



Main Criteria: South Carolina Standards & Learning

Secondary Criteria: JoVE

Subject: Science

Grade: 9-12

Correlation Options: Show Correlated

Adopted: 2014

STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SCIENCE AND ENGINEERING PRACTICES
PERFORMANCE DESCRIPTOR / STANDARD	H.B.1.	The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
GRADE LEVEL EXAMPLE / STAGE	H.B.1A.	Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers. Students who demonstrate this understanding can:
INDICATOR	H.B.1A.1.	Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims. <u>JoVE</u> <ul style="list-style-type: none"> • The Multi-group Experiment • The Simple Experiment: Two-group Design
INDICATOR	H.B.1A.3.	Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures. <u>JoVE</u> <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 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 Motor Control
- 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 the Centrifuge
- An Introduction to the Laboratory Mouse: Mus musculus
- An Introduction to the Micropipettor
- 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
- Anesthesia Induction and Maintenance
- 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
- Aseptic Technique in Environmental Science
- Assessing Dexterity with Reaching Tasks
- Bacterial Growth Curve Analysis and its Environmental Applications
- Balance and Coordination Testing
- Basic Care Procedures
- Basic Chick Care and Maintenance
- 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 Maintenance**
- **Calcium Imaging in Neurons**
- **Carbon and Nitrogen Analysis of Environmental Samples**
- **Categories and Inductive Inferences**
- **Cell Cycle Analysis**
- **Cell-surface Biotinylation Assay**
- **Children's Reliance on Artist Intentions When Identifying Pictures**
- **Chromatin Immunoprecipitation**
- **Community DNA Extraction from Bacterial Colonies**
- **Compound Administration I**
- **Compound Administration II**
- **Compound Administration III**
- **Compound Administration IV**
- **Considerations for Rodent Surgery**
- **Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**
- **Crowding**
- **Culturing and Enumerating Bacteria from Soil Samples**
- **DNA Methylation Analysis**
- **Decision-making and the Iowa Gambling Task**
- **Decoding Auditory Imagery with Multivoxel Pattern Analysis**
- **Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**
- **Detecting Reactive Oxygen Species**
- **Detection of Bacteriophages in Environmental Samples**
- **Diagnostic Necropsy and Tissue Harvest**
- **Dichotic Listening**
- **Drosophila Development and Reproduction**
- **Drosophila Maintenance**
- **Drosophila melanogaster Embryo and Larva Harvesting and Preparation**
- **Electro-encephalography (EEG)**
- **Embryonic Stem Cell Culture and Differentiation**
- **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**
- **Expression Profiling with Microarrays**
- **Eye Tracking in Cognitive Experiments**
- **FM Dyes in Vesicle Recycling**
- **Fate Mapping**
- **Fear Conditioning**
- **From Theory to Design: The Role of Creativity in Designing Experiments**
- **Fundamentals of Breeding and Weaning**

- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Screens
- Gram Staining of Bacteria from Environmental Sources
- Habituation: Studying Infants Before They Can Talk
- Histological Sample Preparation for Light Microscopy
- How Children Solve Problems Using Causal Reasoning
- In ovo Electroporation of Chicken Embryos
- Inattentive Blindness
- Incidental Encoding
- Induced Pluripotency
- Introducing Experimental Agents into the Mouse
- Introduction to Fluorescence Microscopy
- Introduction to Light Microscopy
- Introduction to Serological Pipettes and Pipettors
- Introduction to the Microplate Reader
- Introduction to the Spectrophotometer
- Invasion Assay Using 3D Matrices
- Invertebrate Lifespan Quantification
- Isolating Nucleic Acids from Yeast
- Isolation of Fecal Bacteria from Water Samples by Filtration
- Just-noticeable Differences
- Language: The N400 in Semantic Incongruity
- Lead Analysis of Soil Using Atomic Absorption Spectroscopy
- Learning and Memory: The Remember-Know Task
- 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 Verbal Working Memory Span
- Measuring Vital Signs
- Memory Development: Demonstrating How Repeated Questioning Leads to False Memories
- Mental Rotation
- Metacognitive Development: How Children Estimate Their Memory
- Modeling Social Stress
- Motion-induced Blindness
- Motor Learning in Mirror Drawing
- Motor Maps
- Mouse Genotyping
- Multiple Object Tracking
- Mutual Exclusivity: How Children Learn the Meanings of Words
- Neuronal Transfection Methods
- Numerical Cognition: More or Less

- Nutrients in Aquatic Ecosystems
- Object Substitution Masking
- Observational Research
- PCR: The Polymerase Chain Reaction
- Passaging Cells
- Patch Clamp Electrophysiology
- Pericardiocentesis
- Peripheral Vascular Exam Using a Continuous Wave Doppler
- Perspectives on Cognitive Psychology
- Perspectives on Neuropsychology
- Physiological Correlates of Emotion Recognition
- Piaget's Conservation Task and the Influence of Task Demands
- Pilot Testing
- Placebos in Research
- Plasmid Purification
- Positive Reinforcement Studies
- Primary Neuronal Cultures
- Prospect Theory
- Purification of a Total Lipid Extract with Column Chromatography
- Quantifying Environmental Microorganisms and Viruses Using qPCR
- RNA Analysis of Environmental Samples Using RT-PCR
- RNAi in *C. elegans*
- Realism in Experimentation
- Regulating Temperature in the Lab: Applying Heat
- Regulating Temperature in the Lab: Preserving Samples Using Cold
- Reliability in Psychology Experiments
- Rodent Handling and Restraint Techniques
- Rodent Identification I
- Rodent Identification II
- SNP Genotyping
- Self-administration Studies
- Spatial Cueing
- Spatial Memory Testing Using Mazes
- Sterile Tissue Harvest
- The ATP Bioluminescence Assay
- The Attentional Blink
- The Costs and Benefits of Natural Pedagogy
- The ELISA Method
- The Factorial Experiment
- 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

		<ul style="list-style-type: none"> • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Whole-Mount In Situ Hybridization • Within-subjects Repeated-measures Design • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	H.B.1A.5.	<p>Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, and (3) use grade-level appropriate statistics to analyze data.</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 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
- Annexin V and Propidium Iodide Labeling
- Anterograde Amnesia
- Anxiety Testing
- Approximate Number Sense Test
- Are You Smart or Hardworking? How Praise Influences Children's Motivation
- Assessing Dexterity with Reaching Tasks
- Bacterial Growth Curve Analysis and its Environmental Applications
- Balance and Coordination Testing
- Basic Mouse Care and Maintenance
- Binocular Rivalry
- Blood Pressure Measurement
- C. elegans Chemotaxis Assay
- Calcium Imaging in Neurons
- Categories and Inductive Inferences
- Cell Cycle Analysis
- Cell-surface Biotinylation Assay
- Children's Reliance on Artist Intentions When Identifying Pictures
- Chromatin Immunoprecipitation
- Community DNA Extraction from Bacterial Colonies
- Crowding
- Culturing and Enumerating Bacteria from Soil Samples
- DNA Methylation Analysis
- Decision-making and the Iowa Gambling Task
- Decoding Auditory Imagery with Multivoxel Pattern Analysis
- Detecting Reactive Oxygen Species
- Development and Reproduction of the Laboratory Mouse
- Dichotic Listening
- Drosophila Development and Reproduction
- Electro-encephalography (EEG)
- 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
- Eye Tracking in Cognitive Experiments
- FM Dyes in Vesicle Recycling
- Fate Mapping

- Fear Conditioning
- From Theory to Design: The Role of Creativity in Designing Experiments
- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Screens
- Habituation: Studying Infants Before They Can Talk
- How Children Solve Problems Using Causal Reasoning
- Inattentional Blindness
- Incidental Encoding
- Introducing Experimental Agents into the Mouse
- Introduction to the Spectrophotometer
- Invasion Assay Using 3D Matrices
- Invertebrate Lifespan Quantification
- Isolating Nucleic Acids from Yeast
- Just-noticeable Differences
- Language: The N400 in Semantic Incongruity
- Learning and Memory: The Remember-Know Task
- Manipulating an Independent Variable through Embodiment
- Measuring Children's Trust in Testimony
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- Measuring Verbal Working Memory Span
- Measuring Vital Signs
- Memory Development: Demonstrating How Repeated Questioning Leads to False Memories
- Mental Rotation
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- Modeling Social Stress
- Motion-induced Blindness
- Motor Learning in Mirror Drawing
- Motor Maps
- Multiple Object Tracking
- Mutual Exclusivity: How Children Learn the Meanings of Words
- Numerical Cognition: More or Less
- Object Substitution Masking
- Observational Research
- PCR: The Polymerase Chain Reaction
- Patch Clamp Electrophysiology
- Pericardiocentesis
- Peripheral Vascular Exam Using a Continuous Wave Doppler
- Perspectives on Cognitive Psychology
- Perspectives on Neuropsychology
- Physiological Correlates of Emotion Recognition
- Piaget's Conservation Task and the Influence of Task

