**
INDICATOR	**2.c.1.**	**Cell cycle and mitosis** **JoVE** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Developmental Neurobiology** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• Annexin V and Propidium Iodide Labeling** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• C. elegans Development and Reproduction** **• Cell Cycle Analysis** **• Detecting Reactive Oxygen Species** **• Embryonic Stem Cell Culture and Differentiation** **• Explant Culture of Neural Tissue** **• Induced Pluripotency** **• Live Cell Imaging of Mitosis** **• Murine In Utero Electroporation** **• Neuronal Transfection Methods** **• Primary Neuronal Cultures** **• The TUNEL Assay** **• Yeast Maintenance** **• Yeast Reproduction** **• Yeast Transformation and Cloning**
INDICATOR	**2.c.2.**	**Meiosis, spermatogenesis, and oogenesis** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Zebrafish: Danio rerio** **• C. elegans Development and Reproduction** **• Cytogenetics** **• DNA Methylation Analysis** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Embryonic Stem Cell Culture and Differentiation** **• Genetic Crosses** **• Recombineering and Gene Targeting** **• Yeast Reproduction** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Reproduction and Development**
COMPETENCY	**MS.G.**	**Genetics**

OBJECTIVE	G.2.	Life Science: Analyze the structure and function of the cell and cellular organelles.
NUMBERED ITEMS	2.d.	Explain the significance of the discovery of nucleic acids. (DOK 1) <u>JoVE</u> • An Introduction to Developmental Genetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering
NUMBERED ITEMS	2.e.	Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2) <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation

		• Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The TUNEL Assay • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	2.f.	Cite examples to compare the consequences of the different types of mutations. (DOK 1) JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division

		• An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Cell Cycle Analysis • Chick ex ovo Culture • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Cytogenetics • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Ear Exam • Embryonic Stem Cell Culture and Differentiation • Expression Profiling with Microarrays • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • Introducing Experimental Agents into the Mouse • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Lymph Node Exam • Male Rectal Exam • Mouse Genotyping • Passaging Cells • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • SNP Genotyping • The TUNEL Assay • The Transwell Migration Assay • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization

NUMBERED ITEMS	2.g.	Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3) JoVE • An Introduction to Saccharomyces cerevisiae • An Overview of Gene Expression • An Overview of Genetic Engineering • DNA Ligation Reactions • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • Yeast Transformation and Cloning
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.3.	Life Science: Apply the principles of heredity to demonstrate genetic understandings.
NUMBERED ITEMS	3.a.	Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1) JoVE • An Introduction to Developmental Genetics • Genetic Crosses
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.3.	Life Science: Apply the principles of heredity to demonstrate genetic understandings.
NUMBERED ITEMS	3.b.	Apply classical genetics principles to solve basic genetic problems. (DOK 2)
INDICATOR	3.b.1.	Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment JoVE • Fundamentals of Breeding and Weaning • Genetic Crosses
INDICATOR	3.b.2.	Inheritance of autosomal and sex-linked traits JoVE • An Overview of Epigenetics • An Overview of Genetics and Disease • DNA Methylation Analysis

		• Fundamentals of Breeding and Weaning • Genetic Crosses • The ELISA Method
INDICATOR	3.b.3.	Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance JoVE • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Fundamentals of Breeding and Weaning • Genetic Crosses
INDICATOR	3.b.4.	Chromosomal theory of inheritance JoVE • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • C. elegans Development and Reproduction • Cell Cycle Analysis • Chromatin Immunoprecipitation • Cytogenetics • DNA Methylation Analysis • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Genetic Crosses • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Plasmid Purification • RNA-Seq • SNP Genotyping
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.3.	Life Science: Apply the principles of heredity to demonstrate genetic understandings.
NUMBERED ITEMS	3.c.	Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
INDICATOR	3.c.1.	Genetic variability JoVE • An Overview of Genetic Analysis • C. elegans Development and Reproduction • SNP Genotyping • Yeast Reproduction • Zebrafish Maintenance and Husbandry
INDICATOR	3.c.3.	Migration and genetic drift

		JoVE • An Overview of Genetic Analysis
INDICATOR	3.c.4.	Natural selection in humans JoVE • An Introduction to Cognition • An Introduction to Learning and Memory • Fear Conditioning • Positive Reinforcement Studies • Spatial Memory Testing Using Mazes
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.3.	Life Science: Apply the principles of heredity to demonstrate genetic understandings.
NUMBERED ITEMS	3.d.	Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
INDICATOR	3.d.1.	Steps in genetic engineering experiments JoVE • An Introduction to Aging and Regeneration • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Engineering • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Capillary Electrophoresis (CE) • Chick ex ovo Culture • DNA Gel Electrophoresis • DNA Ligation Reactions • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses

		• Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Making Solutions in the Laboratory • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	**3.d.2.**	**Use of restriction enzymes** **JoVE** • An Introduction to Saccharomyces cerevisiae • An Overview of Gene Expression • An Overview of Genetic Engineering • DNA Ligation Reactions • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery

		• Testing For Genetically Modified Foods • Yeast Transformation and Cloning
INDICATOR	3.d.3.	Role of vectors in genetic research JoVE • An Introduction to Saccharomyces cerevisiae • An Overview of Gene Expression • An Overview of Genetic Engineering • DNA Ligation Reactions • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • Yeast Transformation and Cloning
INDICATOR	3.d.4.	Use of transformation techniques JoVE • An Introduction to Saccharomyces cerevisiae • An Overview of Gene Expression • An Overview of Genetic Engineering • DNA Ligation Reactions • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • Yeast Transformation and Cloning
COMPETENCY	MS.G.	Genetics
OBJECTIVE	G.3.	Life Science: Apply the principles of heredity to demonstrate genetic understandings.
NUMBERED ITEMS	3.e.	Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, pedigrees). (DOK 2) JoVE

		• An Introduction to Saccharomyces cerevisiae • An Overview of Gene Expression • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Cytogenetics • DNA Ligation Reactions • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • Yeast Transformation and Cloning
NUMBERED ITEMS	3.f.	Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Engineering • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Chick ex ovo Culture • DNA Ligation Reactions • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue

		• Fate Mapping • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Plasmid Purification • Primary Neuronal Cultures • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	3.g.	Research genomics (human and other organisms.) and predict benefits and medical advances that may result from the use of genome projects. (DOK 2) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection

		• An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Chick ex ovo Culture • Chromatin Immunoprecipitation • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification

		• Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.MB.**	**Microbiology**
OBJECTIVE	**MB.1.**	**Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
NUMBERED ITEMS	**1.b.**	**Clarify research questions and design laboratory investigations. (DOK 3)** **JoVE** • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through

		Embodiment **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**
NUMBERED ITEMS	**1.c.**	**Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)** **JoVE** **• Ethics in Psychology Research** **• Experimentation using a Confederate** **• From Theory to Design: The Role of Creativity in Designing Experiments** **• Manipulating an Independent Variable through Embodiment** **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**
NUMBERED ITEMS	**1.d.**	**Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)** **JoVE** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology**

		• An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments

		• FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory

		• Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment

		• Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.2.	Life Science: Develop understandings about the importance of historical microbiology to today's society.
NUMBERED ITEMS	2.b.	Research the societal and economic contributions of scientists (e.g., Louis Pasteur, John Snow, Edward Jenner, Joseph Lister, Alexander Fleming, etc.) and explain their impact on microbiology. (DOK 2) JoVE • An Introduction to the Laboratory Mouse: Mus musculus • Gram Staining of Bacteria from Environmental Sources • Introducing Experimental Agents into the Mouse
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.3.	Life Science: Explore and demonstrate an understanding of the classification of microorganisms.
NUMBERED ITEMS	3.a.	Cite examples to differentiate between the characteristics of eukaryotes and prokaryotes. (DOK 1) JoVE • An Introduction to Cell Motility and Migration • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Genetic Engineering • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Culturing and Enumerating Bacteria from Soil Samples • Electrophoretic Mobility Shift Assay (EMSA) • Genetic Engineering of Model Organisms • Invasion Assay Using 3D Matrices • Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • The Transwell Migration Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning

NUMBERED ITEMS	**3.b.**	**Cite examples and compare the characteristics of prokaryotes, fungi, and protists. (DOK 2)** **<u>JoVE</u>** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Cell Motility and Migration** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Transfection** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Overview of Genetic Engineering** **• Aseptic Technique in Environmental Science** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Co-Immunoprecipitation and Pull-Down Assays** **• Community DNA Extraction from Bacterial Colonies** **• Culturing and Enumerating Bacteria from Soil Samples** **• Cyclic Voltammetry (CV)** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Detection of Bacteriophages in Environmental Samples** **• Determination of Moisture Content in Soil** **• Filamentous Fungi** **• Genetic Crosses** **• Genetic Engineering of Model Organisms** **• Genetic Screens** **• Gram Staining of Bacteria from Environmental Sources** **• Invasion Assay Using 3D Matrices** **• Isolating Nucleic Acids from Yeast** **• Isolation of Fecal Bacteria from Water Samples by Filtration** **• Molecular Cloning** **• Plasmid Purification** **• Protein Crystallization** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• Recombineering and Gene Targeting** **• Sonication Extraction of Lipid Biomarkers from Sediment** **• The Transwell Migration Assay** **• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy** **• Water Quality Analysis via Indicator Organisms** **• Yeast Maintenance**

		• Yeast Reproduction • Yeast Transformation and Cloning
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.4.	Life Science: Investigate and summarize concepts related to pathogenic microbiology.
NUMBERED ITEMS	4.b.	Justify an explanation of strategies that can be used to reduce a person's chance of becoming infected with a pathogen. (DOK 3)
INDICATOR	4.b.2.	Hospital procedures for dealing with infectious diseases JoVE • An Introduction to Motor Control • An Overview of Genetics and Disease • Cytogenetics • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.5.	Life Science: Examine and evaluate the classification, morphology, characteristics, pathology, and benefits associated with bacteria.
NUMBERED ITEMS	5.a.	Differentiate between eubacteria and archaebacteria (DOK 1) JoVE • Algae Enumeration via Culturable Methodology • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Culturing and Enumerating Bacteria from Soil Samples • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Genetic Engineering of Model Organisms • Gram Staining of Bacteria from Environmental Sources • Recombineering and Gene Targeting • Sonication Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.5.	Life Science: Examine and evaluate the classification, morphology, characteristics, pathology, and benefits associated with bacteria.
NUMBERED ITEMS	5.b.	Analyze and distinguish the characteristics of bacteria. (DOK 2)
INDICATOR	5.b.1.	Shapes, motility structures, formation of endospores and capsules

		JoVE **• Algae Enumeration via Culturable Methodology** **• An Introduction to Cell Motility and Migration** **• An Introduction to Transfection** **• An Overview of Genetic Engineering** **• Aseptic Technique in Environmental Science** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Community DNA Extraction from Bacterial Colonies** **• Culturing and Enumerating Bacteria from Soil Samples** **• Cyclic Voltammetry (CV)** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Determination of Moisture Content in Soil** **• Genetic Engineering of Model Organisms** **• Genetic Screens** **• Gram Staining of Bacteria from Environmental Sources** **• Invasion Assay Using 3D Matrices** **• Isolation of Fecal Bacteria from Water Samples by Filtration** **• Molecular Cloning** **• Plasmid Purification** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• Recombineering and Gene Targeting** **• Sonication Extraction of Lipid Biomarkers from Sediment** **• The Transwell Migration Assay** **• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy** **• Water Quality Analysis via Indicator Organisms**
INDICATOR	**5.b.2.**	**Structure and function of internal and external bacterial cell components** **JoVE** **• An Introduction to Cell Motility and Migration** **• An Introduction to Transfection** **• An Overview of Genetic Engineering** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Culturing and Enumerating Bacteria from Soil Samples** **• Genetic Engineering of Model Organisms** **• Invasion Assay Using 3D Matrices**

		• Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • The Transwell Migration Assay
INDICATOR	5.b.3.	Principles of Gram staining JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Cell Motility and Migration • An Introduction to Transfection • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Invasion Assay Using 3D Matrices • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Sonication Extraction of Lipid Biomarkers from Sediment • The Transwell Migration Assay • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.5.	Life Science: Examine and evaluate the classification, morphology, characteristics, pathology, and benefits associated with bacteria.
NUMBERED ITEMS	5.c.	Research and explain the characteristics, causes, and treatments of bacterial diseases. (DOK 2) JoVE

		• An Overview of Genetic Analysis • Culturing and Enumerating Bacteria from Soil Samples • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Pelvic Exam III: Bimanual and Rectovaginal Exam
NUMBERED ITEMS	5.d.	Explain and describe the factors leading to antibiotic resistance among bacteria and predict its potential impacts on society. (DOK 2) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Transfection • An Overview of Genetic Analysis • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Pelvic Exam III: Bimanual and Rectovaginal Exam • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
NUMBERED ITEMS	5.e.	Research and evaluate the beneficial aspects of bacteria in medicine, industry, and daily life. (DOK 3) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Gene Expression • An Overview of Genetic Analysis

		• An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • DNA Ligation Reactions • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • In ovo Electroporation of Chicken Embryos • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Pelvic Exam III: Bimanual and Rectovaginal Exam • Plasmid Purification • Primary Neuronal Cultures • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Transformation and Cloning
COMPETENCY	**MS.MB.**	**Microbiology**
OBJECTIVE	**MB.6.**	**Life Science: Differentiate among the growth requirements of bacteria.**
NUMBERED ITEMS	**6.a.**	**Describe growth requirements of bacteria. (DOK 2)**
INDICATOR	**6.a.2.**	**Effect of pH and temperature on bacterial growth** **JoVE** • Algae Enumeration via Culturable Methodology • An Introduction to Transfection • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science

		• Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Sonication Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
COMPETENCY	**MS.MB.**	**Microbiology**
OBJECTIVE	**MB.6.**	**Life Science: Differentiate among the growth requirements of bacteria.**
NUMBERED ITEMS	**6.b.**	**Compare and contrast aerobes and anaerobes, both facultative and obligative, and predict their impact on human life. (DOK 2)** **JoVE** • Algae Enumeration via Culturable Methodology • An Introduction to Transfection • An Overview of Genetic Analysis • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV)

		• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Pelvic Exam III: Bimanual and Rectovaginal Exam • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Sonication Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
NUMBERED ITEMS	6.c.	Compare and interpret the results of investigations with various growth mediums. (DOK 3) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Transfection • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide

		Assay and Microscopy • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.7.	Life Science: Develop an understanding of classification, morphology, characteristics, pathology and benefits associated with viruses.
NUMBERED ITEMS	7.a.	Research and explain the characteristics, causes, and treatments of viral diseases, (e.g., smallpox, polio, influenza, measles, rabies, tumor viruses, common cold, hepatitis, herpes simplex I and II, chickenpox, shingles, HIV, warts, genital warts, etc.) (DOK 3)
INDICATOR	7.a.1.	Structure of viruses, including a phage virus JoVE • An Introduction to the Laboratory Mouse: Mus musculus • An Overview of Genetic Engineering • Co-Immunoprecipitation and Pull-Down Assays • Detection of Bacteriophages in Environmental Samples • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR
INDICATOR	7.a.2.	Methods to culture viruses in a laboratory JoVE • An Introduction to the Laboratory Mouse: Mus musculus • Co-Immunoprecipitation and Pull-Down Assays • Detection of Bacteriophages in Environmental Samples • Pelvic Exam III: Bimanual and Rectovaginal Exam • Protein Crystallization • RNA Analysis of Environmental Samples Using RT-PCR
INDICATOR	7.a.3.	Life cycle of a virus JoVE • An Introduction to the Laboratory Mouse: Mus musculus • An Overview of Genetic Engineering • Co-Immunoprecipitation and Pull-Down Assays • Cyclic Voltammetry (CV) • Detection of Bacteriophages in Environmental Samples • Pelvic Exam III: Bimanual and Rectovaginal Exam • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR
COMPETENCY	MS.MB.	Microbiology

OBJECTIVE	**MB.7.**	**Life Science: Develop an understanding of classification, morphology, characteristics, pathology and benefits associated with viruses.**
NUMBERED ITEMS	**7.b.**	**Cite evidence and explanations to defend the societal and economic importance of viruses. (DOK 2)** **JoVE** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Overview of Genetic Engineering** **• Co-Immunoprecipitation and Pull-Down Assays** **• Detection of Bacteriophages in Environmental Samples** **• Pelvic Exam III: Bimanual and Rectovaginal Exam** **• Protein Crystallization** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR**
COMPETENCY	**MS.MB.**	**Microbiology**
OBJECTIVE	**MB.8.**	**Life Science: Develop an understanding of the classification, morphology, characteristics, pathology, and benefits associated with fungi.**
NUMBERED ITEMS	**8.a.**	**Summarize the characteristics, causes, and treatment of the most common types of fungal diseases. (DOK 2)**
INDICATOR	**8.a.1.**	**Structure of fungal cells** **JoVE** **• An Introduction to Saccharomyces cerevisiae** **• Aseptic Technique in Environmental Science** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Filamentous Fungi** **• Genetic Crosses** **• Isolating Nucleic Acids from Yeast** **• Recombineering and Gene Targeting** **• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy** **• Yeast Maintenance** **• Yeast Reproduction** **• Yeast Transformation and Cloning**
INDICATOR	**8.a.2.**	**Growth requirements and reproduction of fungi** **JoVE** **• An Introduction to Saccharomyces cerevisiae** **• Aseptic Technique in Environmental Science** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Filamentous Fungi** **• Genetic Crosses** **• Isolating Nucleic Acids from Yeast** **• Recombineering and Gene Targeting** **• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy**

		• Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	8.a.3.	Methods to culture fungi in a laboratory JoVE • An Introduction to Saccharomyces cerevisiae
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.8.	Life Science: Develop an understanding of the classification, morphology, characteristics, pathology, and benefits associated with fungi.
NUMBERED ITEMS	8.b.	Cite evidence and explanations to support the societal and economic significance of fungi. (DOK 2) JoVE • An Introduction to Saccharomyces cerevisiae • Aseptic Technique in Environmental Science • Biofuels: Producing Ethanol from Cellulosic Material • Filamentous Fungi • Genetic Crosses • Isolating Nucleic Acids from Yeast • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.9.	Life Science: Demonstrate an understanding of microorganisms as they relate to food processes.
NUMBERED ITEMS	9.a.	Analyze and evaluate microbial actions in major industrial processes involving foods. (DOK 3)
INDICATOR	9.a.1.	Process of pasteurization of milk and its effect on microorganisms JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
INDICATOR	9.a.2.	Process of fermentation in producing certain foods. JoVE • Biofuels: Producing Ethanol from Cellulosic Material
INDICATOR	9.a.3.	Microbial problems in the slaughter of animals and preservation of fresh meat JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation

INDICATOR	9.a.4.	Importance of bacteria in the process of making certain foods JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
INDICATOR	9.a.5.	E.coli-related outbreaks in meats and produce JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.9.	Life Science: Demonstrate an understanding of microorganisms as they relate to food processes.
NUMBERED ITEMS	9.b.	Compare and contrast methods of food preservation. (DOK 2)
INDICATOR	9.b.1.	Home canning and industrial canning JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
INDICATOR	9.b.2.	Dehydration JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
INDICATOR	9.b.3.	Meals, Ready-to-Eat technology (MRE) JoVE • An Introduction to Saccharomyces cerevisiae • Fractional Distillation
COMPETENCY	MS.MB.	Microbiology
OBJECTIVE	MB.9.	Life Science: Demonstrate an understanding of microorganisms as they relate to food processes.
NUMBERED ITEMS	9.c.	Describe the causes and effects of food poisoning and discuss preventive strategies. (DOK 2) JoVE • C. elegans Chemotaxis Assay • Lead Analysis of Soil Using Atomic Absorption Spectroscopy
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)

INDICATOR	1.a.1.	Safety rules and symbols JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Aseptic Technique in Environmental Science • Histological Sample Preparation for Light Microscopy • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.2.	Proper use and care of the compound light microscope, slides, chemicals, etc. JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.

NUMBERED ITEMS	**1.b.**	**Formulate questions that can be answered through research and experimental design. (DOK 3)** **JoVE** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design**
NUMBERED ITEMS	**1.d.**	**Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)** **JoVE** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Genetic Analysis** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Analysis of Earthworm Populations in Soil** **• Annexin V and Propidium Iodide Labeling** **• Anterograde Amnesia** **• Anxiety Testing** **• Approximate Number Sense Test** **• Are You Smart or Hardworking? How Praise Influences Children's Motivation** **• Assessing Dexterity with Reaching Tasks** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Balance and Coordination Testing** **• Basic Mouse Care and Maintenance** **• Binocular Rivalry** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Blood Pressure Measurement** **• C. elegans Chemotaxis Assay** **• Calcium Imaging in Neurons** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Categories and Inductive Inferences**

		• Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate

		Their Memory **• Modeling Social Stress** **• Motion-induced Blindness** **• Motor Learning in Mirror Drawing** **• Motor Maps** **• Multiple Object Tracking** **• Mutual Exclusivity: How Children Learn the Meanings of Words** **• Numerical Cognition: More or Less** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• PCR: The Polymerase Chain Reaction** **• Patch Clamp Electrophysiology** **• Pericardiocentesis** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• Perspectives on Cognitive Psychology** **• Perspectives on Neuropsychology** **• Physiological Correlates of Emotion Recognition** **• Piaget's Conservation Task and the Influence of Task Demands** **• Plasmid Purification** **• Positive Reinforcement Studies** **• Prospect Theory** **• Purification of a Total Lipid Extract with Column Chromatography** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• RNAi in C. elegans** **• SNP Genotyping** **• Self-administration Studies** **• Spatial Cueing** **• Spatial Memory Testing Using Mazes** **• The ATP Bioluminescence Assay** **• The Attentional Blink** **• The Costs and Benefits of Natural Pedagogy** **• The ELISA Method** **• The Inverted-face Effect** **• The Morris Water Maze** **• The Precision of Visual Working Memory with Delayed Estimation** **• The Rouge Test: Searching for a Sense of Self** **• The Split Brain** **• The Staircase Procedure for Finding a Perceptual Threshold** **• The TUNEL Assay** **• The Transwell Migration Assay** **• The Western Blot** **• Using Diffusion Tensor Imaging in Traumatic Brain Injury**

		• Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.f.	Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.2.	Life Science: Distinguish among the characteristics of botanical organization, structure, and function.
NUMBERED ITEMS	2.a.	Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1) JoVE • An Introduction to Cell Metabolism

		• Density Gradient Ultracentrifugation • Reconstitution of Membrane Proteins
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.2.	Life Science: Distinguish among the characteristics of botanical organization, structure, and function.
NUMBERED ITEMS	2.b.	Differentiate the characteristics found in various plant divisions. (DOK 2)
INDICATOR	2.b.2.	Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
INDICATOR	2.b.3.	Major vegetative structures and their modifications in angiosperms and gymnosperms JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.2.	Life Science: Distinguish among the characteristics of botanical organization, structure, and function.
NUMBERED ITEMS	2.c.	Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2) JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.2.	Life Science: Distinguish among the characteristics of botanical organization, structure, and function.
NUMBERED ITEMS	2.d.	Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
INDICATOR	2.d.1.	Classification scheme used in botany JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
INDICATOR	2.d.2.	Classification of native Mississippi plants JoVE • Tree Identification: How To Use a Dichotomous Key

		• Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.2.	Life Science: Distinguish among the characteristics of botanical organization, structure, and function.
NUMBERED ITEMS	2.e.	Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
INDICATOR	2.e.1.	Relationships among photosynthesis, cellular respiration, and translocation JoVE • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
INDICATOR	2.e.2.	Importance of soil type and soil profiles to plant survival JoVE • An Introduction to Cell Metabolism • An Introduction to Cellular and Molecular Neuroscience • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Carbon and Nitrogen Analysis of Environmental Samples • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Culturing and Enumerating Bacteria from Soil Samples • Detecting Reactive Oxygen Species • Determination of Moisture Content in Soil • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Filamentous Fungi • Förster Resonance Energy Transfer (FRET) • Gram Staining of Bacteria from Environmental Sources • Histological Staining of Neural Tissue • Metabolic Labeling • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction

		• Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • The ATP Bioluminescence Assay • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
INDICATOR	2.e.4.	Effects of environmental conditions for plant survival JoVE • Tree Identification: How To Use a Dichotomous Key
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.3.	Life Science: Demonstrate an understanding of plant reproduction.
NUMBERED ITEMS	3.b.	Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1) JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.3.	Life Science: Demonstrate an understanding of plant reproduction.
NUMBERED ITEMS	3.d.	Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2) JoVE • Yeast Reproduction
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.4.	Live Science: Draw conclusions about the factors that affect the adaptation and survival of plants.
NUMBERED ITEMS	4.b.	Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3) JoVE • An Introduction to Cell Metabolism
NUMBERED ITEMS	4.c.	Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus

		musculus • An Introduction to the Zebrafish: Danio rerio • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation
NUMBERED ITEMS	4.d.	Research factors that might influence or alter plant stability and propose actions that may reduce the negative impacts of human activity. (DOK 2) JoVE • Nutrients in Aquatic Ecosystems • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Tree Identification: How To Use a Dichotomous Key • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.5.	Life Science: Relate an understanding of plant genetics to its uses in modern living.
NUMBERED ITEMS	5.a.	Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology (DOK 3) JoVE • An Overview of Genetic Engineering • Solid-Liquid Extraction • Testing For Genetically Modified Foods
NUMBERED ITEMS	5.b.	Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3) JoVE • An Overview of Genetic Analysis • An Overview of Genetic Engineering • Genetic Crosses • Solid-Liquid Extraction • Testing For Genetically Modified Foods
NUMBERED ITEMS	5.c.	Discuss the effects of genetic engineering of plants on society. (DOK 2) JoVE • An Overview of Genetic Engineering • Solid-Liquid Extraction • Testing For Genetically Modified Foods
COMPETENCY	MS.B.	Botany
OBJECTIVE	B.5.	Life Science: Relate an understanding of plant genetics to its uses in modern living.

NUMBERED ITEMS	5.d.	Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
INDICATOR	5.d.2.	Impact of the timber industry on local and national economy JoVE • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
INDICATOR	1.a.1.	Safety rules and symbols JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Aseptic Technique in Environmental Science • Histological Sample Preparation for Light Microscopy • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.2.	Proper use and care of the compound light microscope, slides, chemicals, etc. JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
INDICATOR	1.a.3.	Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers

		JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Formulate questions that can be answered through research and experimental design. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia

		• Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices

		• Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes

		• The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) <u>JoVE</u> • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design

NUMBERED ITEMS	1.f.	Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.2.	Life Science: Develop an understanding of levels of organization and animal classification.
NUMBERED ITEMS	2.a.	Explain how organisms are classified and identify characteristics of major groups. (DOK 1)
INDICATOR	2.a.1.	Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems) JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Learning and Memory • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • C. elegans Development and Reproduction • Chick ex ovo Culture • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Drosophila Development and Reproduction • Drosophila Larval IHC • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Genetic Engineering of Model Organisms • Histological Sample Preparation for Light Microscopy • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Murine In Utero Electroporation • Sterile Tissue Harvest • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Reproduction and Development

INDICATOR	**2.a.2.**	**Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)** **<u>JoVE</u>** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Drosophila melanogaster** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• Aseptic Technique in Environmental Science** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• Biofuels: Producing Ethanol from Cellulosic Material** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Chick ex ovo Culture** **• Culturing and Enumerating Bacteria from Soil Samples** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Detection of Bacteriophages in Environmental Samples** **• Determination of Moisture Content in Soil** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Filamentous Fungi** **• Genetic Crosses** **• Genetic Engineering of Model Organisms** **• Gram Staining of Bacteria from Environmental Sources** **• In ovo Electroporation of Chicken Embryos** **• Introducing Experimental Agents into the Mouse** **• Isolating Nucleic Acids from Yeast** **• Mouse Genotyping** **• RNAi in C. elegans** **• Recombineering and Gene Targeting** **• Sonication Extraction of Lipid Biomarkers from Sediment** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry**

		• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.2.	Life Science: Develop an understanding of levels of organization and animal classification.
NUMBERED ITEMS	2.b.	Identify and describe characteristics of the major phyla. (DOK 1)
INDICATOR	2.b.2.	Germ layers and embryonic development JoVE • An Introduction to Aging and Regeneration • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Basic Chick Care and Maintenance • C. elegans Development and Reproduction • Chick ex ovo Culture • Cytogenetics • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Fate Mapping • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification

		• Metabolic Labeling • Murine In Utero Electroporation • Passaging Cells • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	2.b.3.	Organ systems (e.g., digestive, circulatory, excretory, and reproductive) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Developmental Neurobiology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • Anesthesia Induction and Maintenance • Basic Care Procedures • Blood Withdrawal I • Blood Withdrawal II • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Compound Administration I • Compound Administration II • Compound Administration III • Compound Administration IV • Considerations for Rodent Surgery • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Drosophila Larval IHC • Explant Culture of Neural Tissue • Fundamentals of Breeding and Weaning • Histological Staining of Neural Tissue • Murine In Utero Electroporation • Neuronal Transfection Methods • Primary Neuronal Cultures • Rodent Stereotaxic Surgery • Sterile Tissue Harvest • Zebrafish Reproduction and Development
INDICATOR	2.b.4.	Locomotion and coordination JoVE • An Introduction to Caenorhabditis elegans • C. elegans Chemotaxis Assay • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting

		and Preparation • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.2.	Life Science: Develop an understanding of levels of organization and animal classification.
NUMBERED ITEMS	2.c.	Distinguish Viruses from Bacteria and Protists and give examples. (DOK 1) <u>JoVE</u> • Algae Enumeration via Culturable Methodology • An Introduction to Transfection • An Introduction to the Laboratory Mouse: Mus musculus • An Overview of Genetic Engineering • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Co-Immunoprecipitation and Pull-Down Assays • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detection of Bacteriophages in Environmental Samples • Genetic Engineering of Model Organisms • Genetic Screens • Gram Staining of Bacteria from Environmental Sources • Isolation of Fecal Bacteria from Water Samples by Filtration • Molecular Cloning • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.2.	Life Science: Develop an understanding of levels of organization and animal classification.
NUMBERED ITEMS	2.d.	Differentiate among the characteristics of Bacteria, Archaea, and Eucarya. (DOK 1)

INDICATOR	**2.d.1.**	**Phylogenic sequencing of the major phyla** **JoVE** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Zebrafish: Danio rerio**
INDICATOR	**2.d.2.**	**Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, Arthropoda (Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)** **JoVE** **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Drosophila melanogaster** **• Analysis of Earthworm Populations in Soil** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Genetic Screens** **• Invertebrate Lifespan Quantification** **• RNAi in C. elegans** **• Whole-Mount In Situ Hybridization**
INDICATOR	**2.d.3.**	**Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia** **JoVE** **• An Introduction to Aging and Regeneration** **• An Introduction to Transfection** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• Anesthesia Induction and Maintenance** **• Basic Care Procedures** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• Blood Withdrawal I** **• Blood Withdrawal II** **• Chick ex ovo Culture** **• Compound Administration I** **• Compound Administration II** **• Compound Administration III** **• Compound Administration IV**

		• Comprehensive Breast Exam • Considerations for Rodent Surgery • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Explant Culture for Developmental Studies • Fate Mapping • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • In ovo Electroporation of Chicken Embryos • Introducing Experimental Agents into the Mouse • Male Rectal Exam • Mouse Genotyping • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Rodent Handling and Restraint Techniques • Rodent Identification I • Rodent Identification II • Sterile Tissue Harvest • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.Z.**	**Zoology**
OBJECTIVE	**Z.3.**	**Life Science: Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
NUMBERED ITEMS	**3.a.**	**Describe life cycles, alternation of generations, and metamorphosis of various animals and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)** **JoVE** • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • C. elegans Development and Reproduction • C. elegans Maintenance • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance

		• Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Fundamentals of Breeding and Weaning • Invertebrate Lifespan Quantification • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.3.	Life Science: Differentiate among animal life cycles, behaviors, adaptations, and relationships.
NUMBERED ITEMS	3.b.	Describe and explain concepts of animal behavior and differentiate between learned and innate behavior. (DOK 1)
INDICATOR	3.b.1.	Division of labor within a group of animals JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Culturing and Enumerating Bacteria from Soil Samples • Filamentous Fungi • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.3.	Life Science: Differentiate among animal life cycles, behaviors, adaptations, and relationships.
NUMBERED ITEMS	3.c.	Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • Development of the Chick • Drosophila Development and Reproduction • Drosophila Maintenance
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.3.	Life Science: Differentiate among animal life cycles, behaviors, adaptations, and relationships.

NUMBERED ITEMS	3.d.	Compare and contrast ecological relationships and make predictions about the survival of populations under given circumstances. (DOK 3)
INDICATOR	3.d.1.	Terrestrial and aquatic ecosystems JoVE • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • Zebrafish Maintenance and Husbandry • Zebrafish Reproduction and Development
INDICATOR	3.d.2.	Herbivores, carnivores, omnivores, decomposers and other feeding relationships JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Drosophila melanogaster • An Introduction to the Chick: Gallus gallus domesticus • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Basic Care Procedures • Basic Mouse Care and Maintenance • C. elegans Maintenance • Carbon and Nitrogen Analysis of Environmental Samples • Culturing and Enumerating Bacteria from Soil Samples • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Drosophila Maintenance • Filamentous Fungi • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Zebrafish Maintenance and Husbandry • Zebrafish Reproduction and Development
INDICATOR	3.d.3.	Symbiotic relationships such as mutualism, commensalisms, and parasitism JoVE • C. elegans Development and Reproduction • Genetic Crosses • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.4.	Life Science: Demonstrate an understanding of the principles of animal genetic diversity and evolution.
NUMBERED ITEMS	4.a.	Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, non-

		disjunction) and the population level (e.g., non-random mating, migration, etc.) (DOK 2)
INDICATOR	**4.a.1.**	**Relationship between natural selection and evolution** **JoVE** **• An Overview of Genetic Analysis**
INDICATOR	**4.a.2.**	**Mutations, crossing over, non-disjunction** **JoVE** **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Developmental Genetics** **• An Introduction to Drosophila melanogaster** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Transfection** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetics and Disease** **• Cell Cycle Analysis** **• DNA Ligation Reactions** **• Drosophila Development and Reproduction** **• Genetic Crosses** **• Genetic Engineering of Model Organisms** **• Genetic Screens** **• Isolating Nucleic Acids from Yeast** **• Live Cell Imaging of Mitosis** **• Method of Standard Addition** **• Molecular Cloning** **• PCR: The Polymerase Chain Reaction** **• Passaging Cells** **• Restriction Enzyme Digests** **• The TUNEL Assay** **• Yeast Maintenance** **• Yeast Transformation and Cloning**
INDICATOR	**4.a.3.**	**Non-random mating, migration, etc.** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Zebrafish: Danio rerio** **• C. elegans Development and Reproduction** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick**

		• Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Fundamentals of Breeding and Weaning • Genetic Crosses • Genetic Screens • Yeast Maintenance • Yeast Reproduction • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
INDICATOR	4.a.4.	Effects of genetic drift on evolution JoVE • An Overview of Genetic Analysis
COMPETENCY	MS.Z.	Zoology
OBJECTIVE	Z.4.	Life Science: Demonstrate an understanding of the principles of animal genetic diversity and evolution.
NUMBERED ITEMS	4.b.	Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3) JoVE • An Introduction to Aging and Regeneration • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Genetic Engineering • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • Chick ex ovo Culture • DNA Ligation Reactions • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Fate Mapping • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Molecular Cloning

		• Mouse Genotyping • Plasmid Purification • RNAi in C. elegans • Restriction Enzyme Digests • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.2.	Earth and Space Science: Develop an understanding of physical and chemical properties of water and aquatic environments.
NUMBERED ITEMS	2.a.	Analyze the physical and chemical properties of water and justify why it is essential to living organisms. (DOK 1) JoVE • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.MAS.	Marine & Aquatic Science

OBJECTIVE	MAS.2.	Earth and Space Science: Develop an understanding of physical and chemical properties of water and aquatic environments.
NUMBERED ITEMS	2.f.	Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
INDICATOR	2.f.1.	Plate tectonics JoVE • Igneous Intrusive Rock • Igneous Volcanic Rock
INDICATOR	2.f.2.	Rise, slope, elevation, and depth JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Making a Geologic Cross Section • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	2.f.4.	Watershed formation as it relates to bodies of fresh water JoVE • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.2.	Earth and Space Science: Develop an understanding of physical and chemical properties of water and aquatic environments.
NUMBERED ITEMS	2.g.	Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
INDICATOR	2.g.2.	River, stream, lake, pond, and swamp JoVE • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.3.	Life Science: Apply an understanding of the diverse organisms found in aquatic environments.
NUMBERED ITEMS	3.a.	Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
INDICATOR	3.a.1.	Adaptations of representative organisms for their aquatic environments

		JoVE • An Introduction to the Zebrafish: Danio rerio • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.3.	Life Science: Apply an understanding of the diverse organisms found in aquatic environments.
NUMBERED ITEMS	3.b.	Research, calculate, and interpret population data. (DOK 2) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Analysis of Earthworm Populations in Soil • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Basic Mouse Care and Maintenance • C. elegans Maintenance • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Dissolved Oxygen in Surface Water • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Filamentous Fungi • Isolation of Fecal Bacteria from Water Samples by Filtration • Passaging Cells • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Yeast Maintenance • Yeast Reproduction
NUMBERED ITEMS	3.c.	Research and compare reproductive processes in aquatic organisms. (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to the Chick: Gallus gallus domesticus

		• An Introduction to the Zebrafish: Danio rerio • C. elegans Development and Reproduction • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
NUMBERED ITEMS	3.e.	Explore the taxonomy of aquatic organisms and use dichotomous keys to differentiate among the organisms. (DOK 2) JoVE • Algae Enumeration via Culturable Methodology • An Introduction to the Zebrafish: Danio rerio • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	3.f.	Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3) JoVE • C. elegans Development and Reproduction • Genetic Crosses • Recombineering and Gene Targeting • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
COMPETENCY	MS.MAS.	Marine & Aquatic Science
OBJECTIVE	MAS.4.	Life Science: Draw conclusions about the relationships between human activity and aquatic organisms.
NUMBERED ITEMS	4.a.	Describe the impact of natural and human activity on aquatic ecosystems and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
INDICATOR	4.a.1.	Sources of pollution in aquatic environments and methods to reduce the effects of the pollution JoVE • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Le Châtelier's Principle • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
INDICATOR	4.a.2.	Effectiveness of a variety of methods of environmental management and stewardship

		JoVE • Dissolved Oxygen in Surface Water • Le Châtelier's Principle • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water
INDICATOR	4.a.3.	Effects of urbanization on aquatic ecosystems and the effects of continued expansion JoVE • Dissolved Oxygen in Surface Water • Le Châtelier's Principle • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Clarify research questions and design laboratory investigations. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.c.	Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research

		• Pilot Testing • Placebos in Research • Realism in Experimentation • Reliability in Psychology Experiments • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs) to draw conclusions and make inferences. (DOK 3) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons

		• Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated

		Questioning Leads to False Memories **• Mental Rotation** **• Metacognitive Development: How Children Estimate Their Memory** **• Modeling Social Stress** **• Motion-induced Blindness** **• Motor Learning in Mirror Drawing** **• Motor Maps** **• Multiple Object Tracking** **• Mutual Exclusivity: How Children Learn the Meanings of Words** **• Numerical Cognition: More or Less** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• PCR: The Polymerase Chain Reaction** **• Patch Clamp Electrophysiology** **• Pericardiocentesis** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• Perspectives on Cognitive Psychology** **• Perspectives on Neuropsychology** **• Physiological Correlates of Emotion Recognition** **• Piaget's Conservation Task and the Influence of Task Demands** **• Plasmid Purification** **• Positive Reinforcement Studies** **• Prospect Theory** **• Purification of a Total Lipid Extract with Column Chromatography** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• RNAi in C. elegans** **• SNP Genotyping** **• Self-administration Studies** **• Spatial Cueing** **• Spatial Memory Testing Using Mazes** **• The ATP Bioluminescence Assay** **• The Attentional Blink** **• The Costs and Benefits of Natural Pedagogy** **• The ELISA Method** **• The Inverted-face Effect** **• The Morris Water Maze** **• The Precision of Visual Working Memory with Delayed Estimation** **• The Rouge Test: Searching for a Sense of Self** **• The Split Brain** **• The Staircase Procedure for Finding a Perceptual Threshold** **• The TUNEL Assay** **• The Transwell Migration Assay**

		• The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.2.	Life Science: Demonstrate an understanding of the basic organization of the body.
NUMBERED ITEMS	2.a.	Apply and relate appropriate anatomical terms to the body in anatomical position. (DOK 1)
INDICATOR	2.a.1.	Relationship of body parts JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Introduction to Neuroanatomy

		• Ankle Exam • Arterial Line Placement • Auscultation • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Comprehensive Breast Exam • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Ear Exam • Elbow Exam • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Foot Exam • General Approach to the Physical Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Lymph Node Exam • Male Rectal Exam • Measuring Vital Signs • Motor Exam I • Motor Exam II • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Nose, Sinuses, Oral Cavity and Pharynx Exam • Observation and Inspection • Ophthalmoscopic Examination • Palpation • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Pericardiocentesis

		• Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Proper Adjustment of Patient Attire during the Physical Exam • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Surgical Cricothyrotomy • Thyroid Exam
INDICATOR	2.a.2.	Major cavities and essential organs <u>JoVE</u> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Introduction to Neuroanatomy • Ankle Exam • Arterial Line Placement • Auscultation • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Comprehensive Breast Exam • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Ear Exam • Elbow Exam • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Foot Exam • General Approach to the Physical Exam • Hand and Wrist Exam • Hip Exam

		• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Lymph Node Exam • Male Rectal Exam • Measuring Vital Signs • Motor Exam I • Motor Exam II • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Nose, Sinuses, Oral Cavity and Pharynx Exam • Observation and Inspection • Ophthalmoscopic Examination • Palpation • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Proper Adjustment of Patient Attire during the Physical Exam • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Surgical Cricothyrotomy • Thyroid Exam
COMPETENCY	**MS.HAP.**	**Human Anatomy & Physiology**
OBJECTIVE	**HAP.2.**	**Life Science: Demonstrate an understanding of the basic organization of the body.**
NUMBERED ITEMS	**2.b.**	Explain how specific mechanisms (e.g., feedback, transport, pH, temperature regulation, etc.) maintain homeostasis. (DOK 1) JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Introduction to Cognition • An Introduction to Learning and Memory

