

Main Criteria: Arkansas Curriculum Frameworks

Secondary Criteria: JoVE

Subject: Science

Grade: 9-12

Correlation Options: Show Correlated

Adopted: 2016

STRAND / TOPIC	AR.A.	Astronomy
CONTENT STANDARD		Formation of the Solar System
PERFORMANCE EXPECTATION	A-ESS1-6.	<p>Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.A.	Astronomy
CONTENT STANDARD		The Earth-Moon-Sun System
PERFORMANCE EXPECTATION	A-ESS5-2AR.	<p>Plan and carry out investigations to demonstrate how relative orbital positions of the Earth, Moon, and sun influence energy and matter flow into and out of a system to create tides and seasons, orbital angles between Earth, Moon, and sun create these effects.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Turbidity and Total Solids in Surface Water
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Cycling of Matter and Energy
PERFORMANCE EXPECTATION	BI-LS1-5.	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

		<p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism
PERFORMANCE EXPECTATION	BI-LS1-7.	<p>Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
PERFORMANCE EXPECTATION	BI-LS2-3.	<p>Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Algae Enumeration via Culturable Methodology • An Introduction to Cell Metabolism • 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 • Culturing and Enumerating Bacteria from Soil Samples • Detecting Reactive Oxygen Species • 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 • Metabolic Labeling • Nutrients in Aquatic Ecosystems • 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

		<ul style="list-style-type: none"> • Soxhlet Extraction of Lipid Biomarkers from Sediment • The ATP Bioluminescence Assay • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	BI-LS2-4.	<p>Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	BI-LS2-5.	<p>Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Carbon and Nitrogen Analysis of Environmental Samples • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Metabolic Labeling • 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
PERFORMANCE EXPECTATION	BI-ESS2-6.	<p>Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</p>

		<p>JoVE</p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Carbon and Nitrogen Analysis of Environmental Samples • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Metabolic Labeling • 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
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Structure and Function
PERFORMANCE EXPECTATION	BI-LS1-1.	<p>Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Motility and Migration • 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 Overview of Epigenetics • An Overview of Gene Expression • C. elegans Development and Reproduction • DNA Methylation Analysis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • 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 • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • Induced Pluripotency

		<ul style="list-style-type: none"> • Murine In Utero Electroporation • RNA-Seq • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
<p>PERFORMANCE EXPECTATION</p>	<p>BI-LS1-2.</p>	<p>Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • 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 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 Organogenesis • An Introduction to Reward and Addiction • An Introduction to Stem Cell Biology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • Anesthesia Induction and Maintenance • Anxiety Testing • Approximate Number Sense Test • Assessing Dexterity with Reaching Tasks • Balance and Coordination Testing • Basic Care Procedures • Binocular Rivalry • Blood Withdrawal I • Blood Withdrawal II • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Calcium Imaging in Neurons • Chick ex ovo Culture • Co-Immunoprecipitation and Pull-Down Assays • Color Afterimages • Compound Administration I • Compound Administration II • Compound Administration III • Compound Administration IV • Considerations for Rodent Surgery • Crowding

- Detecting Reactive Oxygen Species
- Development and Reproduction of the Laboratory Mouse
- Development of the Chick
- Diagnostic Necropsy and Tissue Harvest
- Dichotic Listening
- 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
- Finding Your Blind Spot and Perceptual Filling-in
- Fundamentals of Breeding and Weaning
- Genetic Engineering of Model Organisms
- Habituation: Studying Infants Before They Can Talk
- Histological Sample Preparation for Light Microscopy
- Histological Staining of Neural Tissue
- In ovo Electroporation of Chicken Embryos
- Inattentive Blindness
- Incidental Encoding
- Induced Pluripotency
- Just-noticeable Differences
- Measuring Reaction Time and Donders' Method of Subtraction
- Measuring Verbal Working Memory Span
- Mental Rotation
- Modeling Social Stress
- Motion-induced Blindness
- Motor Learning in Mirror Drawing
- Multiple Object Tracking
- Murine In Utero Electroporation
- Neuronal Transfection Methods
- Object Substitution Masking
- Patch Clamp Electrophysiology
- Physiological Correlates of Emotion Recognition
- Primary Neuronal Cultures
- Prospect Theory
- Rodent Stereotaxic Surgery
- Self-administration Studies
- Spatial Cueing
- Sterile Tissue Harvest
- The Ames Room
- The Attentional Blink
- The Inverted-face Effect
- The McGurk Effect
- The Precision of Visual Working Memory with Delayed Estimation
- The Rubber Hand Illusion
- The Staircase Procedure for Finding a Perceptual