Demands

- **Pilot Testing**
- **Placebos in Research**
- **Plasmid Purification**
- **Positive Reinforcement Studies**
- **Prospect Theory**
- **Purification of a Total Lipid Extract with Column Chromatography**
- **RNA Analysis of Environmental Samples Using RT-PCR**
- **RNA-Seq**
- **RNAi in *C. elegans***
- **Realism in Experimentation**
- **Reliability in Psychology Experiments**
- **SNP Genotyping**
- **Self-administration Studies**
- **Self-report vs. Behavioral Measures of Recycling**
- **Spatial Cueing**
- **Spatial Memory Testing Using Mazes**
- **The ATP Bioluminescence Assay**
- **The Attentional Blink**
- **The Costs and Benefits of Natural Pedagogy**
- **The ELISA Method**
- **The Factorial Experiment**
- **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**
- **Using Diffusion Tensor Imaging in Traumatic Brain Injury**
- **Using TMS to Measure Motor Excitability During Action Observation**
- **Using Your Head: Measuring Infants' Rational Imitation of Actions**
- **Verbal Priming**
- **Visual Attention: fMRI Investigation of Object-based Attentional Control**
- **Visual Search for Features and Conjunctions**
- **Visual Statistical Learning**
- **Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy**
- **Within-subjects Repeated-measures Design**

		<ul style="list-style-type: none"> • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	H.B.1A.6.	<p>Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cognition • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Motor Control • An Introduction to Neurophysiology • An Introduction to Reward and Addiction • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay

- **Children's Reliance on Artist Intentions When Identifying Pictures**
- **Chromatin Immunoprecipitation**
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- **Memory Development: Demonstrating How Repeated Questioning Leads to False Memories**
- **Mental Rotation**
- **Metacognitive Development: How Children Estimate Their Memory**
- **Modeling Social Stress**

- **Motion-induced Blindness**
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- **Motor Maps**
- **Multiple Object Tracking**
- **Mutual Exclusivity: How Children Learn the Meanings of Words**
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- **Positive Reinforcement Studies**
- **Prospect Theory**
- **Purification of a Total Lipid Extract with Column Chromatography**
- **Quantifying Environmental Microorganisms and Viruses Using qPCR**
- **RNA Analysis of Environmental Samples Using RT-PCR**
- **RNAi in C. elegans**
- **SNP Genotyping**
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- **Spatial Memory Testing Using Mazes**
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- **The Attentional Blink**
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- **The Morris Water Maze**
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- **The Split Brain**
- **The Staircase Procedure for Finding a Perceptual Threshold**
- **The TUNEL Assay**
- **The Transwell Migration Assay**
- **The Western Blot**
- **Using Diffusion Tensor Imaging in Traumatic Brain Injury**
- **Using TMS to Measure Motor Excitability During Action Observation**

		<ul style="list-style-type: none"> • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SCIENCE AND ENGINEERING PRACTICES
PERFORMANCE DESCRIPTOR / STANDARD	H.B.1.	The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
GRADE LEVEL EXAMPLE / STAGE	H.B.1B.	Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology. Students who demonstrate this understanding can:
INDICATOR	H.B.1B.1.	<p>Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the 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

		<ul style="list-style-type: none"> • The Simple Experiment: Two-group Design • Within-subjects Repeated-measures Design
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		CELLS AS A SYSTEM
PERFORMANCE DESCRIPTOR / STANDARD	H.B.2.	The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.
GRADE LEVEL EXAMPLE / STAGE	H.B.2A.	Conceptual Understanding: The essential functions of a cell involve chemical reactions that take place between many different types of molecules (including carbohydrates, lipids, proteins and nucleic acids) that are catalyzed by enzymes. Students who demonstrate this understanding can:
INDICATOR	H.B.2A.1.	<p>Construct explanations of how the structures of carbohydrates, lipids, proteins, and nucleic acids (including DNA and RNA) are related to their functions in organisms.</p> <p>JoVE</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 Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Maintenance • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Chromatin Immunoprecipitation • Chromatography-Based Biomolecule Purification Methods • Co-Immunoprecipitation and Pull-Down Assays • Column Chromatography • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis

- DNA Ligation Reactions
- DNA Methylation Analysis
- Density Gradient Ultracentrifugation
- Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis
- Detecting Reactive Oxygen Species
- Development and Reproduction of the Laboratory Mouse
- Development of the Chick
- Dialysis: Diffusion Based Separation
- Drosophila Development and Reproduction
- Drosophila Larval IHC
- Drosophila melanogaster Embryo and Larva Harvesting and Preparation
- Electrophoretic Mobility Shift Assay (EMSA)
- Embryonic Stem Cell Culture and Differentiation
- Enzyme Assays and Kinetics
- Explant Culture for Developmental Studies
- Expression Profiling with Microarrays
- FM Dyes in Vesicle Recycling
- Förster Resonance Energy Transfer (FRET)
- Gel Purification
- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Engineering of Model Organisms
- Genetic Screens
- Genome Editing
- In ovo Electroporation of Chicken Embryos
- Induced Pluripotency
- Introduction to Catalysis
- Introduction to Mass Spectrometry
- Invasion Assay Using 3D Matrices
- Invertebrate Lifespan Quantification
- Isolating Nucleic Acids from Yeast
- Live Cell Imaging of Mitosis
- MALDI-TOF Mass Spectrometry
- Metabolic Labeling
- Method of Standard Addition
- Molecular Cloning
- Mouse Genotyping
- PCR: The Polymerase Chain Reaction
- Photometric Protein Determination
- Plasmid Purification
- Protein Crystallization
- Quantifying Environmental Microorganisms and Viruses Using qPCR
- RNA Analysis of Environmental Samples Using RT-PCR
- RNA-Seq
- RNAi in *C. elegans*
- Recombineering and Gene Targeting
- Reconstitution of Membrane Proteins
- Restriction Enzyme Digests

		<ul style="list-style-type: none"> • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		CELLS AS A SYSTEM
PERFORMANCE DESCRIPTOR / STANDARD	H.B.2.	The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.
GRADE LEVEL EXAMPLE / STAGE	H.B.2B.	Conceptual Understanding: Organisms and their parts are made of cells. Cells are the structural units of life and have specialized substructures that carry out the essential functions of life. Viruses lack cellular organization and therefore cannot independently carry out all of the essential functions of life. Students who demonstrate this understanding can:
INDICATOR	H.B.2B.1.	<p>Develop and use models to explain how specialized structures within cells (including the nucleus, chromosomes, cytoskeleton, endoplasmic reticulum, ribosomes and Golgi complex) interact to produce, modify, and transport proteins. Models should compare and contrast how prokaryotic cells meet the same life needs as eukaryotic cells without similar structures.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation

		<ul style="list-style-type: none"> • Bacterial Transformation: The Heat Shock Method • Chromatin Immunoprecipitation • Culturing and Enumerating Bacteria from Soil Samples • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genome Editing • Molecular Cloning • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	H.B.2B.2.	<p>Collect and interpret descriptive data on cell structure to compare and contrast different types of cells (including prokaryotic versus eukaryotic, and animal versus plant versus fungal).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Transfection • An Overview of Genetic Engineering • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Culturing and Enumerating Bacteria from Soil Samples • Density Gradient Ultracentrifugation • Genetic Engineering of Model Organisms • Invasion Assay Using 3D Matrices • Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • The Transwell Migration Assay
INDICATOR	H.B.2B.3.	<p>Obtain information to contrast the structure of viruses from that of cells and to explain, in general, why viruses must use living cells to reproduce.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Laboratory Mouse: Mus musculus • An Overview of Genetic Engineering • Co-Immunoprecipitation and Pull-Down Assays

		<ul style="list-style-type: none"> • Detection of Bacteriophages in Environmental Samples • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		CELLS AS A SYSTEM
PERFORMANCE DESCRIPTOR / STANDARD	H.B.2.	The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.
GRADE LEVEL EXAMPLE / STAGE	H.B.2C.	Conceptual Understanding: Transport processes which move materials into and out of the cell serve to maintain the homeostasis of the cell. Students who demonstrate this understanding can:
INDICATOR	H.B.2C.1.	<p>Develop and use models to exemplify how the cell membrane serves to maintain homeostasis of the cell through both active and passive transport processes.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Detecting Reactive Oxygen Species • Electro-encephalography (EEG) • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • Neuronal Transfection Methods • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Reconstitution of Membrane Proteins • The TUNEL Assay • The Western Blot

		<ul style="list-style-type: none"> • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Yeast Maintenance • Yeast Transformation and Cloning
INDICATOR	H.B.2C.2.	<p>Ask scientific questions to define the problems that organisms face in maintaining homeostasis within different environments (including water of varying solute concentrations).</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 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
- Palpation
- Patch Clamp Electrophysiology
- Pelvic Exam I: Assessment of the External Genitalia

		<ul style="list-style-type: none"> • 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
INDICATOR	H.B.2C.3.	<p>Analyze and interpret data to explain the movement of molecules (including water) across a membrane.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Neurophysiology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Detecting Reactive Oxygen Species • Electro-encephalography (EEG)

		<ul style="list-style-type: none"> • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • Neuronal Transfection Methods • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Reconstitution of Membrane Proteins • The TUNEL Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Yeast Maintenance • Yeast Transformation and Cloning
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		CELLS AS A SYSTEM
PERFORMANCE DESCRIPTOR / STANDARD	H.B.2.	The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.
GRADE LEVEL EXAMPLE / STAGE	H.B.2D.	Conceptual Understanding: The cells of multicellular organisms repeatedly divide to make more cells for growth and repair. During embryonic development, a single cell gives rise to a complex, multicellular organism through the processes of both cell division and differentiation. Students who demonstrate this understanding can:
INDICATOR	H.B.2D.1.	<p>Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.</p> <p><u>JoVE</u></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 Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to the Chick: Gallus gallus domesticus