		• An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Reward and Addiction • Ankle Exam • Anxiety Testing • Arterial Line Placement • Assessing Dexterity with Reaching Tasks • Auscultation • Balance and Coordination Testing • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Comprehensive Breast Exam • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Ear Exam • Elbow Exam • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Fear Conditioning • Foot Exam • General Approach to the Physical Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Lymph Node Exam • Male Rectal Exam • Measuring Vital Signs • Modeling Social Stress • Motor Exam I • Motor Exam II • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Nose, Sinuses, Oral Cavity and Pharynx Exam • Observation and Inspection

		• Ophthalmoscopic Examination • Palpation • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Physiological Correlates of Emotion Recognition • Pilot Testing • Proper Adjustment of Patient Attire during the Physical Exam • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Spatial Memory Testing Using Mazes • Surgical Cricothyrotomy • Thyroid Exam • Using a pH Meter
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.2.	Life Science: Demonstrate an understanding of the basic organization of the body.
NUMBERED ITEMS	2.c.	Describe the relationships and interactions of biochemical composition of the human body to body functions. (DOK 2)
INDICATOR	2.c.1.	Compounds and elements necessary for maintaining life JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering

		• An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Maintenance • Carbon and Nitrogen Analysis of Environmental Samples • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos

		• Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • Nuclear Magnetic Resonance (NMR) Spectroscopy • Nutrients in Aquatic Ecosystems • PCR: The Polymerase Chain Reaction • Passaging Cells • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Restriction Enzyme Digests • SNP Genotyping • Sample Preparation for Analytical Preparation • Separating Protein with SDS-PAGE • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance

		• Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	2.c.2.	Major groups of organic substances in the human body <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology • An Introduction to Reward and Addiction • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation

		• Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • Nuclear Magnetic Resonance (NMR) Spectroscopy • PCR: The Polymerase Chain Reaction • Passaging Cells • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • SNP Genotyping • Sample Preparation for Analytical Preparation • Self-administration Studies • Separating Protein with SDS-PAGE • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods

		• The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	2.c.3.	Major types of chemical reactions employed within the organ systems JoVE • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Cyclic Voltammetry (CV) • DNA Gel Electrophoresis • DNA Ligation Reactions • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gel Purification • Introduction to Catalysis • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • Nuclear Magnetic Resonance (NMR) Spectroscopy • PCR: The Polymerase Chain Reaction • Passaging Cells

		• Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Sample Preparation for Analytical Preparation • Separating Protein with SDS-PAGE • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The ATP Bioluminescence Assay • The ELISA Method • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	2.c.4.	Effects of external factors (e.g., heat, pH, etc.) on enzymatic reactions <u>JoVE</u> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Reward and Addiction • Ankle Exam • Anxiety Testing • Arterial Line Placement • Assessing Dexterity with Reaching Tasks • Auscultation • Balance and Coordination Testing • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Comprehensive Breast Exam • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Ear Exam

		• Elbow Exam • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Fear Conditioning • Foot Exam • General Approach to the Physical Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Lymph Node Exam • Male Rectal Exam • Measuring Vital Signs • Modeling Social Stress • Motor Exam I • Motor Exam II • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Nose, Sinuses, Oral Cavity and Pharynx Exam • Observation and Inspection • Ophthalmoscopic Examination • Palpation • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Physiological Correlates of Emotion Recognition • Pilot Testing • Proper Adjustment of Patient Attire during the Physical Exam • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Spatial Memory Testing Using Mazes • Surgical Cricothyrotomy

		• Thyroid Exam • Using a pH Meter
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.2.	Life Science: Demonstrate an understanding of the basic organization of the body.
NUMBERED ITEMS	2.d.	Categorize the relationship of the cell and its functions to the more complex levels of organization within the body. (DOK 2)
INDICATOR	2.d.1.	Anabolic and catabolic reactions within a human cell <u>JoVE</u> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Development and Reproduction • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Cytogenetics • DNA Ligation Reactions • Detecting Reactive Oxygen Species • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gene Silencing with Morpholinos • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling

		• Molecular Cloning • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Surface Plasmon Resonance (SPR) • The ATP Bioluminescence Assay • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	2.d.2.	Four major categories of tissues and their location, structure, and function JoVE • An Introduction to Cell Motility and Migration • An Introduction to Developmental Neurobiology • Calcium Imaging in Neurons • Explant Culture of Neural Tissue • Histological Staining of Neural Tissue • MALDI-TOF Mass Spectrometry • Murine In Utero Electroporation • Neuronal Transfection Methods • Patch Clamp Electrophysiology • Primary Neuronal Cultures • Tandem Mass Spectrometry
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.a.	Identify structures and explain functions of the components of the integumentary system. (DOK 1) JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Observation and Inspection • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler

		• Sensory Exam • The Rubber Hand Illusion
NUMBERED ITEMS	3.b.	Research and distinguish among common integumentary system disorders in terms of origin, manifestation, and treatments. (DOK 1) JoVE • An Introduction to the Zebrafish: Danio rerio • Mouse Genotyping
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.c.	Compare the structure and functions of the skeletal system with its relationship to movement. (DOK 1)
INDICATOR	3.c.1.	Structures which comprise bone JoVE • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Neck Exam • Shoulder Exam I • Shoulder Exam II
INDICATOR	3.c.3.	Major bones of the axial and appendicular skeleton, noting inherent differences between males and females JoVE • An Introduction to Motor Control • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam

		• Shoulder Exam I • Shoulder Exam II
INDICATOR	3.c.4.	Types of joints and their movements <u>JoVE</u> • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam • Shoulder Exam I • Shoulder Exam II
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.d.	Research and draw conclusions about changes in the skeletal system associated with disease, disorder, injury, age, and stress. (DOK 3) <u>JoVE</u> • An Introduction to Motor Control • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam • Shoulder Exam I • Shoulder Exam II
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.

NUMBERED ITEMS	3.e.	Compare the functions and structures of the muscular system with its relationship to movement. (DOK 1)
INDICATOR	3.e.1.	Major components and functions of skeletal muscle fiber JoVE • An Introduction to Motor Control • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam • Shoulder Exam I • Shoulder Exam II
INDICATOR	3.e.2.	Major skeletal muscles and the process of contraction JoVE • An Introduction to Cell Motility and Migration • Invasion Assay Using 3D Matrices • The Transwell Migration Assay
INDICATOR	3.e.3.	Three types of muscles in the body JoVE • An Introduction to Motor Control • Ankle Exam • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam • Shoulder Exam I • Shoulder Exam II
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.f.	Research and evaluate the impact of medical technology on muscle physiology and disease. (DOK 3) JoVE • An Introduction to Motor Control • An Introduction to the Zebrafish: Danio rerio

		• Ankle Exam • Balance and Coordination Testing • Elbow Exam • Foot Exam • Hand and Wrist Exam • Hip Exam • Knee Exam • Lower Back Exam • Motor Exam I • Motor Exam II • Neck Exam • Shoulder Exam I • Shoulder Exam II • Tissue Regeneration with Somatic Stem Cells
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.g.	Relate the components of the nervous system to the senses and the functions of the human body systems. (DOK 1)
INDICATOR	3.g.1.	Four types of neurological cells and the functions of each JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • Ankle Exam • Anterograde Amnesia • Balance and Coordination Testing • Binocular Rivalry • Calcium Imaging in Neurons • Color Afterimages • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Detecting Reactive Oxygen Species • Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Embryonic Stem Cell Culture and Differentiation • Emergent Lateral Canthotomy and Inferior Catholysis • Event-related Potentials and the Oddball Task

		• Explant Culture of Neural Tissue • Eye Exam • FM Dyes in Vesicle Recycling • Finding Your Blind Spot and Perceptual Filling-in • Foot Exam • Hand and Wrist Exam • Hip Exam • Histological Staining of Neural Tissue • Inattentional Blindness • Just-noticeable Differences • Knee Exam • Lower Back Exam • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Motion-induced Blindness • Motor Exam I • Motor Exam II • Murine In Utero Electroporation • Neck Exam • Neuronal Transfection Methods • Object Substitution Masking • Ophthalmoscopic Examination • Patch Clamp Electrophysiology • Physiological Correlates of Emotion Recognition • Primary Neuronal Cultures • Rodent Stereotaxic Surgery • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Solutions and Concentrations • Spatial Cueing • The Ames Room • The Attentional Blink • The Inverted-face Effect • The McGurk Effect • The Rubber Hand Illusion • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	3.g.2.	Conduction of a nerve impulse JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition

		• An Introduction to Developmental Neurobiology • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • Ankle Exam • Anterograde Amnesia • Balance and Coordination Testing • Calcium Imaging in Neurons • Color Afterimages • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Detecting Reactive Oxygen Species • Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Embryonic Stem Cell Culture and Differentiation • Emergent Lateral Canthotomy and Inferior Catholysis • Event-related Potentials and the Oddball Task • Explant Culture of Neural Tissue • Eye Exam • FM Dyes in Vesicle Recycling • Finding Your Blind Spot and Perceptual Filling-in • Foot Exam • Hand and Wrist Exam • Hip Exam • Histological Staining of Neural Tissue • Inattentional Blindness • Just-noticeable Differences • Knee Exam • Lower Back Exam • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Motion-induced Blindness • Motor Exam I • Motor Exam II • Murine In Utero Electroporation • Neck Exam • Neuronal Transfection Methods • Object Substitution Masking • Ophthalmoscopic Examination • Patch Clamp Electrophysiology • Physiological Correlates of Emotion Recognition • Primary Neuronal Cultures • Rodent Stereotaxic Surgery • Self-administration Studies • Sensory Exam • Shoulder Exam I

		• Shoulder Exam II • Spatial Cueing • The Ames Room • The Attentional Blink • The Inverted-face Effect • The McGurk Effect • The Rubber Hand Illusion • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	3.g.3.	Structures and functions of the brain and spinal cord <u>JoVE</u> • An Introduction to Behavioral Neuroscience • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • Anterograde Amnesia • Anxiety Testing • Assessing Dexterity with Reaching Tasks • Balance and Coordination Testing • Binocular Rivalry • Color Afterimages • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Explant Culture of Neural Tissue • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in

		• Hip Exam • Histological Staining of Neural Tissue • Inattentional Blindness • Incidental Encoding • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Learning and Memory: The Remember-Know Task • Lower Back Exam • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Mental Rotation • Modeling Social Stress • Motion-induced Blindness • Motor Exam I • Motor Exam II • Motor Learning in Mirror Drawing • Motor Maps • Murine In Utero Electroporation • Mutual Exclusivity: How Children Learn the Meanings of Words • Neck Exam • Neuronal Transfection Methods • Object Substitution Masking • Physiological Correlates of Emotion Recognition • Primary Neuronal Cultures • Prospect Theory • Rodent Stereotaxic Surgery • Self-administration Studies • Sensory Exam • Spatial Cueing • Spatial Memory Testing Using Mazes • The Ames Room • The Attentional Blink • The Inverted-face Effect • The McGurk Effect • The Morris Water Maze • The Rubber Hand Illusion • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Within-subjects Repeated-measures Design • fMRI: Functional Magnetic Resonance Imaging

INDICATOR	**3.g.4.**	**Divisions of the nervous system (e.g., central nervous system, peripheral nervous system, sympathetic and parasympathetic, etc.)** **<u>JoVE</u>** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Cellular and Molecular Neuroscience** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neuroanatomy** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• Ankle Exam** **• Anterograde Amnesia** **• Anxiety Testing** **• Assessing Dexterity with Reaching Tasks** **• Balance and Coordination Testing** **• Binocular Rivalry** **• Calcium Imaging in Neurons** **• Color Afterimages** **• Cranial Nerves Exam I (I-VI)** **• Cranial Nerves Exam II (VII-XII)** **• Crowding** **• Decision-making and the Iowa Gambling Task** **• Decoding Auditory Imagery with Multivoxel Pattern Analysis** **• Detecting Reactive Oxygen Species** **• Dichotic Listening** **• Ear Exam** **• Elbow Exam** **• Electro-encephalography (EEG)** **• Emergent Lateral Canthotomy and Inferior Catholysis** **• Event-related Potentials and the Oddball Task** **• Executive Function and the Dimensional Change Card Sort Task** **• Executive Function in Autism Spectrum Disorder** **• Explant Culture of Neural Tissue** **• Eye Exam** **• Eye Tracking in Cognitive Experiments** **• Fear Conditioning** **• Finding Your Blind Spot and Perceptual Filling-in** **• Foot Exam** **• Hand and Wrist Exam** **• Hip Exam** **• Histological Staining of Neural Tissue** **• Inattentional Blindness** **• Just-noticeable Differences**

		• Knee Exam • Language: The N400 in Semantic Incongruity • Learning and Memory: The Remember-Know Task • Lower Back Exam • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Modeling Social Stress • Motion-induced Blindness • Motor Exam I • Motor Exam II • Motor Maps • Murine In Utero Electroporation • Mutual Exclusivity: How Children Learn the Meanings of Words • Neck Exam • Nose, Sinuses, Oral Cavity and Pharynx Exam • Object Substitution Masking • Ophthalmoscopic Examination • Patch Clamp Electrophysiology • Perspectives on Sensation and Perception • Physiological Correlates of Emotion Recognition • Rodent Stereotaxic Surgery • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Spatial Cueing • Spatial Memory Testing Using Mazes • The Ames Room • The Attentional Blink • The Inverted-face Effect • The McGurk Effect • The Rubber Hand Illusion • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • Tissue Regeneration with Somatic Stem Cells • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Within-subjects Repeated-measures Design • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	MS.HAP.	Human Anatomy & Physiology

OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.h.	Describe functions of the various sense organs and identify environmental factors that affect their responses. (DOK 1) <u>JoVE</u> • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • An Introduction to Cognition • An Introduction to Motor Control • An Introduction to Neurophysiology • Balance and Coordination Testing • Binocular Rivalry • Calcium Imaging in Neurons • Color Afterimages • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Dichotic Listening • Ear Exam • Emergent Lateral Canthotomy and Inferior Catholysis • Event-related Potentials and the Oddball Task • Eye Exam • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in • Inattentional Blindness • Just-noticeable Differences • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Motion-induced Blindness • Motor Maps • Nose, Sinuses, Oral Cavity and Pharynx Exam • Object Substitution Masking • Ophthalmoscopic Examination • Palpation • Perspectives on Sensation and Perception • Sensory Exam • Spatial Cueing • The Ames Room • The Attentional Blink • The Inverted-face Effect • The McGurk Effect • The Rubber Hand Illusion • The Split Brain

		• The Staircase Procedure for Finding a Perceptual Threshold • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.i.	Distinguish the location, structure, and functions of the endocrine glands. (DOK 1)
INDICATOR	3.i.1.	Major endocrine glands JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Anxiety Testing • Modeling Social Stress • Thyroid Exam
INDICATOR	3.i.2.	Function of each endocrine gland and the various hormones they generated by each JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Anxiety Testing • Modeling Social Stress • Thyroid Exam
INDICATOR	3.i.3.	Negative feedback mechanisms that regulate hormonal secretions. JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Anxiety Testing • Modeling Social Stress • Thyroid Exam
COMPETENCY	MS.HAP.	Human Anatomy & Physiology

OBJECTIVE	**HAP.3.**	**Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.**
NUMBERED ITEMS	**3.j.**	**Research common disorders or diseases of the endocrine system and assess the unique problems associated with diagnoses and treatments. (DOK 3)** **JoVE** **• An Introduction to Cell Metabolism** **• Anxiety Testing** **• Detecting Reactive Oxygen Species** **• Eye Exam** **• Modeling Social Stress** **• Ophthalmoscopic Examination** **• Peripheral Vascular Exam** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• The ATP Bioluminescence Assay** **• Thyroid Exam**
COMPETENCY	**MS.HAP.**	**Human Anatomy & Physiology**
OBJECTIVE	**HAP.3.**	**Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.**
NUMBERED ITEMS	**3.k.**	**Identify and discuss the structures and functions of the organs of the digestive system and discuss their relationships to the interaction among the human body systems. (DOK 2)**
INDICATOR	**3.k.1.**	**Major organs of the digestive system (e.g., alimentary canal and accessory structures)** **JoVE** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• Cranial Nerves Exam II (VII-XII)** **• Male Rectal Exam** **• Nose, Sinuses, Oral Cavity and Pharynx Exam** **• Sensory Exam**
INDICATOR	**3.k.2.**	**Roles of organs in the mechanical and chemical digestion of food and nutrient absorption** **JoVE** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• Male Rectal Exam**

INDICATOR	3.k.3.	Contents of the alimentary canal and how they are mixed and moved JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Male Rectal Exam
INDICATOR	3.k.4.	Enzymes and gland secretions as related to the absorption of digestion products JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Male Rectal Exam
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.l.	Research common disorders or diseases of the digestive system and identify a diagnosis, based upon a given set of symptoms, for a specific disorder. (DOK 3) JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Introduction to Cell Metabolism • Detecting Reactive Oxygen Species • Eye Exam • Male Rectal Exam • Ophthalmoscopic Examination • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • The ATP Bioluminescence Assay
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.

NUMBERED ITEMS	**3.m.**	**Describe the primary functions of the respiratory organs and the relationships between structure and function. (DOK 1)**
INDICATOR	**3.m.1.**	**Breathing verses respiration** **JoVE** **• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation** **• Cardiac Exam I: Inspection and Palpation** **• Cardiac Exam II: Auscultation** **• Cardiac Exam III: Abnormal Heart Sounds** **• Emergency Tube Thoracostomy (Chest Tube Placement)** **• Measuring Vital Signs** **• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment** **• Percutaneous Cricothyrotomy (Seldinger Technique)** **• Respiratory Exam I: Inspection and Palpation** **• Respiratory Exam II: Percussion and Auscultation** **• Surgical Cricothyrotomy**
INDICATOR	**3.m.2.**	**Gaseous exchange between air and blood and mechanisms of gaseous transport by the blood** **JoVE** **• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation** **• Cardiac Exam I: Inspection and Palpation** **• Cardiac Exam II: Auscultation** **• Cardiac Exam III: Abnormal Heart Sounds** **• Emergency Tube Thoracostomy (Chest Tube Placement)** **• Measuring Vital Signs** **• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment** **• Percutaneous Cricothyrotomy (Seldinger Technique)** **• Respiratory Exam I: Inspection and Palpation** **• Respiratory Exam II: Percussion and Auscultation** **• Surgical Cricothyrotomy**
COMPETENCY	**MS.HAP.**	**Human Anatomy & Physiology**
OBJECTIVE	**HAP.3.**	**Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.**
NUMBERED ITEMS	**3.n.**	**Research to describe various diseases commonly affecting normal respiratory function and assert environmental and social factors which may contribute to the incidence of disease. (DOK 2)** **JoVE** **• An Introduction to Saccharomyces cerevisiae** **• Basic Life Support Part II: Airway/Breathing and**

		Continued Cardiopulmonary Resuscitation • Chromatography-Based Biomolecule Purification Methods • Emergency Tube Thoracostomy (Chest Tube Placement) • Measuring Vital Signs • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Percutaneous Cricothyrotomy (Seldinger Technique) • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • SNP Genotyping • Surgical Cricothyrotomy
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.o.	Demonstrate an understanding of the structures and functions of the circulatory system and their role in maintaining homeostasis. (DOK 2)
INDICATOR	3.o.1.	Blood types and the four parts of blood in terms of morphology, function and origin JoVE • An Introduction to Cell Motility and Migration • Invasion Assay Using 3D Matrices • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry • The Transwell Migration Assay
INDICATOR	3.o.2.	Pulminary and systemic circulation JoVE • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Eye Exam • Measuring Vital Signs • Ophthalmoscopic Examination • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Physiological Correlates of Emotion Recognition
INDICATOR	3.o.3.	Systolic and diastolic pressures in relationship to cardiovascular health

		JoVE • Arterial Line Placement • Blood Pressure Measurement • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Measuring Vital Signs • Ophthalmoscopic Examination • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.p.	Investigate and describe the social and economic impact of technological advances in medical treatment on cardiovascular disorders. (DOK 3) JoVE • An Overview of Genetics and Disease • Anxiety Testing • Arterial Line Placement • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Blood Pressure Measurement • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Modeling Social Stress • Ophthalmoscopic Examination • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Using a pH Meter
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.q.	Describe and discuss the structures and functions of the lymphatic system and the relationships to the circulatory system and immunity. (DOK 1)
INDICATOR	3.q.1.	Major lymphatic organs and pathways JoVE

		• Comprehensive Breast Exam • Lymph Node Exam
INDICATOR	3.q.2.	Functions of lymph nodes, lymphocytes, immunoglobulins, thymus, and spleen JoVE • Comprehensive Breast Exam • Lymph Node Exam
INDICATOR	3.q.3.	Types of immunity and immune responses JoVE • Comprehensive Breast Exam • Lymph Node Exam
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.r.	Research and describe common lymphatic disorders and present conclusions about the effectiveness of available treatment options. (DOK 3) JoVE • Comprehensive Breast Exam • Lymph Node Exam
NUMBERED ITEMS	3.s.	Explain the role of the structures and functions of the urinary system as they relate to the formation, composition and elimination of urine. (DOK 1) JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.u.	Identify and discuss the locations, structures, and functions of the major components of the male and female reproductive systems. (DOK 1)
INDICATOR	3.u.1.	Role of hormones in maturation and reproduction JoVE • Comprehensive Breast Exam • Male Rectal Exam • Pelvic Exam I: Assessment of the External Genitalia

		• Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam
INDICATOR	3.u.2.	Development of a fetus. JoVE • An Introduction to Aging and Regeneration • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • Cytogenetics • Embryonic Stem Cell Culture and Differentiation • Fate Mapping • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies
COMPETENCY	MS.HAP.	Human Anatomy & Physiology
OBJECTIVE	HAP.3.	Life Science: Demonstrate an understanding of the structure, functions, and relationships of the body systems.
NUMBERED ITEMS	3.v.	Research common reproductive diseases and disorders and justify the need for continued research in the diagnosis and treatment of reproductive system diseases. (DOK 3) JoVE • Comprehensive Breast Exam • Male Rectal Exam • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam
COMPETENCY	MS.BR.	Biomedical Research
OBJECTIVE	BR.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.b.	Clarify research questions and design laboratory investigations. (DOK 3) JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
NUMBERED ITEMS	1.c.	Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through

		Embodiment **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**
NUMBERED ITEMS	**1.d.**	**Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)** **JoVE** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Genetic Analysis** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Analysis of Earthworm Populations in Soil** **• Annexin V and Propidium Iodide Labeling** **• Anterograde Amnesia** **• Anxiety Testing** **• Approximate Number Sense Test** **• Are You Smart or Hardworking? How Praise Influences Children's Motivation** **• Assessing Dexterity with Reaching Tasks** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Balance and Coordination Testing** **• Basic Mouse Care and Maintenance** **• Binocular Rivalry** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Blood Pressure Measurement**

		• C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span

		• Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold

		• The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3) JoVE • Ethics in Psychology Research • Experimentation using a Confederate • From Theory to Design: The Role of Creativity in Designing Experiments • Manipulating an Independent Variable through Embodiment • Observational Research • Pilot Testing • Placebos in Research • Reliability in Psychology Experiments • Self-report vs. Behavioral Measures of Recycling • The Factorial Experiment • The Multi-group Experiment • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
COMPETENCY	MS.BR.	Biomedical Research
OBJECTIVE	BR.2.	Life Science: Demonstrate an understanding of the processes and resources used in biomedical research.
NUMBERED ITEMS	2.a.	Explore the processes and technologies by which biomedical scientific literature is stored, catalogued, and retrieved and communicate technical approaches and conclusions pertaining to contemporary professional biomedical research publications. (DOK 2)
INDICATOR	2.a.1.	Student-created glossary of technical scientific terminology from the selected readings JoVE

		• An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Chick ex ovo Culture • Chromatin Immunoprecipitation • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue

		• Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry

		• Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	**2.a.4.**	**Additional resources (e.g., textbooks, periodicals, personal interviews with a scientist or teacher familiar with that area of research) needed to assess research findings** **JoVE** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cell Motility and Migration** **• An Introduction to Cognition** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Motor Control** **• An Introduction to Neuroanatomy** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• Ankle Exam** **• Anterograde Amnesia** **• Arterial Line Placement** **• Auscultation** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation** **• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation** **• Binocular Rivalry** **• Blood Pressure Measurement** **• C. elegans Development and Reproduction** **• Capillary Electrophoresis (CE)**

		• Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Chick ex ovo Culture • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Community DNA Extraction from Bacterial Colonies • Comprehensive Breast Exam • Coordination Chemistry Complexes • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Cyclic Voltammetry (CV) • Cytogenetics • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dichotic Listening • Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Embryonic Stem Cell Culture and Differentiation • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Enzyme Assays and Kinetics • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Eye Exam • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Foot Exam • Fundamentals of Breeding and Weaning

		• Gene Silencing with Morpholinos • General Approach to the Physical Exam • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • Gram Staining of Bacteria from Environmental Sources • Hand and Wrist Exam • Hip Exam • In ovo Electroporation of Chicken Embryos • Incidental Encoding • Induced Pluripotency • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Knee Exam • Live Cell Imaging of Mitosis • Lower Back Exam • Lymph Node Exam • MALDI-TOF Mass Spectrometry • Male Rectal Exam • Measuring Verbal Working Memory Span • Measuring Vital Signs • Metabolic Labeling • Molecular Cloning • Motor Exam I • Motor Exam II • Motor Learning in Mirror Drawing • Mouse Genotyping • Multiple Object Tracking • Murine In Utero Electroporation • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Neuronal Transfection Methods • Nose, Sinuses, Oral Cavity and Pharynx Exam • Nuclear Magnetic Resonance (NMR) Spectroscopy • Observation and Inspection • Ophthalmoscopic Examination • Palpation • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique)

		• Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Plasmid Purification • Primary Neuronal Cultures • Proper Adjustment of Patient Attire during the Physical Exam • Prospect Theory • Protein Crystallization • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Scanning Electron Microscopy (SEM) • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Solid-Liquid Extraction • Solutions and Concentrations • Surgical Cricothyrotomy • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The Precision of Visual Working Memory with Delayed Estimation • The Split Brain • The TUNEL Assay • The Transwell Migration Assay • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using a pH Meter • Verbal Priming • Visual Search for Features and Conjunctions • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.BR.	Biomedical Research

OBJECTIVE	BR.2.	Life Science: Demonstrate an understanding of the processes and resources used in biomedical research.
NUMBERED ITEMS	2.b.	Identify the research area of a particular biomedical researcher and summarize a research article upon which to draw conclusions about the importance of the researcher's work. (DOK 2) <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Stem Cell Biology • An Introduction to the Laboratory Mouse: Mus musculus • An Overview of Gene Expression • An Overview of Genetics and Disease • Capillary Electrophoresis (CE) • DNA Methylation Analysis • Expression Profiling with Microarrays • Genetic Engineering of Model Organisms • Genome Editing • Molecular Cloning • RNA-Seq • Recombineering and Gene Targeting • SNP Genotyping
NUMBERED ITEMS	2.c.	Critique a current research article from a specified internet site. (DOK 3) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling

		• Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Chick ex ovo Culture • Chromatin Immunoprecipitation • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification

		• Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
NUMBERED ITEMS	2.d.	Communicate with science students at other high school sites using electronic communications to compare and contrast conclusions about specified research topics. (DOK 3) <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection

		• An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Chick ex ovo Culture • Chromatin Immunoprecipitation • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to the Microplate Reader

		• Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	**MS.BR.**	**Biomedical Research**
OBJECTIVE	**BR.3.**	**Life Science: Analyze contemporary issues, related to the practice or application of biomedical research, that pose a dilemma or dilemmas for our society.**
NUMBERED ITEMS	**3.a.**	**Identify, research, and summarize current, topical advances in biomedical research and healthcare areas. (Suggested areas of initial focus including fetal tissue research, legalization of drugs, drug abuse, euthanasia, research fraud, use of non-human animals in research, genetic engineering, and universal health care. DOK 4**