		<p>Threshold</p> <ul style="list-style-type: none"> • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Verbal Priming • Visual Search for Features and Conjunctions • Visual Statistical Learning • Whole-Mount In Situ Hybridization • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
<p>PERFORMANCE EXPECTATION</p>	<p>BI-LS1-3.</p>	<p>Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain <p>Assessment</p> <ul style="list-style-type: none"> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Molecular Developmental Biology • An Introduction to Reward and Addiction • An Introduction to Stem Cell Biology • Anesthesia Induction and Maintenance • Ankle Exam • Annexin V and Propidium Iodide Labeling • Arterial Line Placement • Assessing Dexterity with Reaching Tasks • Auscultation • Balance and Coordination Testing • Basic Care Procedures • Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation • Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation • Basic Mouse Care and Maintenance • Blood Pressure Measurement • Blood Withdrawal I • Blood Withdrawal II • C. elegans Development and Reproduction • Calcium Imaging in Neurons • Cardiac Exam I: Inspection and Palpation • Cardiac Exam II: Auscultation • Cardiac Exam III: Abnormal Heart Sounds • 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**
- **Compound Administration I**
- **Compound Administration II**
- **Compound Administration III**
- **Compound Administration IV**
- **Comprehensive Breast Exam**
- **Considerations for Rodent Surgery**
- **Cranial Nerves Exam I (I-VI)**
- **Cranial Nerves Exam II (VII-XII)**
- **Detecting Reactive Oxygen Species**
- **Diagnostic Necropsy and Tissue Harvest**
- **Ear Exam**
- **Elbow Exam**
- **Electro-encephalography (EEG)**
- **Embryonic Stem Cell Culture and Differentiation**
- **Emergency Tube Thoracostomy (Chest Tube Placement)**
- **Emergent Lateral Canthotomy and Inferior Catholysis**
- **Explant Culture of Neural Tissue**
- **Eye Exam**
- **FM Dyes in Vesicle Recycling**
- **Fear Conditioning**
- **Foot Exam**
- **General Approach to the Physical Exam**
- **Hand and Wrist Exam**
- **Hip Exam**
- **Histological Staining of Neural Tissue**
- **In ovo Electroporation of Chicken Embryos**
- **Induced Pluripotency**
- **Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation**
- **Intraosseous Needle Placement**
- **Isolating Nucleic Acids from Yeast**
- **Knee Exam**
- **Lower Back Exam**
- **Lymph Node Exam**
- **Male Rectal Exam**
- **Measuring Vital Signs**
- **Motor Exam I**
- **Motor Exam II**
- **Murine In Utero Electroporation**
- **Neck Exam**
- **Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment**
- **Nose, Sinuses, Oral Cavity and Pharynx Exam**
- **Observation and Inspection**
- **Ophthalmoscopic Examination**

		<ul style="list-style-type: none"> • Palpation • 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) • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Physiological Correlates of Emotion Recognition • Proper Adjustment of Patient Attire during the Physical Exam • Reconstitution of Membrane Proteins • 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 • Sterile Tissue Harvest • Surgical Cricothyrotomy • The ATP Bioluminescence Assay • The TUNEL Assay • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Tree Identification: How To Use a Dichotomous Key • Using a pH Meter • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Maintenance and Husbandry
<p>PERFORMANCE EXPECTATION</p>	<p>BI-LS1-6.</p>	<p>Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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

		<ul style="list-style-type: none"> • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Biodiversity and Population Dynamics
PERFORMANCE EXPECTATION	BI-LS2-2.	<p>Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Analysis of Earthworm Populations in Soil • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method
PERFORMANCE EXPECTATION	BI-LS2-7.	<p>Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	BI-LS4-6.	<p>Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on Biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	BI3-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	BI3-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Genetic Variations in Organisms
PERFORMANCE EXPECTATION	BI-LS1-4.	<p>Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p>

		<p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Motility and Migration • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Overview of Epigenetics • An Overview of Gene Expression • C. elegans Development and Reproduction • Cell Cycle Analysis • DNA Methylation Analysis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • 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 • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • Induced Pluripotency • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • RNA-Seq • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
<p>PERFORMANCE EXPECTATION</p>	<p>BI-LS3-1.</p>	<p>Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • 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 Drosophila melanogaster • An Introduction to Molecular Developmental Biology

- 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 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
- 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* Larval IHC
- *Drosophila* Maintenance
- *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
- Fate Mapping
- Fundamentals of Breeding and Weaning
- Förster Resonance Energy Transfer (FRET)
- Gel Purification
- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Engineering of Model Organisms
- Genetic Screens

		<ul style="list-style-type: none"> • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Molecular Cloning • Mouse Genotyping • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • 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 <i>C. elegans</i> • Recombineering and Gene Targeting • Restriction Enzyme Digests • SNP Genotyping • Testing For Genetically Modified Foods • The TUNEL Assay • 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
<p>PERFORMANCE EXPECTATION</p>	<p>BI-LS3-2.</p>	<p>Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to <i>Caenorhabditis elegans</i> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to <i>Drosophila melanogaster</i> • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to <i>Saccharomyces cerevisiae</i>

		<ul style="list-style-type: none"> • 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 • Drosophila Development and Reproduction • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The ELISA Method • The TUNEL Assay
PERFORMANCE EXPECTATION	BI-LS3-3.	<p>Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis • C. elegans Development and Reproduction • SNP Genotyping • Yeast Reproduction • Zebrafish Maintenance and Husbandry
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Evolution by Natural Selection
PERFORMANCE EXPECTATION	BI-LS4-1.	<p>Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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)
PERFORMANCE EXPECTATION	BI-LS4-2.	<p>Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p>

		<p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Genetic Analysis
PERFORMANCE EXPECTATION	BI-LS4-4.	<p>Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis
PERFORMANCE EXPECTATION	BI-LS4-5.	<p>Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis • High-Performance Liquid Chromatography (HPLC)
PERFORMANCE EXPECTATION	BI-ESS2-7.	<p>Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Life and Earth's Systems
PERFORMANCE EXPECTATION	BI-ESS2-4.	<p>Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material
PERFORMANCE EXPECTATION	BI-ESS2-5.	<p>Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems

		<ul style="list-style-type: none"> • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
PERFORMANCE EXPECTATION	BI-ESS3-5.	<p>Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material
PERFORMANCE EXPECTATION	BI6-ETS1-2.	<p>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	BI6-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
STRAND / TOPIC	AR.BI.	Biology – Integrated
CONTENT STANDARD		Human Impacts on Earth’s Systems
PERFORMANCE EXPECTATION	BI-ESS3-1.	<p>Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Igneous Volcanic Rock • Proton Exchange Membrane Fuel Cells • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method

		<ul style="list-style-type: none"> • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
PERFORMANCE EXPECTATION	BI-ESS3-2.	<p>Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Igneous Intrusive Rock • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	BI-ESS3-3.	<p>Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	BI-ESS3-4.	<p>Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	BI-ESS3-6.	<p>Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy

		<ul style="list-style-type: none"> • Dissolved Oxygen in Surface Water • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • 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 • Water Quality Analysis via Indicator Organisms
PERFORMANCE EXPECTATION	BI7-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	BI7-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling
STRAND / TOPIC	AR.CI.	Chemistry – Integrated
CONTENT STANDARD		Matter and Chemical Reactions
PERFORMANCE EXPECTATION	CI-PS1-1.	<p>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Coordination Chemistry Complexes
PERFORMANCE EXPECTATION	CI-PS1-2.	<p>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes

		<ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	CI-PS1-3.	<p>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Common Lab Glassware and Uses • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Determining the Density of a Solid and Liquid • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Titration • 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 • Using a pH Meter
PERFORMANCE EXPECTATION	CI-PS1-6.	<p>Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.</p>

		<p>JoVE</p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Le Châtelier's Principle • Spectrophotometric Determination of an Equilibrium Constant
PERFORMANCE EXPECTATION	CI-PS1-7.	<p>Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Determining the Empirical Formula
PERFORMANCE EXPECTATION	CI-ESS2-5.	<p>Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p>JoVE</p> <ul style="list-style-type: none"> • High-Performance Liquid Chromatography (HPLC) • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Turbidity and Total Solids in Surface Water
STRAND / TOPIC	AR.CI.	Chemistry – Integrated
CONTENT STANDARD		Nuclear Reactions
PERFORMANCE EXPECTATION	CI-PS1-8.	<p>Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction
PERFORMANCE EXPECTATION	CI-ESS1-6.	<p>Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	CI2-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety,</p>

		<p>reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Nuclear Magnetic Resonance (NMR) Spectroscopy
<p>PERFORMANCE EXPECTATION</p>	<p>CI2-ETS1-4.</p>	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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 • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • 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

		<ul style="list-style-type: none"> • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • 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 • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • 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)
STRAND / TOPIC	AR.CI.	Chemistry – Integrated
CONTENT STANDARD		Energy Flow
PERFORMANCE EXPECTATION	CI-PS1-4.	<p>Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Le Châtelier's Principle • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy

<p>PERFORMANCE EXPECTATION</p>	<p>CI-PS1-5.</p>	<p>Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Introduction to Catalysis
<p>PERFORMANCE EXPECTATION</p>	<p>CI-PS3-1.</p>	<p>Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Enzyme Assays and Kinetics • Introduction to Catalysis • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
<p>PERFORMANCE EXPECTATION</p>	<p>CI-ESS3-4.</p>	<p>Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Cyclic Voltammetry (CV) • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Photometric Protein Determination

		<ul style="list-style-type: none"> • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Reconstitution of Membrane Proteins • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
PERFORMANCE EXPECTATION	CI3-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis
STRAND / TOPIC	AR.CI.	Chemistry – Integrated
CONTENT STANDARD		Waves
PERFORMANCE EXPECTATION	CI-PS4-1.	<p>Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	CI-PS4-3.	<p>Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Ultraviolet-Visible (UV-Vis) Spectroscopy
PERFORMANCE EXPECTATION	CI-PS4-4.	<p>Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Histological Sample Preparation for Light Microscopy • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy

		<ul style="list-style-type: none"> • Introduction to the Spectrophotometer • Nutrients in Aquatic Ecosystems • Photometric Protein Determination • Spectrophotometric Determination of an Equilibrium Constant • Turbidity and Total Solids in Surface Water • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
<p>PERFORMANCE EXPECTATION</p>	<p>CI-PS4-5.</p>	<p>Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Community DNA Extraction from Bacterial Colonies • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cranial Nerves Exam I (I-VI) • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determining the Empirical Formula • Ear Exam • Emergent Lateral Canthotomy and Inferior Catholysis • Eye Exam • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • Histological Sample Preparation for Light Microscopy • Internal Standards • Introduction to Catalysis • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • 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 • Ophthalmoscopic Examination • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Plasmid Purification • Protein Crystallization • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Solid-Liquid Extraction • Spectrophotometric Determination of an Equilibrium

		<p>Constant</p> <ul style="list-style-type: none"> • Tandem Mass Spectrometry • Turbidity and Total Solids in Surface Water • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF) • Yeast Maintenance
<p>PERFORMANCE EXPECTATION</p>	<p>CI4-ETS1-4.</p>	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Centrifuge • 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 • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • 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 • Electro-encephalography (EEG) • 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

		<ul style="list-style-type: none"> • Introduction to Mass Spectrometry • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • 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 • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • 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)
--	--	--

STRAND / TOPIC	AR.CI.	Chemistry – Integrated
CONTENT STANDARD		Forces
PERFORMANCE EXPECTATION	CI-PS3-5.	<p>Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</p> <p><u>JoVE</u></p>

		<ul style="list-style-type: none"> • Introduction to Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Structure of Matter
PERFORMANCE EXPECTATION	CII-PS1-1.	<p>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Coordination Chemistry Complexes
PERFORMANCE EXPECTATION	CII-PS1-3AR.	<p>Use mathematical representations and computational thinking to support a claim that patterns exist among the frequency, wavelength, and speed of waves.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	CII-PS1-4AR.	<p>Analyze and interpret data of absorption and emission of energy in the form of electromagnetic radiation and models of the atom.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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)
PERFORMANCE EXPECTATION	CII-PS1-8.	<p>Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction
PERFORMANCE EXPECTATION	CII-PS4-3.	<p>Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Nuclear Magnetic Resonance (NMR) Spectroscopy

		<ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis • Ultraviolet-Visible (UV-Vis) Spectroscopy
PERFORMANCE EXPECTATION	CII1-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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)
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Properties of Matter
PERFORMANCE EXPECTATION	CII2-PS1-1.	<p>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Coordination Chemistry Complexes
PERFORMANCE EXPECTATION	CII-PS1-3.	<p>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Common Lab Glassware and Uses • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Determining the Density of a Solid and Liquid • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat

		<ul style="list-style-type: none"> • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Titration • 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 • Using a pH Meter
<p>PERFORMANCE EXPECTATION</p>	<p>CII-PS2-1AR.</p>	<p>Develop and use models to explain the differences between chemical compounds using patterns as a method for identification.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Determining the Empirical Formula • Determining the Solubility Rules of Ionic Compounds • Dialysis: Diffusion Based Separation • Freezing-Point Depression to Determine an Unknown Compound • Growing Crystals for X-ray Diffraction Analysis • Performing 1D Thin Layer Chromatography • Purifying Compounds by Recrystallization • Separation of Mixtures via Precipitation
<p>PERFORMANCE EXPECTATION</p>	<p>CII-PS2-3AR.</p>	<p>Use mathematical representations to quantify matter through the analysis of patterns in chemical compounds.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
- Determining the Empirical Formula
- Determining the Solubility Rules of Ionic Compounds
- 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
- Freezing-Point Depression to Determine an Unknown Compound
- Gel Purification
- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Engineering of Model Organisms
- Genetic Screens
- Genome Editing

- Growing Crystals for X-ray Diffraction Analysis
- 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
- Performing 1D Thin Layer Chromatography
- Photometric Protein Determination
- Plasmid Purification
- Protein Crystallization
- 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*
- 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
- Tandem Mass Spectrometry
- The ATP Bioluminescence Assay
- The ELISA Method
- The TUNEL Assay
- The Transwell Migration Assay
- The Western Blot
- 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

PERFORMANCE EXPECTATION	CII-PS2-4AR.	<p>Develop and use a model of two particles interacting through electric fields to illustrate forces between particles and the changes in energy due to the interaction.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Testing For Genetically Modified Foods
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Reactions
PERFORMANCE EXPECTATION	CII-PS1-2.	<p>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	CII-PS1-7.	<p>Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining the Empirical Formula
PERFORMANCE EXPECTATION	CII-PS3-1AR.	<p>Use mathematical representations to analyze the proportion and quantity of particles in solution.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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

		<p>Compound</p> <ul style="list-style-type: none"> • 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
<p>PERFORMANCE EXPECTATION</p>	<p>CII-PS3-2AR.</p>	<p>Construct an explanation of the relationship between energy and the behavior of particles.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Fractional Distillation • Ideal Gas Law • Introduction to Catalysis • The Ideal Gas Law
<p>PERFORMANCE EXPECTATION</p>	<p>CII-PS3-3AR.</p>	<p>Plan and carry out an investigation to predict the outcome of a chemical reaction based on patterns of chemical properties.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • 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 Empirical Formula • 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

		<ul style="list-style-type: none"> • Rotary Evaporation to Remove Solvent • Separation of Mixtures via Precipitation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
<p>PERFORMANCE EXPECTATION</p>	<p>CII3-ETS1-3.</p>	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • 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

		<ul style="list-style-type: none"> • 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 • 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 • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • 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)
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Kinetics and Kinetic Molecular Theory
PERFORMANCE EXPECTATION	CII-PS1-5.	<p>Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p><u>JoVE</u></p>

		<ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Introduction to Catalysis
PERFORMANCE EXPECTATION	CII-PS4-1AR.	<p>Plan and carry out investigations to examine stability and change exhibited by gas particles in a closed system.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
PERFORMANCE EXPECTATION	CII-PS4-2AR.	<p>Argue from evidence cause and effect relationships of factors influencing behavior of gas particles.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
PERFORMANCE EXPECTATION	CII4-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Fractional Distillation • Ideal Gas Law • The Ideal Gas Law
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Thermochemistry
PERFORMANCE EXPECTATION	CII-PS1-4.	<p>Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Le Châtelier's Principle • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	CII-PS5-1AR.	<p>Analyze and interpret data to explain energy (enthalpy) changes of a reaction.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	CII-PS5-2AR.	<p>Plan and conduct an investigation to calculate changes in energy within a system and/or energy flows in and out of</p>

		<p>a system.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	CII5-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Equilibrium
PERFORMANCE EXPECTATION	CII-PS1-6.	<p>Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Le Châtelier's Principle • Spectrophotometric Determination of an Equilibrium Constant
PERFORMANCE EXPECTATION	CII-PS6-1AR.	<p>Analyze and interpret data to explain the change in concentration of products and reactants, and the stable state achieved under reversible conditions.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • 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

		<ul style="list-style-type: none"> • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Understanding Concentration and Measuring Volumes
PERFORMANCE EXPECTATION	CII6-ETS1-2.	<p>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Introduction to Titration • Le Châtelier's Principle • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant
STRAND / TOPIC	AR.CII.	Chemistry II
CONTENT STANDARD		Organic Chemistry
PERFORMANCE EXPECTATION	CII-PS7-1AR.	<p>Obtain and combine information to describe differences between alkanes, alkenes, and alkynes.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 • Density Gradient Ultracentrifugation • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fractional Distillation • 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 • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from

		<p>Sediment</p> <ul style="list-style-type: none"> • Soxhlet Extraction of Lipid Biomarkers from Sediment • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy
PERFORMANCE EXPECTATION	CII-PS7-2AR.	<p>Obtain and combine information to describe differences between various functional groups.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	CII7-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Fractional Distillation
STRAND / TOPIC	AR.ES.	Earth Science
CONTENT STANDARD		History of Earth
PERFORMANCE EXPECTATION	ES-ESS1-5.	<p>Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	ES-ESS1-6.	<p>Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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

		<ul style="list-style-type: none"> • Making a Geologic Cross Section • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry
PERFORMANCE EXPECTATION	ES-ESS2-1.	<p>Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	ES1-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Making a Geologic Cross Section
STRAND / TOPIC	AR.ES.	Earth Science
CONTENT STANDARD		Earth's Systems
PERFORMANCE EXPECTATION	ES-ESS2-5.	<p>Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
PERFORMANCE EXPECTATION	ES-ESS2-6.	<p>Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • 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