		<ul style="list-style-type: none"> • An Introduction to the Laboratory Mouse: <i>Mus musculus</i> • An Introduction to the Zebrafish: <i>Danio rerio</i> • An Overview of Epigenetics • An Overview of Gene Expression • Basic Chick Care and Maintenance • <i>C. elegans</i> Development and Reproduction • Cell Cycle Analysis • Chick ex ovo Culture • Cytogenetics • DNA Methylation Analysis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • <i>Drosophila</i> Development and Reproduction • <i>Drosophila</i> Larval IHC • <i>Drosophila melanogaster</i> Embryo and Larva Harvesting and Preparation • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Gene Silencing with Morpholinos • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Live Cell Imaging of Mitosis • Metabolic Labeling • Murine In Utero Electroporation • Passaging Cells • 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 Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	H.B.2D.2.	<p>Develop and use models to exemplify the changes that occur in a cell during the cell cycle (including changes in cell size, chromosomes, cell membrane/cell wall, and the number of cells produced) and predict, based on the models, what might happen to a cell that does not progress through the cycle correctly.</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>

		<ul style="list-style-type: none"> • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Cell Cycle Analysis • Detecting Reactive Oxygen Species • Embryonic Stem Cell Culture and Differentiation • Explant Culture of Neural Tissue • Genetic Engineering of Model Organisms • Genetic Screens • Induced Pluripotency • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Primary Neuronal Cultures • The TUNEL Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	H.B.2D.3.	<p>Construct explanations for how the cell cycle is monitored by check point systems and communicate possible consequences of the continued cycling of abnormal cells.</p> <p><u>JoVE</u></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 Cell Motility and Migration • An Introduction to Developmental Neurobiology • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae

		<ul style="list-style-type: none"> • An Introduction to Stem Cell Biology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Cell Cycle Analysis • Chick ex ovo Culture • Coordination Chemistry Complexes • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Ear Exam • Embryonic Stem Cell Culture and Differentiation • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Genome Editing • Induced Pluripotency • Introducing Experimental Agents into the Mouse • Invasion Assay Using 3D Matrices • Live Cell Imaging of Mitosis • Lymph Node Exam • Male Rectal Exam • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Primary Neuronal Cultures • The TUNEL Assay • The Transwell Migration Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
INDICATOR	H.B.2D.4.	<p>Construct scientific arguments to support the pros and cons of biotechnological applications of stem cells using examples from both plants and animals.</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 Organogenesis • An Introduction to Stem Cell Biology • An Overview of Gene Expression • C. elegans Development and Reproduction • Development and Reproduction of the Laboratory Mouse • Embryonic Stem Cell Culture and Differentiation • Fate Mapping

		<ul style="list-style-type: none"> • Genetic Engineering of Model Organisms • Induced Pluripotency • Murine In Utero Electroporation • Passaging Cells • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ENERGY TRANSFER
PERFORMANCE DESCRIPTOR / STANDARD	H.B.3.	The student will demonstrate the understanding that all essential processes within organisms require energy which in most ecosystems is ultimately derived from the Sun and transferred into chemical energy by the photosynthetic organisms of that ecosystem.
GRADE LEVEL EXAMPLE / STAGE	H.B.3A.	Conceptual Understanding: Cells transform energy that organisms need to perform essential life functions through a complex sequence of reactions in which chemical energy is transferred from one system of interacting molecules to another. Students who demonstrate this understanding can:
INDICATOR	H.B.3A.1.	<p>Develop and use models to explain how chemical reactions among ATP, ADP, and inorganic phosphate act to transfer chemical energy within cells.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • Detecting Reactive Oxygen Species • Invasion Assay Using 3D Matrices • The ATP Bioluminescence Assay • The Transwell Migration Assay
INDICATOR	H.B.3A.2.	<p>Develop and revise models to describe 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 • Reconstitution of Membrane Proteins
INDICATOR	H.B.3A.3.	<p>Construct scientific arguments to support claims that chemical elements in the sugar molecules produced by photosynthesis may interact with other elements to form amino acids, lipids, nucleic acids or other large organic 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 Cellular and Molecular Neuroscience
 - An Introduction to Developmental Genetics
 - An Introduction to Molecular Developmental Biology
 - An Introduction to *Saccharomyces cerevisiae*
 - An Introduction to Transfection
 - An Overview of Epigenetics
 - An Overview of Gene Expression
 - An Overview of Genetic Analysis
 - An Overview of Genetic Engineering
 - An Overview of Genetics and Disease
 - Annexin V and Propidium Iodide Labeling
 - Bacterial Transformation: Electroporation
 - Bacterial Transformation: The Heat Shock Method
 - *C. elegans* Maintenance
 - Cell Cycle Analysis
 - Cell-surface Biotinylation Assay
 - Chromatin Immunoprecipitation
 - Chromatography-Based Biomolecule Purification
- Methods**
- Co-Immunoprecipitation and Pull-Down Assays
 - Column Chromatography
 - Community DNA Extraction from Bacterial Colonies
 - Cytogenetics
 - DNA Gel Electrophoresis
 - DNA Ligation Reactions
 - DNA Methylation Analysis
 - Density Gradient Ultracentrifugation
 - Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis
 - Detecting Reactive Oxygen Species
 - Development and Reproduction of the Laboratory Mouse
- Mouse**
- Development of the Chick
 - Dialysis: Diffusion Based Separation
 - *Drosophila* Larval IHC
 - *Drosophila melanogaster* Embryo and Larva Harvesting and Preparation
 - Electrophoretic Mobility Shift Assay (EMSA)
 - Embryonic Stem Cell Culture and Differentiation
 - Enzyme Assays and Kinetics
 - Explant Culture for Developmental Studies
 - Expression Profiling with Microarrays
 - FM Dyes in Vesicle Recycling
 - Förster Resonance Energy Transfer (FRET)
 - Gel Purification
 - Gene Silencing with Morpholinos
 - Genetic Crosses
 - Genetic Engineering of Model Organisms
 - Genetic Screens

		<ul style="list-style-type: none"> • Genome Editing • Histological Staining of Neural Tissue • 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 • 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 • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • SNP Genotyping • Separating Protein with SDS-PAGE • Spectrophotometric Determination of an Equilibrium Constant • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	H.B.3A.4.	<p>Develop models of the major inputs and outputs of cellular respiration (aerobic and anaerobic) to exemplify the chemical process in which the bonds of food molecules are broken, the bonds of new compounds are formed and a net transfer of energy results. Use the</p>

		<p>models to explain common exercise phenomena (such as lactic acid buildup, changes in breathing during and after exercise, cool down after exercise).</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
INDICATOR	H.B.3A.5.	<p>Plan and conduct scientific investigations or computer simulations to determine the relationship between variables that affect the processes of fermentation and/or cellular respiration in living organisms and interpret the data in terms of real-world phenomena.</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
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		HEREDITY-INHERITANCE AND VARIATION OF TRAITS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.4.	The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.
GRADE LEVEL EXAMPLE / STAGE	H.B.4A.	Conceptual Understanding: Each chromosome consists of a single DNA molecule. Each gene on the chromosome is a particular segment of DNA. The chemical structure of DNA provides a mechanism that ensures that information is preserved and transferred to subsequent generations. Students who demonstrate this understanding can:
INDICATOR	H.B.4A.1.	<p>Develop and use models at different scales to explain the relationship between DNA, genes, and chromosomes in coding the instructions for characteristic traits transferred from parent 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 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
- Development and Reproduction of the Laboratory Mouse
- *Drosophila melanogaster* Embryo and Larva Harvesting and Preparation
- Electrophoretic Mobility Shift Assay (EMSA)
- Embryonic Stem Cell Culture and Differentiation
- Enzyme Assays and Kinetics
- Explant Culture for Developmental Studies
- Expression Profiling with Microarrays
- Fate Mapping
- Förster Resonance Energy Transfer (FRET)
- Gel Purification
- Gene Silencing with Morpholinos
- Genetic Crosses
- Genetic Engineering of Model Organisms
- Genetic Screens
- Genome Editing
- In ovo Electroporation of Chicken Embryos
- Induced Pluripotency
- Isolating Nucleic Acids from Yeast
- Live Cell Imaging of Mitosis
- Molecular Cloning
- Mouse Genotyping
- Neuronal Transfection Methods
- PCR: The Polymerase Chain Reaction
- Photometric Protein Determination
- Plasmid Purification

		<ul style="list-style-type: none"> • 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 Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	H.B.4A.2.	<p>Develop and use models to explain how genetic information (DNA) is copied for transmission to subsequent generations of cells (mitosis).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Division • Cell Cycle Analysis • DNA Ligation Reactions • Genetic Screens • Live Cell Imaging of Mitosis • Method of Standard Addition • Molecular Cloning • PCR: The Polymerase Chain Reaction • Restriction Enzyme Digests • Yeast Maintenance • Yeast Transformation and Cloning
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		HEREDITY-INHERITANCE AND VARIATION OF TRAITS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.4.	The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.
GRADE LEVEL EXAMPLE / STAGE	H.B.4B.	Conceptual Understanding: In order for information stored in DNA to direct cellular processes, a gene needs to be transcribed from DNA to RNA and then must be translated by the cellular machinery into a protein or an RNA molecule. The protein and RNA products from these processes determine cellular activities and the unique

		characteristics of an individual. Modern techniques in biotechnology can manipulate DNA to solve human problems. Students who demonstrate this understanding can:
INDICATOR	H.B.4B.1.	<p>Develop and use models to describe how the structure of DNA determines the structure of resulting proteins or RNA molecules that carry out the essential functions of life.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • C. elegans Maintenance • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Expression Profiling with Microarrays • Gene Silencing with Morpholinos • Genome Editing • Invertebrate Lifespan Quantification • Metabolic Labeling • Method of Standard Addition • Molecular Cloning • PCR: The Polymerase Chain Reaction • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Rodent Stereotaxic Surgery • Spectrophotometric Determination of an Equilibrium Constant • Whole-Mount In Situ Hybridization • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
INDICATOR	H.B.4B.2.	<p>Obtain, evaluate and communicate information on how biotechnology (including gel electrophoresis, plasmid-based transformation and DNA fingerprinting) may be used in the fields of medicine, agriculture, and forensic science.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans

- An Introduction to *Drosophila melanogaster*
- An Introduction to Molecular Developmental Biology
- An Introduction to Neurophysiology
- An Introduction to Organogenesis
- An Introduction to *Saccharomyces cerevisiae*
- An Introduction to Stem Cell Biology
- An Introduction to Transfection
- An Introduction to the Chick: *Gallus gallus domesticus*
- An Introduction to the Laboratory Mouse: *Mus musculus*
- An Introduction to the Zebrafish: *Danio rerio*
- An Overview of Gene Expression
- An Overview of Genetic Engineering
- An Overview of Genetics and Disease
- Bacterial Growth Curve Analysis and its Environmental Applications
- Bacterial Transformation: Electroporation
- Bacterial Transformation: The Heat Shock Method
- Biofuels: Producing Ethanol from Cellulosic Material
- *C. elegans* Development and Reproduction
- Capillary Electrophoresis (CE)
- Chick ex ovo Culture
- Chromatography-Based Biomolecule Purification Methods
- Cyclic Voltammetry (CV)
- Cytogenetics
- DNA Ligation Reactions
- DNA Methylation Analysis
- Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis
- Development and Reproduction of the Laboratory Mouse
- Development of the Chick
- Electrophoretic Mobility Shift Assay (EMSA)
- Embryonic Stem Cell Culture and Differentiation
- Explant Culture for Developmental Studies
- Explant Culture of Neural Tissue
- Expression Profiling with Microarrays
- Fate Mapping
- Fundamentals of Breeding and Weaning
- 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
- Invertebrate Lifespan Quantification
- Ion-Exchange Chromatography
- Making Solutions in the Laboratory

		<ul style="list-style-type: none"> • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Plasmid Purification • Primary Neuronal Cultures • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in <i>C. elegans</i> • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Separating Protein with SDS-PAGE • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes • Whole-Mount In Situ Hybridization • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
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STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		HEREDITY-INHERITANCE AND VARIATION OF TRAITS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.4.	The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.
GRADE LEVEL EXAMPLE / STAGE	H.B.4C.	Conceptual Understanding: Sex cells are formed by a process of cell division in which the number of chromosomes per cell is halved after replication. With the exception of sex chromosomes, for each chromosome in the body cells of a multicellular organism, there is a second similar, but not identical, chromosome. Although these pairs of similar chromosomes can carry the same genes, they may have slightly different alleles. During meiosis the pairs of similar chromosomes may cross and trade pieces. One chromosome from each pair is randomly passed on to form sex cells resulting in a multitude of possible genetic combinations. The cell produced during fertilization has one set of

		chromosomes from each parent. Students who demonstrate this understanding can:
INDICATOR	H.B.4C.1.	<p>Develop and use models of sex cell formation (meiosis) to explain why the DNA of the daughter cells is different from the DNA of the parent cell.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Cell Division • Genetic Crosses • Recombineering and Gene Targeting • Yeast Reproduction
INDICATOR	H.B.4C.2.	<p>Analyze data on the variation of traits among individual organisms within a population to explain patterns in the data in the context of transmission of genetic information.</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
INDICATOR	H.B.4C.3.	<p>Construct explanations for how meiosis followed by fertilization ensures genetic variation among offspring within the same family and genetic diversity within populations of sexually reproducing organisms.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Caenorhabditis elegans • An Introduction to Cell Division • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio • C. elegans Development and Reproduction • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Fundamentals of Breeding and Weaning • Genetic Crosses • Genetic Screens • Recombineering and Gene Targeting • Yeast Maintenance • Yeast Reproduction • Zebrafish Breeding and Embryo Handling • Zebrafish Reproduction and Development
STANDARD / COURSE	SC.H.B.	BIOLOGY 1

KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		HEREDITY-INHERITANCE AND VARIATION OF TRAITS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.4.	The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.
GRADE LEVEL EXAMPLE / STAGE	H.B.4D.	Conceptual Understanding: Imperfect transmission of genetic information may have positive, negative, or no consequences to the organism. DNA replication is tightly regulated and remarkably accurate, but errors do occur and result in mutations which (rarely) are a source of genetic variation. Students who demonstrate this understanding can:
INDICATOR	H.B.4D.1.	Develop and use models to explain how mutations in DNA that occur during replication (1) can affect the proteins that are produced or the traits that result and (2) may or may not be inherited. <u>JoVE</u> <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 Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The TUNEL Assay

Grade: 9 - Adopted: 2005

STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		BIOLOGY
PERFORMANCE DESCRIPTOR / STANDARD	H.B-5.	The student will demonstrate an understanding of biological evolution and the diversity of life.
GRADE LEVEL EXAMPLE / STAGE	H.B-5.1.	Summarize the process of natural selection.

		<p>JoVE</p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.2.</p>	<p>Explain how genetic processes result in the continuity of life-forms over time.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Genetic Analysis
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.3.</p>	<p>Explain how diversity within a species increases the chances of its survival.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.4.</p>	<p>Explain how genetic variability and environmental factors lead to biological evolution.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Genetic Analysis
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.5.</p>	<p>Exemplify scientific evidence in the fields of anatomy, embryology, biochemistry, and paleontology that underlies the theory of biological evolution.</p> <p>JoVE</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) • Tree Identification: How To Use a Dichotomous Key
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.6 .</p>	<p>Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Overview of Genetic Analysis • High-Performance Liquid Chromatography (HPLC)
<p>GRADE LEVEL EXAMPLE / STAGE</p>	<p>H.B-5.7.</p>	<p>Use a phylogenetic tree to identify the evolutionary relationships among different groups of organisms.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Zebrafish: Danio rerio

Grade: 9 - Adopted: 2014

STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ECOSYSTEM DYNAMICS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.6.	The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.
GRADE LEVEL EXAMPLE / STAGE	H.B.6A.	Conceptual Understanding: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Limiting factors include the availability of biotic and abiotic resources and challenges such as predation, competition, and disease. Students who demonstrate this understanding can:
INDICATOR	H.B.6A.1.	Analyze and interpret data that depict changes in the abiotic and biotic components of an ecosystem over time or space (such as percent change, average change, correlation and proportionality) and propose hypotheses about possible relationships between the changes in the abiotic components and the biotic components of the environment. <u>JoVE</u> <ul style="list-style-type: none"> • Analysis of Earthworm Populations in Soil • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ECOSYSTEM DYNAMICS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.6.	The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.
GRADE LEVEL EXAMPLE / STAGE	H.B.6B.	Conceptual Understanding: Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. Students who demonstrate this understanding can:
INDICATOR	H.B.6B.1.	Develop and use models of the carbon cycle, which include the interactions between photosynthesis, cellular respiration and other processes that release carbon dioxide, to evaluate the effects of increasing atmospheric carbon dioxide on natural and agricultural ecosystems.

		<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 • 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 • 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
INDICATOR	H.B.6B.2.	<p>Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases (such as carbon dioxide and methane) on the carbon cycle and global climate.</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
STANDARD / COURSE	SC.H.B.	BIOLOGY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ECOSYSTEM DYNAMICS
PERFORMANCE DESCRIPTOR / STANDARD	H.B.6.	The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.
GRADE LEVEL EXAMPLE / STAGE	H.B.6D.	Conceptual Understanding: Sustaining biodiversity maintains ecosystem functioning and productivity which are essential to supporting and enhancing life on Earth. Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity can impact biodiversity. Students who demonstrate this understanding can:
INDICATOR	H.B.6D.1.	<p>Design solutions to reduce the impact of human activity on the biodiversity of an ecosystem.</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 • Dissolved Oxygen in Surface Water • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Water Quality Analysis via Indicator Organisms
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SCIENCES AND ENGINEERING PRACTICES
PERFORMANCE DESCRIPTOR / STANDARD	H.C.1.	The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
GRADE LEVEL EXAMPLE / STAGE	H.C.1A.	Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers. Students who demonstrate this understanding can:
INDICATOR	H.C.1A.2.	Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others. <u>JoVE</u> • Determining the Empirical Formula
INDICATOR	H.C.1A.3.	Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures. <u>JoVE</u> • 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
- 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
- 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
- High-Performance Liquid Chromatography (HPLC)
- Internal Standards
- Introduction to Mass Spectrometry
- Introduction to Serological Pipettes and Pipettors
- Introduction to the Microplate Reader
- Introduction to the Spectrophotometer
- Ion-Exchange Chromatography
- 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
- Raman Spectroscopy for Chemical Analysis
- Regulating Temperature in the Lab: Applying Heat
- Regulating Temperature in the Lab: Preserving Samples Using Cold
- Rotary Evaporation to Remove Solvent
- Schlenk Lines Transfer of Solvents
- Separation of Mixtures via Precipitation
- Solid-Liquid Extraction

		<ul style="list-style-type: none"> • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • 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)
INDICATOR	H.C.1A.5.	<p>Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, and (3) use grade-level appropriate statistics to analyze data.</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) • 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)

		<ul style="list-style-type: none"> • Ideal Gas Law • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • 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 • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Reconstitution of Membrane Proteins • 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)
INDICATOR	H.C.1A.6.	<p>Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Calibration Curves • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods

		<ul style="list-style-type: none"> • Column Chromatography • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Cyclic Voltammetry (CV) • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Fractional Distillation • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ideal Gas Law • Internal Standards • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Le Châtelier's Principle • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Metabolic Labeling • Method of Standard Addition • Nuclear Magnetic Resonance (NMR) Spectroscopy • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Protein Crystallization • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • The Ideal Gas Law • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ATOMIC STRUCTURE AND NUCLEAR PROCESSES
PERFORMANCE DESCRIPTOR / STANDARD	H.C.2.	The student will demonstrate an understanding of atomic structure and nuclear processes.

GRADE LEVEL EXAMPLE / STAGE	H.C.2A.	Conceptual Understanding: The existence of atoms can be used to explain the structure and behavior of matter. Each atom consists of a charged nucleus, consisting of protons and neutrons, surrounded by electrons. The interactions of these electrons between and within atoms are the primary factors that determine the chemical properties of matter. In a neutral atom the number of protons is the same as the number of electrons. Students who demonstrate this understanding can:
INDICATOR	H.C.2A.1.	Obtain and communicate information to describe and compare subatomic particles with regard to mass, location, charge, electrical attractions and repulsions, and impact on the properties of an atom. <u>JoVE</u> <ul style="list-style-type: none"> • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Metabolic Labeling • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Scanning Electron Microscopy (SEM) • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis • X-ray Fluorescence (XRF)
INDICATOR	H.C.2A.2.	Use the Bohr and quantum mechanical models of atomic structure to exemplify how electrons are distributed in atoms. <u>JoVE</u> <ul style="list-style-type: none"> • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
INDICATOR	H.C.2A.3.	Analyze and interpret absorption and emission spectra to support explanations that electrons have discrete energy levels. <u>JoVE</u>

		<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)
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		ATOMIC STRUCTURE AND NUCLEAR PROCESSES
PERFORMANCE DESCRIPTOR / STANDARD	H.C.2.	The student will demonstrate an understanding of atomic structure and nuclear processes.
GRADE LEVEL EXAMPLE / STAGE	H.C.2B.	Conceptual Understanding: In nuclear fusion, lighter nuclei combine to form more stable heavier nuclei and in nuclear fission heavier nuclei are split to form lighter nuclei. The energies in fission and fusion reactions exceed the energies in usual chemical reactions. Students who demonstrate this understanding can:
INDICATOR	H.C.2B.1.	<p>Obtain and communicate information to compare alpha, beta, and gamma radiation in terms of mass, charge, penetrating power, and their practical applications (including medical benefits and associated risks).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Behavioral Neuroscience • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Motor Control • An Introduction to Neuroanatomy • Color Afterimages • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Electro-encephalography (EEG) • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Introduction to Mass Spectrometry • Learning and Memory: The Remember-Know Task

		<ul style="list-style-type: none"> • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Metabolic Labeling • Motion-induced Blindness • Motor Maps • Physical Properties Of Minerals I: Crystals and Cleavage • Protein Crystallization • Purifying Compounds by Recrystallization • Solid-Liquid Extraction • Spatial Cueing • The Attentional Blink • The Rubber Hand Illusion • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Visual Attention: fMRI Investigation of Object-based Attentional Control • X-ray Fluorescence (XRF) • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	H.C.2B.2.	<p>Develop models to exemplify radioactive decay and use the models to explain the concept of half-life and its use in determining the age of materials (such as radiocarbon dating or the use of radioisotopes to date rocks).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Rate Laws and the Order of Reaction
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		BONDING AND CHEMICAL FORMULAS
PERFORMANCE DESCRIPTOR / STANDARD	H.C.3.	The student will demonstrate an understanding of the structures and classification of chemical compounds.
GRADE LEVEL EXAMPLE / STAGE	H.C.3A.	<p>Conceptual Understanding: Elements are made up of only one kind of atom. With increasing atomic number, a predictable pattern for the addition of electrons exists. This pattern is the basis for the arrangement of elements in the periodic table. The chemical properties of an element are determined by an element's electron configuration. Elements can react to form chemical compounds/molecules that have unique properties determined by the kinds of atoms combined to make up the compound/molecule. Essentially, the ways in which electrons are involved in bonds determines whether ionic or covalent bonds are formed. Compounds have characteristic shapes that are determined by the type and number of bonds formed. Students who demonstrate this understanding can:</p>

INDICATOR	H.C.3A.1.	<p>Construct explanations for the formation of molecular compounds via sharing of electrons and for the formation of ionic compounds via transfer of electrons.</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 • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Raman Spectroscopy for Chemical Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	H.C.3A.2.	<p>Use the periodic table to write and interpret the formulas and names of chemical compounds (including binary ionic compounds, binary covalent compounds, and straight-chain alkanes up to six carbons).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining the Empirical Formula • Purification of a Total Lipid Extract with Column Chromatography
INDICATOR	H.C.3A.4.	<p>Plan and conduct controlled scientific investigations to generate data on the properties of substances and analyze the data to infer the types of bonds (including ionic, polar covalent, and nonpolar covalent) in simple compounds.</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 • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Detecting Environmental Microorganisms with the

		<p>Polymerase Chain Reaction and Gel Electrophoresis</p> <ul style="list-style-type: none"> • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • High-Performance Liquid Chromatography (HPLC) • Ion-Exchange Chromatography • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy
INDICATOR	H.C.3A.6.	<p>Construct explanations of how the basic structure of common natural and synthetic polymers is related to their bulk properties.</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**

		<ul style="list-style-type: none"> • Le Châtelier's Principle • 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 <i>C. elegans</i> • 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 • Surface Plasmon Resonance (SPR) • 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
INDICATOR	H.C.3A.7.	<p>Analyze and interpret data to determine the empirical formula of a compound and the percent composition of a compound.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Introduction to Mass Spectrometry

		<ul style="list-style-type: none"> • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		STATES OF MATTER
PERFORMANCE DESCRIPTOR / STANDARD	H.C.4.	The student will demonstrate an understanding of the structure and behavior of the different states of matter.
GRADE LEVEL EXAMPLE / STAGE	H.C.4A.	<p>Conceptual Understanding: Matter can exist as a solid, liquid, or gas, and in very high-energy states, as plasma. In general terms, for a given chemical, the particles making up the solid are at a lower energy state than the liquid phase, which is at a lower energy state than the gaseous phase. The changes from one state of matter into another are energy dependent. The behaviors of gases are dependent on the factors of pressure, volume, and temperature. Students who demonstrate this understanding can:</p>
INDICATOR	H.C.4A.1.	<p>Develop and use models to explain the arrangement and movement of the particles in solids, liquids, gases, and plasma as well as the relative strengths of their intermolecular forces.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Degassing Liquids with Freeze-Pump-Thaw Cycling • Fractional Distillation • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • Ideal Gas Law • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Protein Crystallization • Purifying Compounds by Recrystallization • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • The Ideal Gas Law
INDICATOR	H.C.4A.2.	<p>Analyze and interpret heating curve graphs to explain that changes from one state of matter to another are energy dependent.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	H.C.4A.3.	Conduct controlled scientific investigations and use models to explain the behaviors of gases (including the

		<p>proportional relationships among pressure, volume, and temperature).</p> <p>JoVE</p> <ul style="list-style-type: none"> • Degassing Liquids with Freeze-Pump-Thaw Cycling • Determining Rate Laws and the Order of Reaction • Fractional Distillation • Gas Chromatography (GC) with Flame-Ionization Detection • Ideal Gas Law • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • The Ideal Gas Law
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SOLUTIONS, ACIDS, AND BASES
PERFORMANCE DESCRIPTOR / STANDARD	H.C.5.	The student will demonstrate an understanding of the nature and properties of various types of chemical solutions.
GRADE LEVEL EXAMPLE / STAGE	H.C.5A.	<p>Conceptual Understanding: Solutions can exist in any of three physical states: gas, liquid, or solid. Solution concentrations can be expressed by specifying the relative amounts of solute and solvent. The nature of the solute, the solvent, the temperature, and the pressure can affect solubility. Solutes can affect such solvent properties as freezing point, boiling point, and vapor pressure. Acids, bases, and salts have characteristic properties. Several definitions of acids and bases are used in chemistry. Students who demonstrate this understanding can:</p>
INDICATOR	H.C.5A.1.	<p>Obtain and communicate information to describe how a substance can dissolve in water by dissociation, dispersion, or ionization and how intermolecular forces affect solvation.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to the Micropipettor • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Calibration Curves • Capillary Electrophoresis (CE) • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry

		<ul style="list-style-type: none"> • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Determining the Mass Percent Composition in an Aqueous Solution • Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Growing Crystals for X-ray Diffraction Analysis • Internal Standards • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Making Solutions in the Laboratory • Method of Standard Addition • Performing 1D Thin Layer Chromatography • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Schlenk Lines Transfer of Solvents • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Understanding Concentration and Measuring Volumes
INDICATOR	H.C.5A.2.	<p>Analyze and interpret data to explain the effects of temperature and pressure on the solubility of solutes in a given amount of solvent.</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 • Determining the Solubility Rules of Ionic Compounds • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Growing Crystals for X-ray Diffraction Analysis • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry

		<ul style="list-style-type: none"> • Sample Preparation for Analytical Preparation • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
INDICATOR	H.C.5A.3.	<p>Use mathematical representations to analyze the concentrations of unknown solutions in terms of molarity and percent by mass.</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 Compound • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Le Châtelier's Principle • Making Solutions in the Laboratory • Photometric Protein Determination • Sample Preparation for Analytical Preparation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Understanding Concentration and Measuring Volumes
INDICATOR	H.C.5A.4.	<p>Analyze and interpret data to describe the properties of acids, bases, and salts.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Determining the Empirical Formula • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Introduction to Titration • Ion-Exchange Chromatography • Le Châtelier's Principle • Two-Dimensional Gel Electrophoresis • Using a pH Meter
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		CHEMICAL REACTIONS

PERFORMANCE DESCRIPTOR / STANDARD	H.C.6.	The student will demonstrate an understanding of the types, the causes, and the effects of chemical reactions.
GRADE LEVEL EXAMPLE / STAGE	H.C.6A.	<p>Conceptual Understanding: A chemical reaction occurs when elements and/or compounds interact, resulting in a rearrangement of the atoms of these elements and/or compounds to produce substances with unique properties. Mass is conserved in chemical reactions. Reactions tend to proceed in a direction that favors lower energies. Chemical reactions can be categorized using knowledge about the reactants to predict products. Chemical reactions are quantifiable. When stress is applied to a chemical system that is in equilibrium, the system will shift in a direction that reduces that stress. Students who demonstrate this understanding can:</p>
INDICATOR	H.C.6A.1.	<p>Develop and use models to predict the products of chemical reactions (1) based upon movements of ions; (2) based upon movements of protons; and (3) based upon movements of electrons.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to the Micropipettor • Assembly of a Reflux System for Heated Chemical Reactions • Common Lab Glassware and Uses • 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 Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Le Châtelier's Principle • Making Solutions in the Laboratory • Measuring Mass in the Laboratory • Photometric Protein Determination • Preparing Anhydrous Reagents and Equipment • Proton Exchange Membrane Fuel Cells • Purifying Compounds by Recrystallization • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Rotary Evaporation to Remove Solvent

		<ul style="list-style-type: none"> • Separation of Mixtures via Precipitation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using a pH Meter
INDICATOR	H.C.6A.2.	<p>Use Le Châtelier's principle to predict shifts in chemical equilibria resulting from changes in concentration, pressure, and temperature.</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 • Separation of Mixtures via Precipitation • Spectrophotometric Determination of an Equilibrium Constant
INDICATOR	H.C.6A.4.	<p>Use mathematical and computational thinking to predict the amounts of reactants required and products produced in specific chemical reactions.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Assembly of a Reflux System for Heated Chemical Reactions • Calibration Curves • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determining Rate Laws and the Order of Reaction • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds • Introduction to Catalysis • Introduction to Titration • Method of Standard Addition • 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
STANDARD / COURSE	SC.H.C.	CHEMISTRY 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		THERMOCHEMISTRY AND CHEMICAL KINETICS

PERFORMANCE DESCRIPTOR / STANDARD	H.C.7.	The student will demonstrate an understanding of the conservation of energy and energy transfer.
GRADE LEVEL EXAMPLE / STAGE	H.C.7A.	Conceptual Understanding: The first law of thermodynamics states that the amount of energy in the universe is constant. An energy diagram is used to represent changes in the energy of the reactants and products in a chemical reaction. Enthalpy refers to the heat content that is present in an atom, ion, or compound. While some chemical reactions occur spontaneously, other reactions may require that activation energy be lowered in order for the reaction to occur. Students who demonstrate this understanding can:
INDICATOR	H.C.7A.1.	Analyze and interpret data from energy diagrams and investigations to support claims that the amount of energy released or absorbed during a chemical reaction depends on changes in total bond energy. <u>JoVE</u> <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
INDICATOR	H.C.7A.3.	Plan and conduct controlled scientific investigations to determine the effects of temperature, surface area, stirring, concentration of reactants, and the presence of various catalysts on the rate of chemical reactions. <u>JoVE</u> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Coordination Chemistry Complexes • Determining Rate Laws and the Order of Reaction • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Enzyme Assays and Kinetics • Introduction to Catalysis
INDICATOR	H.C.7A.4.	Develop and use models to explain the relationships between collision frequency, the energy of collisions, the orientation of molecules, activation energy, and the rates of chemical reactions. <u>JoVE</u> <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

STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SCIENCE AND ENGINEERING PRACTICES
PERFORMANCE DESCRIPTOR / STANDARD	H.P.1.	The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
GRADE LEVEL EXAMPLE / STAGE	H.P.1A.	Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers. Students who demonstrate this understanding can:
INDICATOR	H.P.1A.3.	Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures. <u>JoVE</u> <ul style="list-style-type: none"> • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND FORCES
PERFORMANCE DESCRIPTOR / STANDARD	H.P.2.	The student will demonstrate an understanding of how the interactions among objects and their subsequent motion can be explained and predicted using the concept of forces.
GRADE LEVEL EXAMPLE / STAGE	H.P.2B.	Conceptual Understanding: The interactions among objects and their subsequent motion can be explained and predicted by analyzing the forces acting on the objects and applying Newton's laws of motion. Students who demonstrate this understanding can:
INDICATOR	H.P.2B.7.	Apply physics principles to design a device that minimizes the force on an object during a collision and construct an explanation for the design. <u>JoVE</u> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
INDICATOR	H.P.2B.8.	Develop and use models (such as a computer simulation, drawing, or demonstration) and Newton's Second Law of

		<p>Motion to construct explanations for why an object moving at a constant speed in a circle is accelerating.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to the Centrifuge
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND FORCES
PERFORMANCE DESCRIPTOR / STANDARD	H.P.2.	The student will demonstrate an understanding of how the interactions among objects and their subsequent motion can be explained and predicted using the concept of forces.
GRADE LEVEL EXAMPLE / STAGE	H.P.2D.	<p>Conceptual Understanding: The non-contact (at a distance) interactions among objects and their subsequent motion can be explained and predicted by analyzing the gravitational, electric, and magnetic forces acting on the objects and applying Newton's laws of motion. These non-contact forces can be represented as fields. Students who demonstrate this understanding can:</p>
INDICATOR	H.P.2D.1.	<p>Develop and use models (such as computer simulations, demonstrations, diagrams, and drawings) to explain how neutral objects can become charged and how objects mutually repel or attract each other and include the concept of conservation of charge in the explanation.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Introduction to Mass Spectrometry • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry • Testing For Genetically Modified Foods
INDICATOR	H.P.2D.5.	<p>Construct explanations for how the non-contact forces of gravity, electricity, and magnetism can be modeled as fields by sketching field diagrams for two given charges, two massive objects, or a bar magnet and use these diagrams to qualitatively interpret the direction and magnitude of the force at a particular location in the field.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Introduction to Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy
STANDARD / COURSE	SC.H.P.	PHYSICS 1

KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3A.	Conceptual Understanding: Work and energy are equivalent to each other. Work is defined as the product of displacement and the force causing that displacement; this results in the transfer of mechanical energy. Therefore, in the case of mechanical energy, energy is seen as the ability to do work. This is called the work-energy principle. The rate at which work is done (or energy is transformed) is called power. For machines that do useful work for humans, the ratio of useful power output is the efficiency of the machine. For all energies and in all instances, energy in a closed system remains constant. Students who demonstrate this understanding can:
INDICATOR	H.P.3A.3.	Obtain information to communicate how energy is conserved in elastic and inelastic collisions. <u>JoVE</u> • Raman Spectroscopy for Chemical Analysis
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3B.	Conceptual Understanding: Mechanical energy refers to a combination of motion (kinetic energy) and stored energy (potential energy). When only conservative forces act on an object and when no mass is converted to energy, mechanical energy is conserved. Gravitational and electrical potential energy can be modeled as energy stored in the fields created by massive objects or charged particles. Students who demonstrate this understanding can:
INDICATOR	H.P.3B.3.	Use drawings or diagrams to identify positions of relative high and low potential energy in a gravitational and electrical field (with the source of the field being positive as well as negative and the charge experiencing the field being positive as well as negative). <u>JoVE</u>

		<ul style="list-style-type: none"> • Cyclic Voltammetry (CV) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3C.	<p>Conceptual Understanding: When there is a temperature difference between two objects, an interaction occurs in the form of a transfer of thermal energy (heat) from the hotter object to the cooler object. Thermal energy is the total internal kinetic energy of the molecules and/or atoms of a system and is related to temperature, which is the average kinetic energy of the particles of a system. Energy always flows from hot to cold through the processes of conduction, convection, or radiation. Students who demonstrate this understanding can:</p>
INDICATOR	H.P.3C.1.	<p>Plan and conduct controlled scientific investigations to determine the variables that affect the rate of heat transfer between two objects.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	H.P.3C.2.	<p>Analyze and interpret data to describe the thermal conductivity of different materials.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Conducting Reactions Below Room Temperature
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3D.	<p>Conceptual Understanding: Sound is a mechanical, longitudinal wave that is the result of vibrations (kinetic energy) that transfer energy through a medium. Students who demonstrate this understanding can:</p>
INDICATOR	H.P.3D.1.	Develop and use models (such as drawings) to exemplify the interaction of mechanical waves with different

		<p>boundaries (sound wave interference) including the formation of standing waves and two-source interference patterns.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Raman Spectroscopy for Chemical Analysis
INDICATOR	H.P.3D.2.	<p>Use the principle of superposition to explain everyday examples of resonance (including musical instruments and the human voice).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • An Introduction to Behavioral Neuroscience • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Motor Control • An Introduction to Neuroanatomy • Color Afterimages • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Electro-encephalography (EEG) • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in • Introduction to Catalysis • Introduction to Mass Spectrometry • Learning and Memory: The Remember-Know Task • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Metabolic Labeling • Motion-induced Blindness • Motor Maps • Solid-Liquid Extraction • Spatial Cueing • The Attentional Blink • The Rubber Hand Illusion • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Visual Attention: fMRI Investigation of Object-based Attentional Control • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	H.P.3D.3.	<p>Develop and use models to explain what happens to the observed frequency of a sound wave when the relative positions of an observer and wave source changes (Doppler effect).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Peripheral Vascular Exam Using a Continuous Wave Doppler

STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3E.	Conceptual Understanding: During electric circuit interactions, electrical energy (energy stored in a battery or energy transmitted by a current) is transformed into other forms of energy and transferred to circuit devices and the surroundings. Charged particles and magnets create fields that store energy. Magnetic fields exert forces on moving charged particles. Changing magnetic fields cause electrons in wires to move, creating current. Students who demonstrate this understanding can:
INDICATOR	H.P.3E.6.	Obtain and communicate information about the relationship between magnetism and electric currents to explain the role of magnets and coils of wire in microphones, speakers, generators, and motors. <u>JoVE</u> • fMRI: Functional Magnetic Resonance Imaging
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3F.	Conceptual Understanding: During radiant energy interactions, energy can be transferred over long distances without a medium. Radiation can be modeled as an electromagnetic wave or as a stream of discrete packets of energy (photons); all radiation travels at the same speed in a vacuum (speed of light). This electromagnetic radiation is a major source of energy for life on Earth. Students who demonstrate this understanding can:
INDICATOR	H.P.3F.2.	Plan and conduct controlled scientific investigations to determine the interaction between the visible light portion of the electromagnetic spectrum and various objects (including mirrors, lenses, barriers with two slits, and diffraction gratings) and to construct explanations of the behavior of light (reflection, refraction, transmission, interference) in these instances using models (including ray diagrams).

		<p>JoVE</p> <ul style="list-style-type: none"> • Color Afterimages • Crowding • Finding Your Blind Spot and Perceptual Filling-in • Histological Sample Preparation for Light Microscopy • Inattentional Blindness • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Just-noticeable Differences • Motion-induced Blindness • Object Substitution Masking • 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
<p>INDICATOR</p>	<p>H.P.3F.5.</p>	<p>Obtain information to communicate the similarities and differences among the different bands of the electromagnetic spectrum (including radio waves, microwaves, infrared, visible light, ultraviolet, and gamma rays) and give examples of devices or phenomena from each band.</p> <p>JoVE</p> <ul style="list-style-type: none"> • An Introduction to Behavioral Neuroscience • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Motor Control • An Introduction to Neuroanatomy • Color Afterimages • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Electro-encephalography (EEG) • Eye Tracking in Cognitive Experiments • Fear Conditioning • Finding Your Blind Spot and Perceptual Filling-in • Growing Crystals for X-ray Diffraction Analysis • Introduction to Catalysis • Introduction to Mass Spectrometry • Learning and Memory: The Remember-Know Task • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Metabolic Labeling • Motion-induced Blindness • Motor Maps • Physical Properties Of Minerals I: Crystals and Cleavage

		<ul style="list-style-type: none"> • Protein Crystallization • Purifying Compounds by Recrystallization • Solid-Liquid Extraction • Spatial Cueing • The Attentional Blink • The Rubber Hand Illusion • Ultraviolet-Visible (UV-Vis) Spectroscopy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Visual Attention: fMRI Investigation of Object-based Attentional Control • X-ray Fluorescence (XRF) • fMRI: Functional Magnetic Resonance Imaging
INDICATOR	H.P.3F.6.	<p>Obtain information to construct explanations on how waves are used to produce, transmit, and capture signals and store and interpret information (including ultrasound imaging, telescopes, cell phones, and bar code scanners).</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 Introduction to Behavioral Neuroscience • An Introduction to Cognition • An Introduction to Learning and Memory • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Auscultation • Color Afterimages • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cranial Nerves Exam I (I-VI) • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Ear Exam • Electro-encephalography (EEG) • Emergent Lateral Canthotomy and Inferior Catholysis • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Exam • Eye Tracking in Cognitive Experiments • Fear Conditioning

		<ul style="list-style-type: none"> • Finding Your Blind Spot and Perceptual Filling-in • Growing Crystals for X-ray Diffraction Analysis • Histological Sample Preparation for Light Microscopy • Introduction to Catalysis • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Mass Spectrometry • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Metabolic Labeling • Motion-induced Blindness • Motor Maps • Nutrients in Aquatic Ecosystems • Ophthalmoscopic Examination • Percussion • Peripheral Vascular Exam Using a Continuous Wave Doppler • Physical Properties Of Minerals I: Crystals and Cleavage • Protein Crystallization • Purifying Compounds by Recrystallization • Raman Spectroscopy for Chemical Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • The Attentional Blink • The Rubber Hand Illusion • The Staircase Procedure for Finding a Perceptual Threshold • Turbidity and Total Solids in Surface Water • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Visual Attention: fMRI Investigation of Object-based Attentional Control • X-ray Fluorescence (XRF) • fMRI: Functional Magnetic Resonance Imaging
STANDARD / COURSE	SC.H.P.	PHYSICS 1
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		INTERACTIONS AND ENERGY
PERFORMANCE DESCRIPTOR / STANDARD	H.P.3.	The student will demonstrate an understanding of how the interactions among objects can be explained and

		predicted using the concept of the conservation of energy.
GRADE LEVEL EXAMPLE / STAGE	H.P.3G.	Conceptual Understanding: Nuclear energy is energy stored in an atom's nucleus; this energy holds the atom together and is called binding energy. Binding energy is a reflection of the equivalence of mass and energy; the mass of any nucleus is always less than the sum of the masses of the individual constituent nucleons that comprise it. Binding energy is also a measure of the strong nuclear force that exists in the nucleus and is responsible for overcoming the repulsive forces among protons. The strong and weak nuclear forces, gravity, and the electromagnetic force are the fundamental forces in nature. Strong and weak nuclear forces determine nuclear sizes, stability, and rates of radioactive decay. At the subatomic scale, the conservation of energy becomes the conservation of mass-energy. Students who demonstrate this understanding can:
INDICATOR	H.P.3G.1.	Develop and use models to represent the basic structure of an atom (including protons, neutrons, electrons, and the nucleus). <u>JoVE</u> <ul style="list-style-type: none"> • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • X-ray Fluorescence (XRF)
STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		SCIENCE AND ENGINEERING PRACTICES
PERFORMANCE DESCRIPTOR / STANDARD	H.E.1.	The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.
GRADE LEVEL EXAMPLE / STAGE	H.E.1A.	Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers. Students who demonstrate this understanding can:
INDICATOR	H.E.1A.2.	Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others. <u>JoVE</u> <ul style="list-style-type: none"> • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Intrusive Rock

		<ul style="list-style-type: none"> • Igneous Volcanic Rock • Making a Geologic Cross Section • Using GIS to Investigate Urban Forestry • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	H.E.1A.5.	<p>Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, or (3) use grade-level appropriate statistics to analyze data.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Making a Geologic Cross Section • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	H.E.1A.6.	<p>Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soxhlet Extraction of Lipid Biomarkers from Sediment
STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		EARTH'S GEOSPHERE
PERFORMANCE DESCRIPTOR / STANDARD	H.E.3.	The student will demonstrate an understanding of the internal and external dynamics of Earth's geosphere.

GRADE LEVEL EXAMPLE / STAGE	H.E.3A.	Conceptual Understanding: Evidence indicates Earth’s interior is divided into a solid inner core, a liquid outer core, a solid (but flowing) mantle and solid crust. Although the crust is solid, it is in constant motion and is recycled through time. Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth’s surface and provides a coherent account of its geological history. Weathering (physical and chemical) and soil formation are a result of the interactions of Earth’s geosphere, hydrosphere, and atmosphere. All forms of resource extraction and land use have associated economic, social, environmental, and geopolitical costs, risks, and benefits. Natural hazards and other geological events have shaped the course of human history. Students who demonstrate this understanding can:
INDICATOR	H.E.3A.1.	Analyze and interpret data to explain the differentiation of Earth’s internal structure using (1) the production of internal heat from the radioactive decay of unstable isotopes, (2) gravitational energy, (3) data from seismic waves, and (4) Earth’s magnetic field. <u>JoVE</u> <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 • Igneous Volcanic Rock • Making a Geologic Cross Section • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk’37 Paleothermometry • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	H.E.3A.2.	Analyze and interpret data from ocean topography, correlation of rock assemblages, the fossil record, the role of convection current, and the action at plate boundaries to explain the theory of plate tectonics. <u>JoVE</u> <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
INDICATOR	H.E.3A.3.	Construct explanations of how forces cause crustal changes as evidenced in sea floor spreading, earthquake

		<p>activity, volcanic eruptions, and mountain building using evidence of tectonic environments (such as mid-ocean ridges and subduction zones).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Igneous Intrusive Rock • Igneous Volcanic Rock
INDICATOR	H.E.3A.5.	<p>Analyze and interpret data to describe the physical and chemical properties of minerals and rocks and classify each based on the properties and environment in which they were formed.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Igneous Intrusive Rock • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis
INDICATOR	H.E.3A.6.	<p>Develop and use models to explain how various rock formations on the surface of Earth result from geologic processes (including weathering, erosion, deposition, and glaciation).</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Igneous Intrusive Rock • Igneous Volcanic Rock • Making a Geologic Cross Section • Turbidity and Total Solids in Surface Water • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	H.E.3A.8.	<p>Analyze and interpret data of soil from different locations to compare the major physical components of soil (such as the amounts of sand, silt, clay, and humus) as evidence of Earth processes in that region producing each type of soil.</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 • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Culturing and Enumerating Bacteria from Soil Samples • Determination of Moisture Content in Soil

		<ul style="list-style-type: none"> • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Filamentous Fungi • Gram Staining of Bacteria from Environmental Sources • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
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STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		EARTH'S GEOSPHERE
PERFORMANCE DESCRIPTOR / STANDARD	H.E.3.	The student will demonstrate an understanding of the internal and external dynamics of Earth's geosphere.
GRADE LEVEL EXAMPLE / STAGE	H.E.3B.	Conceptual Understanding: The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Human transformation of the natural environment can contribute to the frequency and intensity of some natural hazards. Students who demonstrate this understanding can:
INDICATOR	H.E.3B.1.	Obtain and communicate information to explain how the formation, availability, and use of ores and fossil fuels impact the environment. <u>JoVE</u> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Fractional Distillation • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells
INDICATOR	H.E.3B.2.	Construct scientific arguments to support claims that responsible management of natural resources is necessary for the sustainability of human societies and the biodiversity that supports them.

		<p>JoVE</p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material • 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
INDICATOR	H.E.3B.4.	<p>Obtain and evaluate available data on a current controversy regarding human activities which may affect the frequency, intensity, or consequences of natural hazards.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material
STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		EARTH'S PALEOBIOSPHERE
PERFORMANCE DESCRIPTOR / STANDARD	H.E.4.	The student will demonstrate an understanding of the dynamic relationship between Earth's conditions over geologic time and the diversity of organisms.
GRADE LEVEL EXAMPLE / STAGE	H.E.4A.	Conceptual Understanding: Living things have changed the makeup of Earth's geosphere, hydrosphere, and atmosphere over geological time. Organisms ranging from bacteria to human beings may contribute to the global carbon cycle. They may influence the global climate by modifying the chemical makeup of the atmosphere. As Earth changes, life on Earth adapts and evolves to those changes. Just as life influences components of the Earth System, changes in the Earth System influences life. Students who demonstrate this understanding can:
INDICATOR	H.E.4A.1.	<p>Construct scientific arguments to support claims that the physical conditions of Earth enable the planet to support carbon-based life.</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 • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from

		<p>Sediment</p> <ul style="list-style-type: none"> • Soxhlet Extraction of Lipid Biomarkers from Sediment
INDICATOR	H.E.4A.2.	<p>Construct explanations for how various life forms have altered the geosphere, hydrosphere and atmosphere over geological time.</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 • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
INDICATOR	H.E.4A.3.	<p>Construct explanations of how changes to Earth's surface are related to changes in the complexity and diversity of life using evidence from the geologic time scale.</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
INDICATOR	H.E.4A.5.	<p>Develop and use models of various dating methods (including index fossils, ordering of rock layers, and radiometric dating) to estimate geologic time.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Making a Geologic Cross Section
INDICATOR	H.E.4A.7.	<p>Develop and use models to predict the effects of an environmental change (such as the changing life forms, tectonic change, or human activity) on global carbon cycling.</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

		<p>Paleoclimatology</p> <ul style="list-style-type: none"> • 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 • 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
STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		EARTH'S ATMOSPHERE-WEATHER AND CLIMATE
PERFORMANCE DESCRIPTOR / STANDARD	H.E.5.	The student will demonstrate an understanding of the dynamics of Earth's atmosphere.
GRADE LEVEL EXAMPLE / STAGE	H.E.5A.	Conceptual Understanding: Weather is the condition of the atmosphere at a particular location at a particular time. Weather is primarily determined by the angle and amount (time) of sunlight. Climate is the general weather conditions over a long period of time and is influenced by many factors. Students who demonstrate this understanding can:
INDICATOR	H.E.5A.1.	<p>Develop and use models to describe the thermal structures (including the changes in air temperature due to changing altitude in the lower troposphere), the gaseous composition, and the location of the layers of Earth's atmosphere.</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
INDICATOR	H.E.5A.8.	<p>Analyze scientific arguments regarding the nature of the relationship between human activities and climate change.</p> <p><u>JoVE</u></p> <ul style="list-style-type: none"> • Biofuels: Producing Ethanol from Cellulosic Material
STANDARD / COURSE	SC.H.E.	EARTH SCIENCE
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		EARTH'S HYDROSPHERE

PERFORMANCE DESCRIPTOR / STANDARD	H.E.6.	The student will demonstrate an understanding of Earth's freshwater and ocean systems.
GRADE LEVEL EXAMPLE / STAGE	H.E.6A.	Conceptual Understanding: Water is an essential resource on Earth. Organisms (including humans) on Earth depend on water for life. Its unique physical and chemical properties are important to the dynamics of Earth systems. Multiple factors affect the quality, availability, and distribution of Earth's water. Students who demonstrate this understanding can:
INDICATOR	H.E.6A.1.	<p>Analyze and interpret data to describe and compare the physical and chemical properties of saltwater and freshwater.</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
INDICATOR	H.E.6A.2.	<p>Obtain and communicate information to explain how location, movement, and energy transfers are involved in making water available for use on Earth's surface (including lakes, surface-water drainage basins, freshwater wetlands, and groundwater zones).</p> <p>JoVE</p> <ul style="list-style-type: none"> • Dissolved Oxygen in Surface Water • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
INDICATOR	H.E.6A.4.	<p>Analyze and interpret data of a local drainage basin to predict how changes caused by human activity and other factors influence the hydrology of the basin and amount of water available for use in the ecosystem.</p> <p>JoVE</p> <ul style="list-style-type: none"> • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
INDICATOR	H.E.6A.5.	Analyze and interpret data to describe how the quality of the water in drainage basins is influenced by natural and human factors (such as land use, domestic and industrial waste, weather/climate conditions, topography of the river channel, pollution, or flooding).

		<u>JoVE</u> <ul style="list-style-type: none"> • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Le Châtelier's Principle • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water
INDICATOR	H.E.6A.6.	Develop and use models to explain how groundwater processes affect limestone formations leading to the formation of caves and karst topography. <u>JoVE</u> <ul style="list-style-type: none"> • Making a Geologic Cross Section

Grade: 9 - Adopted: 2010

STANDARD / COURSE	SC.CC.RST.9-10.	Reading Standards for Literacy in Science and Technical Subjects
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		Craft and Structure
PERFORMANCE DESCRIPTOR / STANDARD	RST.9-10.4.	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. <u>JoVE</u> <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
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<p>PERFORMANCE DESCRIPTOR / STANDARD</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

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- 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
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- 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
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		<p>the Brunton Compass</p> <ul style="list-style-type: none"> • Determining the Density of a Solid and Liquid • Determining the Empirical Formula • Determining the Mass Percent Composition in an Aqueous Solution <p>Aqueous Solution</p> <ul style="list-style-type: none"> • Determining the Solubility Rules of Ionic Compounds • Development and Reproduction of the Laboratory Mouse <p>Mouse</p> <ul style="list-style-type: none"> • 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
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- Fundamentals of Breeding and Weaning
- Förster Resonance Energy Transfer (FRET)
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- 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)
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KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		Integration of Knowledge and Ideas
PERFORMANCE DESCRIPTOR / STANDARD	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

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- 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
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- Purifying Compounds by Recrystallization
- Quantifying Environmental Microorganisms and Viruses Using qPCR
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- Separation of Mixtures via Precipitation
- Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium
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- 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

		<ul style="list-style-type: none"> • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
STANDARD / COURSE	SC.CC.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		Text Types and Purposes
PERFORMANCE DESCRIPTOR / STANDARD	WHST.9-10.1.	Write arguments focused on discipline-specific content.
GRADE LEVEL EXAMPLE / STAGE	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
STANDARD / COURSE	SC.CC.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		Text Types and Purposes
PERFORMANCE DESCRIPTOR / STANDARD	WHST.9-10.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
GRADE LEVEL EXAMPLE / STAGE	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
GRADE LEVEL EXAMPLE / STAGE	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)

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- 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
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- The Simple Experiment: Two-group Design
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- 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

		<ul style="list-style-type: none"> • 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
STANDARD / COURSE	SC.CC.WHST.9-10.	Writing Standards for Literacy in Science and Technical Subjects
KNOWLEDGE AND SKILLS / ESSENTIAL QUESTION		Text Types and Purposes
PERFORMANCE DESCRIPTOR / STANDARD	WHST.9-10.3.	(See note; not applicable as a separate requirement)
GRADE LEVEL EXAMPLE / STAGE	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