INDICATOR	**3.a.1.**	**Biomedical science areas of personal interest** **JoVE** **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cognition** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• Annexin V and Propidium Iodide Labeling** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Cell Cycle Analysis** **• Chick ex ovo Culture** **• Chromatin Immunoprecipitation** **• Cytogenetics** **• DNA Gel Electrophoresis** **• DNA Ligation Reactions** **• DNA Methylation Analysis** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Electrophoretic Mobility Shift Assay (EMSA)** **• Embryonic Stem Cell Culture and Differentiation**

		• Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning

		• Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	3.a.2.	Key areas of human physiology towards which a major commitment of United States federal funding of biomedical research is applied <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Developmental Neurobiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Engineering • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • DNA Ligation Reactions • Development and Reproduction of the Laboratory Mouse • Embryonic Stem Cell Culture and Differentiation • Explant Culture of Neural Tissue • Fate Mapping • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Plasmid Purification • Primary Neuronal Cultures • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Yeast Transformation and Cloning
COMPETENCY	MS.BR.	Biomedical Research
OBJECTIVE	BR.3.	Life Science: Analyze contemporary issues, related to the practice or application of biomedical research, that pose a dilemma or dilemmas for our society.
NUMBERED ITEMS	3.b.	Research, develop, and present a justifiable argument for or against a biomedical issue. (DOK 3)

		JoVE **• An Introduction to Aging and Regeneration** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cognition** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• Annexin V and Propidium Iodide Labeling** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Capillary Electrophoresis (CE)** **• Cell Cycle Analysis** **• Chick ex ovo Culture** **• Chromatin Immunoprecipitation** **• Cytogenetics** **• DNA Gel Electrophoresis** **• DNA Ligation Reactions** **• DNA Methylation Analysis** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Electrophoretic Mobility Shift Assay (EMSA)** **• Embryonic Stem Cell Culture and Differentiation**

		• Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Passaging Cells • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction

		• Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
COMPETENCY	MS.BR.	Biomedical Research
OBJECTIVE	BR.4.	Life Science: Investigate and describe the basic elements of genetics and molecular biology that are fundamental to modern biomedical research.
NUMBERED ITEMS	4.a.	Research and describe major historical events leading to the development of the science of genetics. (DOK 3)
INDICATOR	4.a.1.	Events that have revolutionized genetic analysis and manipulation, including the polymerase chain reaction (PCR), gene transfection, the Human Genome Project, protein sequencing, and in vitro fertilization <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Cell Cycle Analysis • Chick ex ovo Culture

		• Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to the Microplate Reader • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery

		• SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	4.a.2.	Influence that environmental pollutants and other man-made chemicals could have on the regulation of protein synthesis and reproduction JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The TUNEL Assay
INDICATOR	4.a.3.	Subcellular organelles responsible for protein synthesis and reproduction JoVE • An Overview of Epigenetics

		• An Overview of Gene Expression • Chromatin Immunoprecipitation • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genome Editing • Molecular Cloning • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Whole-Mount In Situ Hybridization
COMPETENCY	MS.BR.	Biomedical Research
OBJECTIVE	BR.4.	Life Science: Investigate and describe the basic elements of genetics and molecular biology that are fundamental to modern biomedical research.
NUMBERED ITEMS	4.b.	Apply formulas and properties in analyzing hydrocarbon families. (DOK 1)
INDICATOR	4.b.1.	Bonding families of hydrocarbons JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Annexin V and Propidium Iodide Labeling • Assembly of a Reflux System for Heated Chemical Reactions • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation

		• Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Dialysis: Diffusion Based Separation • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • FM Dyes in Vesicle Recycling • Fractional Distillation • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Introduction to Catalysis • Introduction to Mass Spectrometry • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Molecular Cloning • Mouse Genotyping

		• Nuclear Magnetic Resonance (NMR) Spectroscopy • PCR: The Polymerase Chain Reaction • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Plasmid Purification • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	4.b.2.	Structural formulas for substituted and non-substituted hydrocarbons JoVE • Purification of a Total Lipid Extract with Column Chromatography • Sonication Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.BR.	Biomedical Research

OBJECTIVE	BR.4.	Life Science: Investigate and describe the basic elements of genetics and molecular biology that are fundamental to modern biomedical research.
NUMBERED ITEMS	4.c.	Interpret the basis for optical resolution between stereoisomers and the use of nuclear magnetic resonance, MRI, CAT, PET, etc., for structural determinations. (DOK 2) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Motor Control • An Introduction to Neuroanatomy • Color Afterimages • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Electro-encephalography (EEG) • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in • Introduction to Catalysis • Introduction to Mass Spectrometry • Learning and Memory: The Remember-Know Task • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Metabolic Labeling • Motion-induced Blindness • Motor Maps • Solid-Liquid Extraction • Spatial Cueing • The Attentional Blink • The Rubber Hand Illusion • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Visual Attention: fMRI Investigation of Object-based Attentional Control • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	4.d.	Describe the use of protein crystallography in the determination of the structure of deoxyribonucleic acid (DNA). (DOK 2) JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics

		• An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Cell Cycle Analysis • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq

		• Recombineering and Gene Targeting • Restriction Enzyme Digests • SNP Genotyping • Testing For Genetically Modified Foods • The TUNEL Assay • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling
COMPETENCY	**MS.BR.**	**Biomedical Research**
OBJECTIVE	**BR.5.**	**Life Science: Demonstrate proficiency in the application of fundamental technical procedures related to biomedical laboratory research activities.**
NUMBERED ITEMS	**5.a.**	**Demonstrate an understanding of the skills necessary to set up, operate, and interpret the results from the use of the laboratory spectrophotometer. (DOK 2)** **JoVE** • Community DNA Extraction from Bacterial Colonies • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determining the Empirical Formula • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to the Spectrophotometer • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Nutrients in Aquatic Ecosystems • Photometric Protein Determination • Plasmid Purification • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Solid-Liquid Extraction • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF) • Yeast Maintenance

NUMBERED ITEMS	**5.b.**	**Utilize the process of paper chromatography to identify the components of a chemical mixture. (DOK 2)** **JoVE** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Chromatography-Based Biomolecule Purification Methods** **• Column Chromatography** **• Fractional Distillation** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• High-Performance Liquid Chromatography (HPLC)** **• Internal Standards** **• Ion-Exchange Chromatography** **• MALDI-TOF Mass Spectrometry** **• Performing 1D Thin Layer Chromatography** **• Purification of a Total Lipid Extract with Column Chromatography** **• Solid-Liquid Extraction** **• Tandem Mass Spectrometry**
NUMBERED ITEMS	**5.c.**	**Use the Lowry method to distinguish among chemical reactions essential to the calculation of protein concentrations in a solution. (DOK 1)** **JoVE** **• An Introduction to Cell Motility and Migration** **• An Introduction to Saccharomyces cerevisiae** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• Cell-surface Biotinylation Assay** **• Chromatin Immunoprecipitation** **• Co-Immunoprecipitation and Pull-Down Assays** **• Density Gradient Ultracentrifugation** **• Dialysis: Diffusion Based Separation** **• Drosophila Larval IHC** **• Electrophoretic Mobility Shift Assay (EMSA)** **• Enzyme Assays and Kinetics** **• FM Dyes in Vesicle Recycling** **• Förster Resonance Energy Transfer (FRET)** **• Genetic Engineering of Model Organisms** **• Introduction to Catalysis** **• Introduction to Mass Spectrometry** **• Invasion Assay Using 3D Matrices** **• Ion-Exchange Chromatography** **• MALDI-TOF Mass Spectrometry** **• Metabolic Labeling** **• Photometric Protein Determination** **• Protein Crystallization**

		• Reconstitution of Membrane Proteins • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The ELISA Method • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Yeast Transformation and Cloning
NUMBERED ITEMS	5.e.	Explain the process used to sample organic compounds, including methane, ethane, acetic acid, ethyl ethanoate, and methanol. (DOK 1) <u>JoVE</u> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • Introduction to Catalysis • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.

NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.3.	Earth and Space Science: Discuss factors which are used to explain the geological history of Earth.
NUMBERED ITEMS	3.a.	Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
INDICATOR	3.a.1.	Plate tectonic boundaries (e.g., divergent, convergent, and transform) JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	3.a.2.	Modern and ancient geological features to each kind of plate tectonic boundary JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	3.a.3.	Production of particular groups of igneous and metamorphic rocks and mineral resources JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Igneous Intrusive Rock • Igneous Volcanic Rock

		• Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
INDICATOR	3.a.4.	Sedimentary basins created and destroyed through time JoVE • Igneous Volcanic Rock
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.3.	Earth and Space Science: Discuss factors which are used to explain the geological history of Earth.
NUMBERED ITEMS	3.b.	Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2) JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography
NUMBERED ITEMS	3.c.	Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2) JoVE • Igneous Intrusive Rock • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis
NUMBERED ITEMS	3.e.	Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the Earth. (DOK 2) JoVE • Making a Geologic Cross Section
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.3.	Earth and Space Science: Discuss factors which are used to explain the geological history of Earth.
NUMBERED ITEMS	3.f.	Apply principles of relative age (e.g., superposition, original horizontality, cross-cutting relations, and original lateral continuity) to support an opinion related to Earth's geological history. (DOK 3)
INDICATOR	3.f.1.	Types of unconformity (e.g., disconformity, angular unconformity, nonconformity) JoVE • Making a Geologic Cross Section
INDICATOR	3.f.2.	Geological timetable

		JoVE • Making a Geologic Cross Section
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.3.	Earth and Space Science: Discuss factors which are used to explain the geological history of Earth.
NUMBERED ITEMS	3.h.	Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the Earth. (DOK 1) JoVE • Making a Geologic Cross Section • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.4.	Earth and Space Science: Demonstrate an understanding of Earth systems relating to weather and climate.
NUMBERED ITEMS	4.b.	Interpret the patterns in temperature and precipitation that produce the climate regions on Earth and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Nino/La Nina, global warming). (DOK 2) JoVE • Biofuels: Producing Ethanol from Cellulosic Material
NUMBERED ITEMS	4.c.	Justify how changes in global climate and variation in Earth/Sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2) JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
NUMBERED ITEMS	4.d.	Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1) JoVE • Turbidity and Total Solids in Surface Water
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.5.	Earth and Space Science: Apply an understanding of ecological factors to explain relationships between Earth systems.

NUMBERED ITEMS	**5.a.**	**Draw conclusions about how life on Earth shapes Earth systems and responds to the interaction of Earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)**
INDICATOR	**5.a.1.**	**Nature and distribution of life on Earth, including humans, to the chemistry and availability of water** **JoVE** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Dissolved Oxygen in Surface Water** **• Igneous Intrusive Rock** **• Nutrients in Aquatic Ecosystems** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Turbidity and Total Solids in Surface Water** **• Using GIS to Investigate Urban Forestry** **• Water Quality Analysis via Indicator Organisms**
INDICATOR	**5.a.2.**	**Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time** **JoVE** **• Dissolved Oxygen in Surface Water** **• Nutrients in Aquatic Ecosystems** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Turbidity and Total Solids in Surface Water** **• Using GIS to Investigate Urban Forestry** **• Water Quality Analysis via Indicator Organisms** **• Zebrafish Maintenance and Husbandry**
INDICATOR	**5.a.3.**	**Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)** **JoVE** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction** **• Introduction to Mass Spectrometry** **• Lead Analysis of Soil Using Atomic Absorption**

		Spectroscopy • Making a Geologic Cross Section • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.5.	Earth and Space Science: Apply an understanding of ecological factors to explain relationships between Earth systems.
NUMBERED ITEMS	5.b.	Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2) JoVE • An Overview of Genetic Analysis
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.5.	Earth and Space Science: Apply an understanding of ecological factors to explain relationships between Earth systems.
NUMBERED ITEMS	5.c.	Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped Earth systems. (DOK 1)
INDICATOR	5.c.1.	Photosynthesis and the atmosphere JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment

INDICATOR	5.c.3.	Land plants and terrestrial environments JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Igneous Intrusive Rock • Making a Geologic Cross Section • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry
COMPETENCY	MS.ESS.	Earth and Space Science
OBJECTIVE	ESS.5.	Earth and Space Science: Apply an understanding of ecological factors to explain relationships between Earth systems.
NUMBERED ITEMS	5.d.	Cite evidence about how dramatic changes in Earth's atmosphere influenced the evolution of life. (DOK 1) JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.a.	Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
INDICATOR	1.a.1.	Safety rules and symbols JoVE • An Introduction to the Centrifuge • An Introduction to the Micropipettor • Aseptic Technique in Environmental Science • Histological Sample Preparation for Light Microscopy • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy

		• Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons

		• Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Dichotic Listening • Electro-encephalography (EEG) • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Gene Silencing with Morpholinos • Genetic Crosses • Habituation: Studying Infants Before They Can Talk • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories

		• Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNAi in C. elegans • SNP Genotyping • Self-administration Studies • Spatial Cueing • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain

		Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	1.e.	Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3) JoVE • Aseptic Technique in Environmental Science
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.2.	Earth and Space Science: Develop an understanding of the relationship of ecological factors that effect an ecosystem.
NUMBERED ITEMS	2.a.	Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2) JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.2.	Earth and Space Science: Develop an understanding of the relationship of ecological factors that effect an ecosystem.
NUMBERED ITEMS	2.b.	Explain the flow of matter and energy in ecosystems. (DOK 2)

INDICATOR	**2.b.1.**	**Interactions between biotic and abiotic factors** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Analysis of Earthworm Populations in Soil** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Filamentous Fungi** **• Fundamentals of Breeding and Weaning** **• Nutrients in Aquatic Ecosystems** **• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium** **• Using GIS to Investigate Urban Forestry**
INDICATOR	**2.b.2.**	**Indigenous plants and animals and their roles in various ecosystems** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Analysis of Earthworm Populations in Soil** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Filamentous Fungi** **• Fundamentals of Breeding and Weaning** **• Nutrients in Aquatic Ecosystems** **• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium** **• Using GIS to Investigate Urban Forestry**
INDICATOR	**2.b.3.**	**Biogeochemical cycles within the environment** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Analysis of Earthworm Populations in Soil** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Filamentous Fungi** **• Fundamentals of Breeding and Weaning**