		<ul style="list-style-type: none"> • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Metabolic Labeling • 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 • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	ES-ESS2-7.	<p>Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	ES2-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	ES2-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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

STRAND / TOPIC	AR.ES.	Earth Science
CONTENT STANDARD		Human Sustainability
PERFORMANCE EXPECTATION	ES-ESS3-1.	<p>Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Igneous Volcanic Rock • Proton Exchange Membrane Fuel Cells • 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
PERFORMANCE EXPECTATION	ES-ESS3-2.	<p>Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	ES-ESS3-3.	<p>Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	ES-ESS3-4.	<p>Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications

		<ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	ES-ESS3-6.	<p>Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 • 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
PERFORMANCE EXPECTATION	ES3-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	ES3-ETS1-2.	<p>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using

		UV-VIS Spectroscopy <ul style="list-style-type: none"> • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	ES3-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Using GIS to Investigate Urban Forestry
STRAND / TOPIC	AR.ES.	Earth Science
CONTENT STANDARD		Weather and Climate
PERFORMANCE EXPECTATION	ES4-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.EVS.	Environmental Science
CONTENT STANDARD		Systems
PERFORMANCE EXPECTATION	EVS-ESS2-5.	<p>Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms

<p>PERFORMANCE EXPECTATION</p>	<p>EVS-ESS2-6.</p>	<p>Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • 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 • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Metabolic Labeling • 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 • Using GIS to Investigate Urban Forestry
<p>PERFORMANCE EXPECTATION</p>	<p>EVS-ESS3-5.</p>	<p>Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material
<p>PERFORMANCE EXPECTATION</p>	<p>EVS1-ETS1-1.</p>	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • 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

		<ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
STRAND / TOPIC	AR.EVS.	Environmental Science
CONTENT STANDARD		Energy
PERFORMANCE EXPECTATION	EVS-PS3-3.	<p>Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • fMRI: Functional Magnetic Resonance Imaging
PERFORMANCE EXPECTATION	EVS-ESS2-4.	<p>Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
STRAND / TOPIC	AR.EVS.	Environmental Science
CONTENT STANDARD		Populations
PERFORMANCE EXPECTATION	EVS-LS2-2.	<p>Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Passaging Cells • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Yeast Maintenance • Yeast Reproduction
PERFORMANCE EXPECTATION	EVS3-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
STRAND / TOPIC	AR.EVS.	Environmental Science
CONTENT STANDARD		Sustainability
PERFORMANCE EXPECTATION	EVS-ESS3-1.	<p>Construct an explanation based on evidence for how the availability of natural resources, occurrences of natural hazards, and changes in climate have influenced human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Igneous Volcanic Rock • Proton Exchange Membrane Fuel Cells • 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
PERFORMANCE EXPECTATION	EVS-ESS3-2.	<p>Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Igneous Intrusive Rock • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry

<p>PERFORMANCE EXPECTATION</p>	<p>EVS-ESS3-3.</p>	<p>Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
<p>PERFORMANCE EXPECTATION</p>	<p>EVS-ESS3-4.</p>	<p>Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
<p>PERFORMANCE EXPECTATION</p>	<p>EVS-ESS3-6.</p>	<p>Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water

		<ul style="list-style-type: none"> • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms
PERFORMANCE EXPECTATION	EVS-ESS3-7.	<p>Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	EVS4-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Patterns
PERFORMANCE EXPECTATION	HAP-LS1-1AR.	Construct an explanation based on evidence obtained from a variety of sources for the pattern of hierarchical organization of each body system:
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.1.	<p>Integumentary System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.2.	<p>Skeletal System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Motor Control • Ankle Exam • Elbow Exam • Foot Exam

		<ul style="list-style-type: none"> • 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
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.3.	<p>Muscular System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.4.	<p>Respiratory System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.5.	<p>Circulatory System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Motility and Migration • Arterial Line Placement

		<ul style="list-style-type: none"> • 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 • Eye Exam • Intraosseous Needle Placement • Invasion Assay Using 3D Matrices • MALDI-TOF Mass Spectrometry • Measuring Vital Signs • Ophthalmoscopic Examination • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Physiological Correlates of Emotion Recognition • Tandem Mass Spectrometry • The Transwell Migration Assay • fMRI: Functional Magnetic Resonance Imaging
<p>BENCHMARK / PROFICIENCY</p>	<p>HAP-LS1-1AR.6.</p>	<p>Digestive System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
<p>BENCHMARK / PROFICIENCY</p>	<p>HAP-LS1-1AR.7.</p>	<p>Nervous System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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)**
- **Embryonic Stem Cell Culture and Differentiation**
- **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**
- **FM Dyes in Vesicle Recycling**
- **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**
- **Incidental Encoding**
- **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**
- **Mental Rotation**
- **Modeling Social Stress**
- **Motion-induced Blindness**
- **Motor Exam I**

		<ul style="list-style-type: none"> • 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 • Ophthalmoscopic Examination • Patch Clamp Electrophysiology • Perspectives on Sensation and Perception • Physiological Correlates of Emotion Recognition • Primary Neuronal Cultures • Prospect Theory • Rodent Stereotaxic Surgery • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Solutions and Concentrations • 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 • 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
<p>BENCHMARK / PROFICIENCY</p>	<p>HAP-LS1-1AR.8.</p>	<p>Endocrine System</p> <p>JoVE</p> <ul style="list-style-type: none"> • Anxiety Testing • Modeling Social Stress • Thyroid Exam

BENCHMARK / PROFICIENCY	HAP-LS1-1AR.9.	<p>Lymphatic System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Laboratory Mouse: Mus musculus • Comprehensive Breast Exam • Lymph Node Exam • The TUNEL Assay
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.10.	<p>Urinary System</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment
BENCHMARK / PROFICIENCY	HAP-LS1-1AR.11.	<p>Reproductive Systems</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Stability and Change
PERFORMANCE EXPECTATION	HAP-LS4-1AR.	<p>Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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

		<ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Cause and Effect
PERFORMANCE EXPECTATION	HAP-LS5-1AR.	<p>Argue from evidence the cause(s) for a dysfunction in a body system and the mechanisms by which it occurred.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam IV: Acute Abdominal Pain <p>Assessment</p> <ul style="list-style-type: none"> • 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 Cognition • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Modeling Behavioral Disorders and Stress <ul style="list-style-type: none"> • 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 the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Ankle Exam • Anterograde Amnesia • Anxiety Testing • Arterial Line Placement • Assessing Dexterity with Reaching Tasks

- 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
- C. elegans Chemotaxis Assay
- Cardiac Exam I: Inspection and Palpation
- Cardiac Exam II: Auscultation
- Cardiac Exam III: Abnormal Heart Sounds
- Cell Cycle Analysis
- Chick ex ovo Culture
- Chromatin Immunoprecipitation
- Chromatography-Based Biomolecule Purification Methods
- Coordination Chemistry Complexes
- Cranial Nerves Exam I (I-VI)
- Cranial Nerves Exam II (VII-XII)
- Crowding
- Cytogenetics
- DNA Methylation Analysis
- Decision-making and the Iowa Gambling Task
- Decoding Auditory Imagery with Multivoxel Pattern Analysis
- Detecting Reactive Oxygen Species
- Dichotic Listening
- Ear Exam
- Elbow Exam
- Embryonic Stem Cell Culture and Differentiation
- Emergent Lateral Canthotomy and Inferior Catholysis
- Executive Function and the Dimensional Change Card Sort Task
- Executive Function in Autism Spectrum Disorder
- Expression Profiling with Microarrays
- Eye Exam
- Eye Tracking in Cognitive Experiments
- Fear Conditioning
- Foot Exam
- Gene Silencing with Morpholinos
- Genetic Screens
- Genome Editing
- Hand and Wrist Exam
- Hip Exam
- Incidental Encoding
- Introducing Experimental Agents into the Mouse
- Invasion Assay Using 3D Matrices
- Knee Exam
- Learning and Memory: The Remember-Know Task
- Live Cell Imaging of Mitosis
- Lower Back Exam
- Lymph Node Exam
- Male Rectal Exam

		<ul style="list-style-type: none"> • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Verbal Working Memory Span • Modeling Social Stress • Motor Exam I • Motor Exam II • Motor Maps • Mouse Genotyping • Multiple Object Tracking • Neck Exam • Ophthalmoscopic Examination • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Physiological Correlates of Emotion Recognition • Prospect Theory • Respiratory Exam I: Inspection and Palpation • SNP Genotyping • Self-administration Studies • Sensory Exam • Shoulder Exam I • Shoulder Exam II • Spatial Memory Testing Using Mazes • The ATP Bioluminescence Assay • The Inverted-face Effect • The Morris Water Maze • The Precision of Visual Working Memory with Delayed Estimation • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • 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 • fMRI: Functional Magnetic Resonance Imaging
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Energy and Matter
PERFORMANCE EXPECTATION	HAP-LS6-1AR.	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy among body systems and their associated processes.

		<p>JoVE</p> <ul style="list-style-type: none"> • 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 • An Introduction to Cellular and Molecular Neuroscience • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Enzyme Assays and Kinetics • Förster Resonance Energy Transfer (FRET) • Histological Staining of Neural Tissue • Male Rectal Exam • Metabolic Labeling • The ATP Bioluminescence Assay
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Systems and System Models
PERFORMANCE EXPECTATION	HAP-LS7-1AR.	<p>Develop and use a model to illustrate the interactions between systems that control or affect specific functions within the human body.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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 • 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 • Elbow Exam • 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**
- **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**
- **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**
- **Object Substitution Masking**
- **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**
- **Thyroid Exam**
- **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 <ul style="list-style-type: none"> • Within-subjects Repeated-measures Design • fMRI: Functional Magnetic Resonance Imaging
STRAND / TOPIC	AR.HAP.	Human Anatomy and Physiology
CONTENT STANDARD		Career Exploration with Engineering Practices
PERFORMANCE EXPECTATION	HAP-8-1AR.	<p>Obtain, evaluate, and communicate information related to health science professions.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • 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

		<ul style="list-style-type: none"> • 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
<p>PERFORMANCE EXPECTATION</p>	<p>HAP-8-2AR.</p>	<p>Design a solution to a complex real-world problem affecting body systems that can be solved through engineering.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • 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 Cell Metabolism • An Introduction to Cognition • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • 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 the Laboratory Mouse: Mus musculus

- An Overview of Genetic Analysis
- An Overview of Genetic Engineering
- An Overview of Genetics and Disease
- Arterial Line Placement
- Assembly of a Reflux System for Heated Chemical Reactions
- Auscultation
- Bacterial Growth Curve Analysis and its Environmental Applications
- Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation
- Blood Pressure Measurement
- Calcium Imaging in Neurons
- Capillary Electrophoresis (CE)
- 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
- Chromatin Immunoprecipitation
- Chromatography-Based Biomolecule Purification Methods
- Co-Immunoprecipitation and Pull-Down Assays
- Column Chromatography
- Community DNA Extraction from Bacterial Colonies
- Coordination Chemistry Complexes
- Cranial Nerves Exam I (I-VI)
- Cranial Nerves Exam II (VII-XII)
- Culturing and Enumerating Bacteria from Soil Samples
- Cyclic Voltammetry (CV)
- Cytogenetics
- DNA Ligation Reactions
- DNA Methylation Analysis
- Decision-making and the Iowa Gambling Task
- Decoding Auditory Imagery with Multivoxel Pattern Analysis
- Detecting Reactive Oxygen Species
- Detection of Bacteriophages in Environmental Samples
- Ear 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
- Event-related Potentials and the Oddball Task
- Expression Profiling with Microarrays

- Eye Exam
- Eye Tracking in Cognitive Experiments
- Fate Mapping
- Fear Conditioning
- General Approach to the Physical Exam
- Genetic Crosses
- Genetic Screens
- Genome Editing
- Gram Staining of Bacteria from Environmental Sources
- Growing Crystals for X-ray Diffraction Analysis
- Induced Pluripotency
- Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation
- Intraosseous Needle Placement
- Introducing Experimental Agents into the Mouse
- Introduction to Mass Spectrometry
- Introduction to Titration
- Isolation of Fecal Bacteria from Water Samples by Filtration
- Language: The N400 in Semantic Incongruity
- Learning and Memory: The Remember-Know Task
- Live Cell Imaging of Mitosis
- MALDI-TOF Mass Spectrometry
- Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain
- Measuring Vital Signs
- Metabolic Labeling
- Molecular Cloning
- Motor Exam II
- Motor Maps
- Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment
- Nose, Sinuses, Oral Cavity and Pharynx Exam
- Nuclear Magnetic Resonance (NMR) Spectroscopy
- Ophthalmoscopic Examination
- Patch Clamp Electrophysiology
- 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
- Physiological Correlates of Emotion Recognition
- Protein Crystallization
- Purifying Compounds by Recrystallization
- Quantifying Environmental Microorganisms and Viruses Using qPCR

		<ul style="list-style-type: none"> • RNA-Seq • Recombineering and Gene Targeting • Respiratory Exam II: Percussion and Auscultation • SNP Genotyping • Scanning Electron Microscopy (SEM) • Solutions and Concentrations • Surface Plasmon Resonance (SPR) • Surgical Cricothyrotomy • Tandem Mass Spectrometry • The ATP Bioluminescence Assay • The ELISA Method • Tissue Regeneration with Somatic Stem Cells • Two-Dimensional Gel Electrophoresis • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using a pH Meter • Visual Attention: fMRI Investigation of Object-based Attentional Control • fMRI: Functional Magnetic Resonance Imaging
<p>PERFORMANCE EXPECTATION</p>	<p>HAP-8-3AR.</p>	<p>Evaluate a solution to a complex real-world human health problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to Developmental Neurobiology • An Introduction to Motor Control • An Introduction to Organogenesis • An Introduction to Stem Cell Biology • An Overview of Gene Expression • An Overview of Genetic Engineering • An Overview of Genetics and Disease • C. elegans Development and Reproduction • Cytogenetics • Development and Reproduction of the Laboratory Mouse • Embryonic Stem Cell Culture and Differentiation • Fate Mapping • Genetic Engineering of Model Organisms • Induced Pluripotency • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Murine In Utero Electroporation • Passaging Cells • Recombineering and Gene Targeting • The TUNEL Assay

		<ul style="list-style-type: none"> • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Elements, Matter, and Interactions
PERFORMANCE EXPECTATION	PSI-PS1-1.	<p>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Coordination Chemistry Complexes
PERFORMANCE EXPECTATION	PSI-PS1-2.	<p>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	PSI-PS1-3.	<p>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Common Lab Glassware and Uses • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Determining the Density of a Solid and Liquid • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds

		<ul style="list-style-type: none"> • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Titration • 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 • Using a pH Meter
PERFORMANCE EXPECTATION	PSI-PS1-4.	<p>Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Determining Rate Laws and the Order of Reaction • Le Châtelier's Principle • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	PSI-PS1-7.	<p>Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining the Empirical Formula
PERFORMANCE EXPECTATION	PSI-ESS2-7.	<p>Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Matter in Organisms

PERFORMANCE EXPECTATION	PSI-LS1-5.	<p>Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism
PERFORMANCE EXPECTATION	PSI-LS1-7.	<p>Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
PERFORMANCE EXPECTATION	PSI-LS2-4.	<p>Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	PSI2-ETS1-2.	<p>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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 • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatography-Based Biomolecule Purification

		<p>Methods</p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Forces and Motion
PERFORMANCE EXPECTATION	PSI-PS2-3.	<p>Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	PSI-PS2-5.	<p>Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.</p>

		<u>JoVE</u> • fMRI: Functional Magnetic Resonance Imaging
PERFORMANCE EXPECTATION	PSI-PS2-6.	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. <u>JoVE</u> • Le Châtelier's Principle
PERFORMANCE EXPECTATION	PSI-ESS1-5.	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. <u>JoVE</u> • Making a Geologic Cross Section
PERFORMANCE EXPECTATION	PSI3-ETS1-1.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. <u>JoVE</u> • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Using GIS to Investigate Urban Forestry
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Energy
PERFORMANCE EXPECTATION	PSI-PS3-1.	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. <u>JoVE</u> • Conducting Reactions Below Room Temperature • Enzyme Assays and Kinetics • Introduction to Catalysis • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	PSI-PS3-2.	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). <u>JoVE</u> • Fractional Distillation • Ideal Gas Law • The Ideal Gas Law
PERFORMANCE EXPECTATION	PSI-PS3-3.	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

		<u>JoVE</u> <ul style="list-style-type: none"> • fMRI: Functional Magnetic Resonance Imaging
PERFORMANCE EXPECTATION	PSI4-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Waves
PERFORMANCE EXPECTATION	PSI-PS4-1.	<p>Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	PSI-PS4-2.	<p>Evaluate questions about the advantages of using a digital transmission and storage of information.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
STRAND / TOPIC	AR.PSI.	Physical Science – Integrated
CONTENT STANDARD		Interactions of Humans and the Environment
PERFORMANCE EXPECTATION	PSI-LS2-7.	<p>Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Self-report vs. Behavioral Measures of Recycling
PERFORMANCE EXPECTATION	PSI-LS4-5.	<p>Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis • High-Performance Liquid Chromatography (HPLC)

<p>PERFORMANCE EXPECTATION</p>	<p>PSI-ESS2-1.</p>	<p>Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section • Using Topographic Maps to Generate Topographic Profiles
<p>PERFORMANCE EXPECTATION</p>	<p>PSI-ESS3-1.</p>	<p>Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Igneous Volcanic Rock • Proton Exchange Membrane Fuel Cells • 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
<p>PERFORMANCE EXPECTATION</p>	<p>PSI-ESS3-2.</p>	<p>Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Igneous Intrusive Rock • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry
<p>PERFORMANCE EXPECTATION</p>	<p>PSI6-ETS1-1.</p>	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using

		UV-VIS Spectroscopy <ul style="list-style-type: none"> • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	PSI6-ETS1-3.	<p>Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
PERFORMANCE EXPECTATION	PSI6-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Using GIS to Investigate Urban Forestry
STRAND / TOPIC	AR.P.	Physics
CONTENT STANDARD		Work and Energy
PERFORMANCE EXPECTATION	P-PS2-4AR.	<p>Analyze data to demonstrate the relationship between rotational and linear motion, energy, and momentum.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Centrifuge
STRAND / TOPIC	AR.P.	Physics
CONTENT STANDARD		Heat and Thermodynamics
PERFORMANCE EXPECTATION	P-PS3-1.	<p>Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.</p>

		<p>JoVE</p> <ul style="list-style-type: none"> • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PERFORMANCE EXPECTATION	P-PS3-1AR.	<p>Construct an explanation based on evidence of the relationships between heat, temperature, and the Kinetic Molecular Theory.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Fractional Distillation • Ideal Gas Law • The Ideal Gas Law
PERFORMANCE EXPECTATION	P-PS3-2AR.	<p>Plan and conduct an investigation of the relationships between pressure, volume, temperature, and amount of gas.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
PERFORMANCE EXPECTATION	P3-ETS1-1.	<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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
PERFORMANCE EXPECTATION	P3-ETS1-4.	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p>JoVE</p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.P.	Physics
CONTENT STANDARD		Waves, Sound, and Simple Harmonic Motion
PERFORMANCE EXPECTATION	P-PS4-3AR.	<p>Develop and use models to describe the interaction of light with matter.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Color Afterimages

		<ul style="list-style-type: none"> • Crowding • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Finding Your Blind Spot and Perceptual Filling-in • Histological Sample Preparation for Light Microscopy • Inattentive Blindness • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to the Spectrophotometer • Just-noticeable Differences • Motion-induced Blindness • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Photometric Protein Determination • 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 • Turbidity and Total Solids in Surface Water • Ultraviolet-Visible (UV-Vis) Spectroscopy
<p>PERFORMANCE EXPECTATION</p>	<p>P4-ETS1-4.</p>	<p>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam IV: Acute Abdominal Pain Assessment • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Auscultation • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Percussion • Peripheral Vascular Exam Using a Continuous Wave Doppler • 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

		<ul style="list-style-type: none"> • The Staircase Procedure for Finding a Perceptual Threshold
STRAND / TOPIC	AR.P.	Physics
CONTENT STANDARD		Electricity
PERFORMANCE EXPECTATION	P-PS2-5.	<p>Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • fMRI: Functional Magnetic Resonance Imaging
PERFORMANCE EXPECTATION	P-PS3-2.	<p>Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Testing For Genetically Modified Foods
PERFORMANCE EXPECTATION	P-PS5-2AR.	<p>Evaluate competing design solutions for construction and use of electrical consumer products.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Biofuels: Producing Ethanol from Cellulosic Material • Electro-encephalography (EEG) • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis
PERFORMANCE EXPECTATION	P-PS5-3AR.	<p>Obtain and combine information on alternating and direct current circuits in various applications.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Nuclear Magnetic Resonance (NMR) Spectroscopy

Grade: 9 - Adopted: 2010

STRAND / TOPIC	AR.RST.9-10.	Reading Standards for Literacy in Science and Technical Subjects
CONTENT STANDARD		Craft and Structure
PERFORMANCE EXPECTATION	RST.9-10.4.	<p>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.</p>

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
- Inattentive 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

		<ul style="list-style-type: none"> • 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
<p>PERFORMANCE EXPECTATION</p>	<p>RST.9-10.5.</p>	<p>Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
- Inattentive 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

		<p>Observation</p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.RST.9-10.	Reading Standards for Literacy in Science and Technical Subjects
CONTENT STANDARD		Integration of Knowledge and Ideas
PERFORMANCE EXPECTATION	RST.9-10.7.	<p>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.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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**

		<ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
CONTENT STANDARD		Text Types and Purposes
PERFORMANCE EXPECTATION	WHST.9-10.1.	Write arguments focused on discipline-specific content.
BENCHMARK / PROFICIENCY	WHST.9-10.1(a)	<p>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.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • The Multi-group Experiment • The Simple Experiment: Two-group Design
BENCHMARK / PROFICIENCY	WHST.9-10.1(b)	<p>Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
STRAND / TOPIC	AR.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
CONTENT STANDARD		Text Types and Purposes
PERFORMANCE EXPECTATION	WHST.9-10.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

BENCHMARK / PROFICIENCY	WHST.9-10.2(a)	<p>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.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • The Multi-group Experiment • The Simple Experiment: Two-group Design
BENCHMARK / PROFICIENCY	WHST.9-10.2(d)	<p>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.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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
- Inattentive 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

		<ul style="list-style-type: none"> • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
STRAND / TOPIC	AR.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
CONTENT STANDARD		Text Types and Purposes
PERFORMANCE EXPECTATION	WHST.9-10.3.	(See note; not applicable as a separate requirement)
BENCHMARK / PROFICIENCY	WHST.9-10.3(a)	<p>Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • 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