		• Nutrients in Aquatic Ecosystems • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.2.	Earth and Space Science: Develop an understanding of the relationship of ecological factors that effect an ecosystem.
NUMBERED ITEMS	2.c.	Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3) JoVE • Analysis of Earthworm Populations in Soil • Tree Survey: Point-Centered Quarter Sampling Method
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.2.	Earth and Space Science: Develop an understanding of the relationship of ecological factors that effect an ecosystem.
NUMBERED ITEMS	2.d.	Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
INDICATOR	2.d.1.	How a species adapts to its niche JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Nutrients in Aquatic Ecosystems • Recombineering and Gene Targeting • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
INDICATOR	2.d.2.	Process of primary and secondary succession and its effects on a population JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples

		• Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Nutrients in Aquatic Ecosystems • Recombineering and Gene Targeting • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
INDICATOR	2.d.3.	How changes in the environment might affect organisms JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Nutrients in Aquatic Ecosystems • Recombineering and Gene Targeting • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.ES.	Environmental Science
OBJECTIVE	ES.2.	Earth and Space Science: Develop an understanding of the relationship of ecological factors that effect an ecosystem.
NUMBERED ITEMS	2.g.	Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1) JoVE • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms • Zebrafish Maintenance and Husbandry
COMPETENCY	MS.ES.	Environmental Science

OBJECTIVE	**ES.3.**	**Earth and Space Science: Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
NUMBERED ITEMS	**3.a.**	**Summarize the effects of human activities on resources in the local environments. (DOK 2)**
INDICATOR	**3.a.1.**	**Sources, uses, quality, and conservation of water** **JoVE** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Introduction to Mass Spectrometry** **• Lead Analysis of Soil Using Atomic Absorption Spectroscopy** **• Making a Geologic Cross Section** **• Measuring Tropospheric Ozone** **• Nutrients in Aquatic Ecosystems** **• Proton Exchange Membrane Fuel Cells** **• Self-report vs. Behavioral Measures of Recycling** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Turbidity and Total Solids in Surface Water** **• Using GIS to Investigate Urban Forestry** **• Water Quality Analysis via Indicator Organisms**
INDICATOR	**3.a.2.**	**Renewable and nonrenewable resources** **JoVE** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Dissolved Oxygen in Surface Water** **• Introduction to Mass Spectrometry** **• Lead Analysis of Soil Using Atomic Absorption Spectroscopy** **• Making a Geologic Cross Section** **• Measuring Tropospheric Ozone** **• Nutrients in Aquatic Ecosystems** **• Proton Exchange Membrane Fuel Cells** **• Self-report vs. Behavioral Measures of Recycling** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Turbidity and Total Solids in Surface Water** **• Using GIS to Investigate Urban Forestry** **• Water Quality Analysis via Indicator Organisms**
INDICATOR	**3.a.3.**	**Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem** **JoVE** **• Biofuels: Producing Ethanol from Cellulosic Material**

		• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Making a Geologic Cross Section • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms
COMPETENCY	**MS.ES.**	**Environmental Science**
OBJECTIVE	**ES.3.**	**Earth and Space Science: Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
NUMBERED ITEMS	3.b.	Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere and atmosphere and develop a logical argument to support how communities restore ecosystems. (DOK 3) JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Making a Geologic Cross Section • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
NUMBERED ITEMS	3.c.	Research and evaluate the use of renewable and nonrenewable resources and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3) JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using

		UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.GEO.	Geology
OBJECTIVE	GEO.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.GEO.	Geology
OBJECTIVE	GEO.2.	Earth and Space Science: Develop an understanding of plate tectonics and geochemical and ecological processes that affect Earth.
NUMBERED ITEMS	2.a.	Differentiate the components of the Earth's atmosphere and lithosphere. (DOK 1) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Volcanic Rock • Measuring Tropospheric Ozone • Using Topographic Maps to Generate Topographic Profiles
COMPETENCY	MS.GEO.	Geology
OBJECTIVE	GEO.2.	Earth and Space Science: Develop an understanding of plate tectonics and geochemical and ecological processes that affect Earth.
NUMBERED ITEMS	2.d.	Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
INDICATOR	2.d.1.	Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis) JoVE

		• Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	2.d.3.	Asthenosphere JoVE • Igneous Intrusive Rock • Igneous Volcanic Rock • Using Topographic Maps to Generate Topographic Profiles
COMPETENCY	MS.GEO.	Geology
OBJECTIVE	GEO.2.	Earth and Space Science: Develop an understanding of plate tectonics and geochemical and ecological processes that affect Earth.
NUMBERED ITEMS	2.e.	Summarize the theories of plate development and continental drift and describe the causes and effects involved in each. (DOK 2) JoVE • Igneous Intrusive Rock • Igneous Volcanic Rock • Using Topographic Maps to Generate Topographic Profiles
NUMBERED ITEMS	2.f.	Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers). (DOK 2) JoVE • Algae Enumeration via Culturable Methodology • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy

		• Dissolved Oxygen in Surface Water • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Filamentous Fungi • Fundamentals of Breeding and Weaning • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry
NUMBERED ITEMS	2.h.	Research and describe different techniques for determining relative and absolute age of the Earth (e.g., index of fossil layers, superposition, radiometric dating, etc.) (DOK 1) JoVE • Making a Geologic Cross Section
NUMBERED ITEMS	2.k.	Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3) JoVE • Igneous Volcanic Rock
COMPETENCY	MS.A.	Astronomy
OBJECTIVE	A.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea

		Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.AS.	Aerospace Studies
OBJECTIVE	AS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.AS.	Aerospace Studies
OBJECTIVE	AS.2.	Earth and Space Science: Develop an understanding of the concepts involved in aerodynamics, flight control, and aircraft propulsion.
NUMBERED ITEMS	2.e.	Calculate the expansion ratio of gases in an engine (gas laws). (DOK 1) JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
NUMBERED ITEMS	2.f.	Use appropriate instruments and perform calculations involved in navigation (e.g., locating a point on the globe from its global coordinates and plotting a point-point course using a sectional map). (DOK 2) JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Making a Geologic Cross Section • Using GIS to Investigate Urban Forestry • Using Topographic Maps to Generate Topographic Profiles
COMPETENCY	MS.SIS.	Spatial Information Science
OBJECTIVE	SIS.1.	Inquiry: Apply inquiry-based and problem-solving processes and skills to scientific investigations.
NUMBERED ITEMS	1.d.	Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and

		legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3) JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
COMPETENCY	MS.SIS.	Spatial Information Science
OBJECTIVE	SIS.2.	Earth and Space Science: Develop an understanding of geographic information systems.
NUMBERED ITEMS	2.a.	Demonstrate the basic concepts of global positioning systems (GPS) by determining locations, (e.g., latitude, longitude, and elevation of the school flag pole or a site where a GPS receiver is unable to make an accurate measurement). (DOK 1) JoVE • Using GIS to Investigate Urban Forestry
NUMBERED ITEMS	2.b.	Calculate various angle units and the average and standard deviation from repeated measurements. (DOK 1) JoVE • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.SIS.	Spatial Information Science
OBJECTIVE	SIS.2.	Earth and Space Science: Develop an understanding of geographic information systems.
NUMBERED ITEMS	2.c.	Explain the basic concepts of remote sensing. (DOK 2)
INDICATOR	2.c.1.	Characteristics of the electromagnetic spectrum JoVE • Using GIS to Investigate Urban Forestry
INDICATOR	2.c.2.	Passive verses active sensor systems JoVE • Using GIS to Investigate Urban Forestry
INDICATOR	2.c.3.	Types of sensor platforms JoVE • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.SIS.	Spatial Information Science

OBJECTIVE	SIS.2.	Earth and Space Science: Develop an understanding of geographic information systems.
NUMBERED ITEMS	2.e.	Interpret the absorption/reflection spectrum using images and graphs. (DOK 2) JoVE • Coordination Chemistry Complexes • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Introduction to Fluorescence Microscopy • Introduction to the Microplate Reader • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • MALDI-TOF Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy • Protein Crystallization • Raman Spectroscopy for Chemical Analysis • Tandem Mass Spectrometry • Ultraviolet-Visible (UV-Vis) Spectroscopy
COMPETENCY	MS.SIS.	Spatial Information Science
OBJECTIVE	SIS.2.	Earth and Space Science: Develop an understanding of geographic information systems.
NUMBERED ITEMS	2.f.	Explain the basic concepts of data and image processing. (DOK 1)
INDICATOR	2.f.2.	Variety of sources for geological data and imaging JoVE • Using GIS to Investigate Urban Forestry
COMPETENCY	MS.SIS.	Spatial Information Science
OBJECTIVE	SIS.2.	Earth and Space Science: Develop an understanding of geographic information systems.
NUMBERED ITEMS	2.g.	Formulate a hypothesis of geological factors/problems and determine data sets pertinent to the hypothesis.(DOK 3) JoVE • Using GIS to Investigate Urban Forestry
NUMBERED ITEMS	2.h.	Explain how data sets are geo-referenced and geo-rectified. (DOK 1) JoVE • Using GIS to Investigate Urban Forestry
NUMBERED ITEMS	2.i.	Assess the quality and accuracy of GPS and/or remote sensing data. (DOK 2) JoVE • Using GIS to Investigate Urban Forestry

COMPETENCY	**MS.SIS.**	**Spatial Information Science**
OBJECTIVE	**SIS.2.**	**Earth and Space Science: Develop an understanding of geographic information systems.**
NUMBERED ITEMS	**2.j.**	**Analyze and apply the basic concepts of geographic information systems. (DOK 2)**
INDICATOR	**2.j.1.**	**Compatible geographic data layers of information utilizing computer software** **JoVE** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass** **• Making a Geologic Cross Section** **• Using GIS to Investigate Urban Forestry** **• Using Topographic Maps to Generate Topographic Profiles**
INDICATOR	**2.j.2.**	**Relationships between geographic data** **JoVE** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass** **• Making a Geologic Cross Section** **• Using GIS to Investigate Urban Forestry** **• Using Topographic Maps to Generate Topographic Profiles**
INDICATOR	**2.j.3.**	**Geographic information image showing results of analysis** **JoVE** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass** **• Making a Geologic Cross Section** **• Using Topographic Maps to Generate Topographic Profiles**
COMPETENCY	**MS.SIS.**	**Spatial Information Science**
OBJECTIVE	**SIS.2.**	**Earth and Space Science: Develop an understanding of geographic information systems.**
NUMBERED ITEMS	**2.m.**	**Describe the proper use and care of GPS receivers, computers, and other scientific equipment. (DOK 1)** **JoVE** **• Using GIS to Investigate Urban Forestry**

Grade: **9** - Adopted: **2016**

COMPETENCY	**MS.RST.9-10.**	**Reading Standards for Literacy in Science and Technical Subjects**
OBJECTIVE		**Craft and Structure**
NUMBERED ITEMS	**RST.9-10.4.**	**Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades**

		9-10 texts and topics. **<u>JoVE</u>** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Aging and Regeneration** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cell Motility and Migration** **• An Introduction to Cellular and Molecular Neuroscience** **• An Introduction to Cognition** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Motor Control** **• An Introduction to Neuroanatomy** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Reward and Addiction** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to Working in the Hood** **• An Introduction to the Centrifuge** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Micropipettor** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Analysis of Earthworm Populations in Soil** **• Anesthesia Induction and Maintenance**

		• Ankle Exam • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Arterial Line Placement • Aseptic Technique in Environmental Science • Assembly of a Reflux System for Heated Chemical Reactions • Assessing Dexterity with Reaching Tasks • Auscultation • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Balance and Coordination Testing • Basic Care Procedures • Basic Chick Care and Maintenance • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • Blood Withdrawal I • Blood Withdrawal II • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Calcium Imaging in Neurons • Calibration Curves • Capillary Electrophoresis (CE) • Carbon and Nitrogen Analysis of Environmental Samples • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Chick ex ovo Culture • Children's Reliance on Artist Intentions When Identifying Pictures

		• Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Color Afterimages • Column Chromatography • Common Lab Glassware and Uses • Community DNA Extraction from Bacterial Colonies • Compound Administration I • Compound Administration II • Compound Administration III • Compound Administration IV • Comprehensive Breast Exam • Conducting Reactions Below Room Temperature • Considerations for Rodent Surgery • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Detection of Bacteriophages in Environmental Samples • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Determining Rate Laws and the Order of Reaction • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Dialysis: Diffusion Based Separation

		• Dichotic Listening • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Enzyme Assays and Kinetics • Ethics in Psychology Research • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Exam • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Filamentous Fungi • Finding Your Blind Spot and Perceptual Filling-in • Foot Exam • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • From Theory to Design: The Role of Creativity in Designing Experiments • Fundamentals of Breeding and Weaning • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Gel Purification • Gene Silencing with Morpholinos • General Approach to the Physical Exam • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens

		• Genome Editing • Gram Staining of Bacteria from Environmental Sources • Growing Crystals for X-ray Diffraction Analysis • Habituation: Studying Infants Before They Can Talk • Hand and Wrist Exam • High-Performance Liquid Chromatography (HPLC) • Hip Exam • Histological Sample Preparation for Light Microscopy • Histological Staining of Neural Tissue • How Children Solve Problems Using Causal Reasoning • Ideal Gas Law • Igneous Intrusive Rock • Igneous Volcanic Rock • In ovo Electroporation of Chicken Embryos • Inattentional Blindness • Incidental Encoding • Induced Pluripotency • Internal Standards • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Mass Spectrometry • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Bunsen Burner • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Isolation of Fecal Bacteria from Water Samples by Filtration • Just-noticeable Differences • Knee Exam • Language: The N400 in Semantic Incongruity • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Live Cell Imaging of Mitosis • Lower Back Exam • Lymph Node Exam • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Male Rectal Exam • Manipulating an Independent Variable through

		Embodiment **• Measuring Children's Trust in Testimony** **• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain** **• Measuring Mass in the Laboratory** **• Measuring Reaction Time and Donders' Method of Subtraction** **• Measuring Tropospheric Ozone** **• Measuring Verbal Working Memory Span** **• Measuring Vital Signs** **• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories** **• Mental Rotation** **• Metabolic Labeling** **• Metacognitive Development: How Children Estimate Their Memory** **• Method of Standard Addition** **• Modeling Social Stress** **• Molecular Cloning** **• Motion-induced Blindness** **• Motor Exam I** **• Motor Exam II** **• Motor Learning in Mirror Drawing** **• Motor Maps** **• Mouse Genotyping** **• Multiple Object Tracking** **• Murine In Utero Electroporation** **• Mutual Exclusivity: How Children Learn the Meanings of Words** **• Neck Exam** **• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment** **• Neuronal Transfection Methods** **• Nose, Sinuses, Oral Cavity and Pharynx Exam** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Numerical Cognition: More or Less** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• Observation and Inspection** **• Observational Research** **• Ophthalmoscopic Examination** **• PCR: The Polymerase Chain Reaction** **• Palpation** **• Passaging Cells** **• Patch Clamp Electrophysiology** **• Pelvic Exam I: Assessment of the External Genitalia** **• Pelvic Exam II: Speculum Exam** **• Pelvic Exam III: Bimanual and Rectovaginal Exam** **• Percussion** **• Percutaneous Cricothyrotomy (Seldinger Technique)** **• Performing 1D Thin Layer Chromatography** **• Pericardiocentesis**

		• Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Perspectives on Sensation and Perception • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Preparing Anhydrous Reagents and Equipment • Primary Neuronal Cultures • Proper Adjustment of Patient Attire during the Physical Exam • Prospect Theory • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Restriction Enzyme Digests • Rodent Handling and Restraint Techniques • Rodent Identification I • Rodent Identification II • Rodent Stereotaxic Surgery • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM)

		• Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Sensory Exam • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Shoulder Exam I • Shoulder Exam II • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Sterile Tissue Harvest • Surface Plasmon Resonance (SPR) • Surgical Cricothyrotomy • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Ames Room • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The McGurk Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Rubber Hand Illusion • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water

		• Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Whole-Mount In Situ Hybridization • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
NUMBERED ITEMS	RST.9-10.5.	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Algae Enumeration via Culturable Methodology • An Introduction to Aging and Regeneration • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism

		• An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Reward and Addiction • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to Working in the Hood • An Introduction to the Centrifuge • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Micropipettor • An Introduction to the Zebrafish: Danio rerio • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Anesthesia Induction and Maintenance • Ankle Exam • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Arterial Line Placement • Aseptic Technique in Environmental Science • Assembly of a Reflux System for Heated Chemical Reactions • Assessing Dexterity with Reaching Tasks • Auscultation • Bacterial Growth Curve Analysis and its Environmental

		Applications **• Bacterial Transformation: Electroporation** **• Bacterial Transformation: The Heat Shock Method** **• Balance and Coordination Testing** **• Basic Care Procedures** **• Basic Chick Care and Maintenance** **• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation** **• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation** **• Basic Mouse Care and Maintenance** **• Binocular Rivalry** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Blood Pressure Measurement** **• Blood Withdrawal I** **• Blood Withdrawal II** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Calcium Imaging in Neurons** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Cardiac Exam I: Inspection and Palpation** **• Cardiac Exam II: Auscultation** **• Cardiac Exam III: Abnormal Heart Sounds** **• Categories and Inductive Inferences** **• Cell Cycle Analysis** **• Cell-surface Biotinylation Assay** **• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance** **• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance** **• Central Venous Catheter Insertion: Subclavian Vein** **• Chick ex ovo Culture** **• Children's Reliance on Artist Intentions When Identifying Pictures** **• Chromatin Immunoprecipitation** **• Chromatography-Based Biomolecule Purification Methods** **• Co-Immunoprecipitation and Pull-Down Assays** **• Color Afterimages** **• Column Chromatography** **• Common Lab Glassware and Uses** **• Community DNA Extraction from Bacterial Colonies** **• Compound Administration I** **• Compound Administration II** **• Compound Administration III** **• Compound Administration IV** **• Comprehensive Breast Exam**

		• Conducting Reactions Below Room Temperature • Considerations for Rodent Surgery • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Detection of Bacteriophages in Environmental Samples • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Determining Rate Laws and the Order of Reaction • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Dialysis: Diffusion Based Separation • Dichotic Listening • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat

		• Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Enzyme Assays and Kinetics • Ethics in Psychology Research • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Exam • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Filamentous Fungi • Finding Your Blind Spot and Perceptual Filling-in • Foot Exam • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • From Theory to Design: The Role of Creativity in Designing Experiments • Fundamentals of Breeding and Weaning • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Gel Purification • Gene Silencing with Morpholinos • General Approach to the Physical Exam • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • Gram Staining of Bacteria from Environmental Sources • Growing Crystals for X-ray Diffraction Analysis • Habituation: Studying Infants Before They Can Talk • Hand and Wrist Exam • High-Performance Liquid Chromatography (HPLC) • Hip Exam • Histological Sample Preparation for Light Microscopy • Histological Staining of Neural Tissue • How Children Solve Problems Using Causal Reasoning • Ideal Gas Law

		• Igneous Intrusive Rock • Igneous Volcanic Rock • In ovo Electroporation of Chicken Embryos • Inattentional Blindness • Incidental Encoding • Induced Pluripotency • Internal Standards • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Mass Spectrometry • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Bunsen Burner • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Isolation of Fecal Bacteria from Water Samples by Filtration • Just-noticeable Differences • Knee Exam • Language: The N400 in Semantic Incongruity • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Live Cell Imaging of Mitosis • Lower Back Exam • Lymph Node Exam • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Male Rectal Exam • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Mass in the Laboratory • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Tropospheric Ozone • Measuring Verbal Working Memory Span • Measuring Vital Signs

		• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metabolic Labeling • Metacognitive Development: How Children Estimate Their Memory • Method of Standard Addition • Modeling Social Stress • Molecular Cloning • Motion-induced Blindness • Motor Exam I • Motor Exam II • Motor Learning in Mirror Drawing • Motor Maps • Mouse Genotyping • Multiple Object Tracking • Murine In Utero Electroporation • Mutual Exclusivity: How Children Learn the Meanings of Words • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Neuronal Transfection Methods • Nose, Sinuses, Oral Cavity and Pharynx Exam • Nuclear Magnetic Resonance (NMR) Spectroscopy • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Observation and Inspection • Observational Research • Ophthalmoscopic Examination • PCR: The Polymerase Chain Reaction • Palpation • Passaging Cells • Patch Clamp Electrophysiology • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Performing 1D Thin Layer Chromatography • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Perspectives on Sensation and Perception • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis

		• Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Preparing Anhydrous Reagents and Equipment • Primary Neuronal Cultures • Proper Adjustment of Patient Attire during the Physical Exam • Prospect Theory • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Restriction Enzyme Digests • Rodent Handling and Restraint Techniques • Rodent Identification I • Rodent Identification II • Rodent Stereotaxic Surgery • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Sensory Exam • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Shoulder Exam I • Shoulder Exam II

		• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Sterile Tissue Harvest • Surface Plasmon Resonance (SPR) • Surgical Cricothyrotomy • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Ames Room • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The McGurk Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Rubber Hand Illusion • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury

		• Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Whole-Mount In Situ Hybridization • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	**MS.RST.9-10.**	**Reading Standards for Literacy in Science and Technical Subjects**
OBJECTIVE		**Integration of Knowledge and Ideas**
NUMBERED ITEMS	RST.9-10.7.	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. JoVE • Algae Enumeration via Culturable Methodology • An Introduction to Aging and Regeneration • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology

		• An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assembly of a Reflux System for Heated Chemical Reactions • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Calibration Curves • Capillary Electrophoresis (CE) • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Crowding • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis

		• Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Determining Rate Laws and the Order of Reaction • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Development and Reproduction of the Laboratory Mouse • Dialysis: Diffusion Based Separation • Dichotic Listening • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Ethics in Psychology Research • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • From Theory to Design: The Role of Creativity in Designing Experiments • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Screens • Growing Crystals for X-ray Diffraction Analysis

		• Habituation: Studying Infants Before They Can Talk • High-Performance Liquid Chromatography (HPLC) • How Children Solve Problems Using Causal Reasoning • Ideal Gas Law • Igneous Intrusive Rock • Igneous Volcanic Rock • Inattentional Blindness • Incidental Encoding • Internal Standards • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Tropospheric Ozone • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metabolic Labeling • Metacognitive Development: How Children Estimate Their Memory • Method of Standard Addition • Modeling Social Stress • Motion-induced Blindness • Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words

		• Nuclear Magnetic Resonance (NMR) Spectroscopy • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Observational Research • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Performing 1D Thin Layer Chromatography • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Preparing Anhydrous Reagents and Equipment • Prospect Theory • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Reconstitution of Membrane Proteins • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Separation of Mixtures via Precipitation • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium

		• Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control

		• Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
COMPETENCY	MS.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
OBJECTIVE		Text Types and Purposes
NUMBERED ITEMS	WHST.9-10.1.	Write arguments focused on discipline-specific content.
INDICATOR	WHST.9-10.1(a)	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
COMPETENCY	MS.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
OBJECTIVE		Text Types and Purposes
NUMBERED ITEMS	WHST.9-10.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
INDICATOR	WHST.9-10.2(a)	Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. JoVE • The Multi-group Experiment • The Simple Experiment: Two-group Design
INDICATOR	WHST.9-10.2(d)	Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Algae Enumeration via Culturable Methodology • An Introduction to Aging and Regeneration

		• An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Reward and Addiction • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to Working in the Hood • An Introduction to the Centrifuge • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Micropipettor • An Introduction to the Zebrafish: Danio rerio • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Anesthesia Induction and Maintenance • Ankle Exam • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Arterial Line Placement • Aseptic Technique in Environmental Science

		• Assembly of a Reflux System for Heated Chemical Reactions • Assessing Dexterity with Reaching Tasks • Auscultation • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Balance and Coordination Testing • Basic Care Procedures • Basic Chick Care and Maintenance • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • Blood Withdrawal I • Blood Withdrawal II • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Calcium Imaging in Neurons • Calibration Curves • Capillary Electrophoresis (CE) • Carbon and Nitrogen Analysis of Environmental Samples • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance • Central Venous Catheter Insertion: Subclavian Vein • Chick ex ovo Culture • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Color Afterimages • Column Chromatography • Common Lab Glassware and Uses • Community DNA Extraction from Bacterial Colonies

		• Compound Administration I • Compound Administration II • Compound Administration III • Compound Administration IV • Comprehensive Breast Exam • Conducting Reactions Below Room Temperature • Considerations for Rodent Surgery • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Coordination Chemistry Complexes • Cranial Nerves Exam I (I-VI) • Cranial Nerves Exam II (VII-XII) • Crowding • Culturing and Enumerating Bacteria from Soil Samples • Cyclic Voltammetry (CV) • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Detection of Bacteriophages in Environmental Samples • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Determining Rate Laws and the Order of Reaction • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Diagnostic Necropsy and Tissue Harvest • Dialysis: Diffusion Based Separation • Dichotic Listening • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation

		• Ear Exam • Elbow Exam • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Emergency Tube Thoracostomy (Chest Tube Placement) • Emergent Lateral Canthotomy and Inferior Catholysis • Enzyme Assays and Kinetics • Ethics in Psychology Research • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Exam • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Filamentous Fungi • Finding Your Blind Spot and Perceptual Filling-in • Foot Exam • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • From Theory to Design: The Role of Creativity in Designing Experiments • Fundamentals of Breeding and Weaning • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Gel Purification • Gene Silencing with Morpholinos • General Approach to the Physical Exam • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • Gram Staining of Bacteria from Environmental Sources • Growing Crystals for X-ray Diffraction Analysis • Habituation: Studying Infants Before They Can Talk • Hand and Wrist Exam • High-Performance Liquid Chromatography (HPLC)

		• Hip Exam • Histological Sample Preparation for Light Microscopy • Histological Staining of Neural Tissue • How Children Solve Problems Using Causal Reasoning • Ideal Gas Law • Igneous Intrusive Rock • Igneous Volcanic Rock • In ovo Electroporation of Chicken Embryos • Inattentional Blindness • Incidental Encoding • Induced Pluripotency • Internal Standards • Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation • Intraosseous Needle Placement • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Mass Spectrometry • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Bunsen Burner • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Isolation of Fecal Bacteria from Water Samples by Filtration • Just-noticeable Differences • Knee Exam • Language: The N400 in Semantic Incongruity • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Live Cell Imaging of Mitosis • Lower Back Exam • Lymph Node Exam • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Male Rectal Exam • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Mass in the Laboratory

		• Measuring Reaction Time and Donders' Method of Subtraction • Measuring Tropospheric Ozone • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metabolic Labeling • Metacognitive Development: How Children Estimate Their Memory • Method of Standard Addition • Modeling Social Stress • Molecular Cloning • Motion-induced Blindness • Motor Exam I • Motor Exam II • Motor Learning in Mirror Drawing • Motor Maps • Mouse Genotyping • Multiple Object Tracking • Murine In Utero Electroporation • Mutual Exclusivity: How Children Learn the Meanings of Words • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Neuronal Transfection Methods • Nose, Sinuses, Oral Cavity and Pharynx Exam • Nuclear Magnetic Resonance (NMR) Spectroscopy • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Observation and Inspection • Observational Research • Ophthalmoscopic Examination • PCR: The Polymerase Chain Reaction • Palpation • Passaging Cells • Patch Clamp Electrophysiology • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Performing 1D Thin Layer Chromatography • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation

		• Perspectives on Sensation and Perception • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Preparing Anhydrous Reagents and Equipment • Primary Neuronal Cultures • Proper Adjustment of Patient Attire during the Physical Exam • Prospect Theory • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation • Restriction Enzyme Digests • Rodent Handling and Restraint Techniques • Rodent Identification I • Rodent Identification II • Rodent Stereotaxic Surgery • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling

		• Sensory Exam • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Shoulder Exam I • Shoulder Exam II • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Sterile Tissue Harvest • Surface Plasmon Resonance (SPR) • Surgical Cricothyrotomy • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Ames Room • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The McGurk Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Rubber Hand Illusion • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy

		• Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Whole-Mount In Situ Hybridization • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging