**Main Criteria**: Georgia Standards of Excellence
**Secondary Criteria**: JoVE
**Subject**: Science
**Grade**: 9-12
**Correlation Options**: Show Correlated
**Adopted**: 2009

| STRAND/TOPIC | GA.SCSh. | Characteristics of Science |
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| STANDARD / DESCRIPTION | SCSh1. | Habits of Mind: Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. |
| ELEMENT | SCSh1.a. | Exhibit the above traits in their own scientific activities.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Developmental Genetics<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• Anesthesia Induction and Maintenance<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Basic Care Procedures<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• Blood Withdrawal I<br>• Blood Withdrawal II<br>• C. elegans Maintenance<br>• Categories and Inductive Inferences<br>• Children's Reliance on Artist Intentions When Identifying Pictures<br>• Community DNA Extraction from Bacterial Colonies<br>• Compound Administration I<br>• Compound Administration II<br>• Compound Administration III<br>• Compound Administration IV |

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| | | • Considerations for Rodent Surgery<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Diagnostic Necropsy and Tissue Harvest<br>• Drosophila Development and Reproduction<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Embryonic Stem Cell Culture and Differentiation<br>• Ethics in Psychology Research<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Explant Culture for Developmental Studies<br>• Fate Mapping<br>• Fundamentals of Breeding and Weaning<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• How Children Solve Problems Using Causal Reasoning<br>• In ovo Electroporation of Chicken Embryos<br>• Induced Pluripotency<br>• Introducing Experimental Agents into the Mouse<br>• Invertebrate Lifespan Quantification<br>• Isolating Nucleic Acids from Yeast<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Mouse Genotyping<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neuronal Transfection Methods<br>• Numerical Cognition: More or Less<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Primary Neuronal Cultures<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Realism in Experimentation<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Reliability in Psychology Experiments<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Sterile Tissue Harvest<br>• The Costs and Benefits of Natural Pedagogy<br>• The Rouge Test: Searching for a Sense of Self<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies |

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| | | • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Microinjection Techniques |
| ELEMENT | SCSh1.c. | Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.<br><br><u>JoVE</u><br>• Abdominal Exam II: Percussion<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Anterograde Amnesia<br>• Auscultation<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Color Afterimages<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Development of the Chick<br>• Drosophila Maintenance<br>• General Approach to the Physical Exam |

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| | | • Genetic Crosses<br>• Inattentional Blindness<br>• Le Châtelier's Principle<br>• Making a Geologic Cross Section<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Motion-induced Blindness<br>• Object Substitution Masking<br>• Percussion<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Rotary Evaporation to Remove Solvent<br>• Spatial Cueing<br>• The Attentional Blink<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Yeast Transformation and Cloning |
| **STRAND/TOPIC** | **GA.SCSh.** | **Characteristics of Science** |
| **STANDARD / DESCRIPTION** | **SCSh2.** | **Habits of Mind: Students will use standard safety practices for all classroom laboratory and field investigations.** |
| ELEMENT | SCSh2.a. | Follow correct procedures for use of scientific apparatus.<br><br>JoVE<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Micropipettor<br>• Aseptic Technique in Environmental Science<br>• Common Lab Glassware and Uses<br>• Conducting Reactions Below Room Temperature<br>• Histological Sample Preparation for Light Microscopy<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Making Solutions in the Laboratory<br>• Measuring Mass in the Laboratory<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Understanding Concentration and Measuring Volumes |
| ELEMENT | SCSh2.b. | Demonstrate appropriate technique in all laboratory situations.<br><br>JoVE |

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| | | • An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Micropipettor<br>• Aseptic Technique in Environmental Science<br>• Common Lab Glassware and Uses<br>• Conducting Reactions Below Room Temperature<br>• Histological Sample Preparation for Light Microscopy<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Making Solutions in the Laboratory<br>• Measuring Mass in the Laboratory<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Understanding Concentration and Measuring Volumes |
| ELEMENT | SCSh2.c. | Follow correct protocol for identifying and reporting safety problems and violations.<br><br>JoVE<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Micropipettor<br>• Aseptic Technique in Environmental Science<br>• Common Lab Glassware and Uses<br>• Conducting Reactions Below Room Temperature<br>• Histological Sample Preparation for Light Microscopy<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Making Solutions in the Laboratory<br>• Measuring Mass in the Laboratory<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Understanding Concentration and Measuring Volumes |
| STRAND/TOPIC | GA.SCSh. | Characteristics of Science |
| STANDARD / DESCRIPTION | SCSh3. | Habits of Mind: Students will identify and investigate problems scientifically. |
| ELEMENT | SCSh3.a. | Suggest reasonable hypotheses for identified problems.<br><br>JoVE |

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| | | • The Multi-group Experiment<br>• The Simple Experiment: Two-group Design |
| ELEMENT | SCSh3.b. | Develop procedures for solving scientific problems.<br><br><u>JoVE</u><br>• Aseptic Technique in Environmental Science<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Chromatography-Based Biomolecule Purification Methods<br>• Cyclic Voltammetry (CV)<br>• Density Gradient Ultracentrifugation<br>• Dialysis: Diffusion Based Separation<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Ethics in Psychology Research<br>• Experimentation using a Confederate<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• High-Performance Liquid Chromatography (HPLC)<br>• Internal Standards<br>• Introduction to Mass Spectrometry<br>• Ion-Exchange Chromatography<br>• Manipulating an Independent Variable through Embodiment<br>• Method of Standard Addition<br>• Observational Research<br>• Pilot Testing<br>• Placebos in Research<br>• Preparing Anhydrous Reagents and Equipment<br>• Protein Crystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Reliability in Psychology Experiments<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Self-report vs. Behavioral Measures of Recycling<br>• The Factorial Experiment<br>• The Multi-group Experiment<br>• The Simple Experiment: Two-group Design<br>• Two-Dimensional Gel Electrophoresis<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SCSh3.d. | Graphically compare and analyze data points and/or summary statistics.<br><br><u>JoVE</u><br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans |

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| | | • An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of Genetic Analysis<br>• An Overview of Genetics and Disease<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Annexin V and Propidium Iodide Labeling<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Approximate Number Sense Test<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Assessing Dexterity with Reaching Tasks<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Balance and Coordination Testing<br>• Basic Mouse Care and Maintenance<br>• Binocular Rivalry<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Blood Pressure Measurement<br>• C. elegans Chemotaxis Assay<br>• Calcium Imaging in Neurons<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Categories and Inductive Inferences<br>• Cell Cycle Analysis<br>• Cell-surface Biotinylation Assay<br>• Children's Reliance on Artist Intentions When Identifying Pictures<br>• Chromatin Immunoprecipitation<br>• Chromatography-Based Biomolecule Purification Methods<br>• Column Chromatography<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Conversion of Fatty Acid Methyl Esters by |

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| | | **Saponification for Uk'37 Paleothermometry**<br>**• Coordination Chemistry Complexes**<br>**• Crowding**<br>**• Cyclic Voltammetry (CV)**<br>**• DNA Methylation Analysis**<br>**• Decision-making and the Iowa Gambling Task**<br>**• Decoding Auditory Imagery with Multivoxel Pattern Analysis**<br>**• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**<br>**• Detecting Reactive Oxygen Species**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Determination of Moisture Content in Soil**<br>**• Determining Rate Laws and the Order of Reaction**<br>**• Dichotic Listening**<br>**• Electro-encephalography (EEG)**<br>**• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat**<br>**• Enzyme Assays and Kinetics**<br>**• Event-related Potentials and the Oddball Task**<br>**• Executive Function and the Dimensional Change Card Sort Task**<br>**• Executive Function in Autism Spectrum Disorder**<br>**• Expression Profiling with Microarrays**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Eye Tracking in Cognitive Experiments**<br>**• FM Dyes in Vesicle Recycling**<br>**• Fate Mapping**<br>**• Fear Conditioning**<br>**• Fractional Distillation**<br>**• Förster Resonance Energy Transfer (FRET)**<br>**• Gas Chromatography (GC) with Flame-Ionization Detection**<br>**• Gene Silencing with Morpholinos**<br>**• Genetic Crosses**<br>**• Growing Crystals for X-ray Diffraction Analysis**<br>**• Habituation: Studying Infants Before They Can Talk**<br>**• High-Performance Liquid Chromatography (HPLC)**<br>**• How Children Solve Problems Using Causal Reasoning**<br>**• Ideal Gas Law**<br>**• Inattentional Blindness**<br>**• Incidental Encoding**<br>**• Internal Standards**<br>**• Introduction to Catalysis**<br>**• Introduction to Mass Spectrometry**<br>**• Introduction to Titration**<br>**• Introduction to the Microplate Reader**<br>**• Invasion Assay Using 3D Matrices**<br>**• Ion-Exchange Chromatography** |

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| | | • Isolating Nucleic Acids from Yeast<br>• Just-noticeable Differences<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Multiple Object Tracking<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• PCR: The Polymerase Chain Reaction<br>• Patch Clamp Electrophysiology<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Perspectives on Cognitive Psychology<br>• Perspectives on Neuropsychology<br>• Photometric Protein Determination<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Prospect Theory<br>• Protein Crystallization |

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| | | • Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• SNP Genotyping<br>• Self-administration Studies<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Surface Plasmon Resonance (SPR)<br>• Tandem Mass Spectrometry<br>• The ATP Bioluminescence Assay<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The Morris Water Maze<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning |

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| | | • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Yeast Maintenance<br>• fMRI: Functional Magnetic Resonance Imaging |
| **STRAND/TOPIC** | **GA.SCSh.** | **Characteristics of Science** |
| **STANDARD / DESCRIPTION** | **SCSh4.** | **Habits of Mind: Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.** |
| **ELEMENT** | **SCSh4.b.** | **Use technology to produce tables and graphs.**<br><br>**JoVE**<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of Genetic Analysis<br>• An Overview of Genetics and Disease<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Annexin V and Propidium Iodide Labeling<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Approximate Number Sense Test<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Assessing Dexterity with Reaching Tasks<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Balance and Coordination Testing<br>• Basic Mouse Care and Maintenance<br>• Binocular Rivalry<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Blood Pressure Measurement<br>• C. elegans Chemotaxis Assay<br>• Calcium Imaging in Neurons<br>• Calibration Curves<br>• Capillary Electrophoresis (CE) |

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| | | • Carbon and Nitrogen Analysis of Environmental Samples<br>• Categories and Inductive Inferences<br>• Cell Cycle Analysis<br>• Cell-surface Biotinylation Assay<br>• Children's Reliance on Artist Intentions When Identifying Pictures<br>• Chromatin Immunoprecipitation<br>• Chromatography-Based Biomolecule Purification Methods<br>• Column Chromatography<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Coordination Chemistry Complexes<br>• Crowding<br>• Cyclic Voltammetry (CV)<br>• DNA Methylation Analysis<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Dichotic Listening<br>• Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Enzyme Assays and Kinetics<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Expression Profiling with Microarrays<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fate Mapping<br>• Fear Conditioning<br>• Fractional Distillation<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Growing Crystals for X-ray Diffraction Analysis |

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| | | • Habituation: Studying Infants Before They Can Talk<br>• High-Performance Liquid Chromatography (HPLC)<br>• How Children Solve Problems Using Causal Reasoning<br>• Ideal Gas Law<br>• Inattentional Blindness<br>• Incidental Encoding<br>• Internal Standards<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to Titration<br>• Introduction to the Microplate Reader<br>• Invasion Assay Using 3D Matrices<br>• Ion-Exchange Chromatography<br>• Isolating Nucleic Acids from Yeast<br>• Just-noticeable Differences<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Multiple Object Tracking<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• PCR: The Polymerase Chain Reaction<br>• Patch Clamp Electrophysiology<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis |

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| | | • Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Perspectives on Cognitive Psychology<br>• Perspectives on Neuropsychology<br>• Photometric Protein Determination<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Prospect Theory<br>• Protein Crystallization<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• SNP Genotyping<br>• Self-administration Studies<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Surface Plasmon Resonance (SPR)<br>• Tandem Mass Spectrometry<br>• The ATP Bioluminescence Assay<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The Morris Water Maze<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes |

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| | | • Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Yeast Maintenance<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SCSh4.c. | Use technology to develop, test, and revise experimental or mathematical models.<br><br><u>JoVE</u><br>• An Introduction to Cell Division<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Micropipettor<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Common Lab Glassware and Uses<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Coordination Chemistry Complexes<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gram Staining of Bacteria from Environmental Sources<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Histological Sample Preparation for Light Microscopy<br>• Internal Standards<br>• Introduction to Catalysis<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy |

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| | | • Introduction to Mass Spectrometry<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Live Cell Imaging of Mitosis<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Measuring Mass in the Laboratory<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Nutrients in Aquatic Ecosystems<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Purifying Compounds by Recrystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Solid-Liquid Extraction<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Tandem Mass Spectrometry<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance |
| **STRAND/TOPIC** | **GA.SCSh.** | **Characteristics of Science** |
| **STANDARD / DESCRIPTION** | **SCSh5.** | **Habits of Mind: Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.** |
| **ELEMENT** | **SCSh5.a.** | **Trace the source on any large disparity between estimated and calculated answers to problems.**<br><br>**JoVE**<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Chromatography-Based Biomolecule Purification Methods<br>• Cyclic Voltammetry (CV)<br>• Density Gradient Ultracentrifugation<br>• Dialysis: Diffusion Based Separation<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Ethics in Psychology Research<br>• Experimentation using a Confederate<br>• From Theory to Design: The Role of Creativity in |

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| | | **Designing Experiments**<br>**• Gas Chromatography (GC) with Flame-Ionization Detection**<br>**• High-Performance Liquid Chromatography (HPLC)**<br>**• Internal Standards**<br>**• Introduction to Mass Spectrometry**<br>**• Ion-Exchange Chromatography**<br>**• Manipulating an Independent Variable through Embodiment**<br>**• Method of Standard Addition**<br>**• Observational Research**<br>**• Pilot Testing**<br>**• Preparing Anhydrous Reagents and Equipment**<br>**• Protein Crystallization**<br>**• Raman Spectroscopy for Chemical Analysis**<br>**• Realism in Experimentation**<br>**• Reliability in Psychology Experiments**<br>**• Sample Preparation for Analytical Preparation**<br>**• Scanning Electron Microscopy (SEM)**<br>**• Self-report vs. Behavioral Measures of Recycling**<br>**• The Factorial Experiment**<br>**• The Multi-group Experiment**<br>**• The Simple Experiment: Two-group Design**<br>**• Two-Dimensional Gel Electrophoresis**<br>**• Within-subjects Repeated-measures Design**<br>**• X-ray Fluorescence (XRF)** |
| **ELEMENT** | **SCSh5.b.** | **Consider possible effects of measurement errors on calculations.**<br><br>**JoVE**<br>**• Determining Spatial Orientation of Rock Layers with the Brunton Compass**<br>**• Sample Preparation for Analytical Preparation** |
| **ELEMENT** | **SCSh5.c.** | **Recognize the relationship between accuracy and precision.**<br><br>**JoVE**<br>**• Determining Spatial Orientation of Rock Layers with the Brunton Compass**<br>**• Method of Standard Addition**<br>**• Observational Research** |
| **ELEMENT** | **SCSh5.d.** | **Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.**<br><br>**JoVE**<br>**• Sample Preparation for Analytical Preparation** |
| **ELEMENT** | **SCSh5.e.** | **Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.** |

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| | | JoVE<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Ideal Gas Law<br>• Introduction to Titration<br>• Solutions and Concentrations<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• The Ideal Gas Law<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using a pH Meter |
| **STRAND/TOPIC** | **GA.SCSh.** | **Characteristics of Science** |
| **STANDARD / DESCRIPTION** | **SCSh7.** | **The Nature of Science: Students analyze how scientific knowledge is developed. Students recognize that:** |
| **ELEMENT** | **SCSh7.c.** | **From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.**<br><br>**JoVE**<br>• Abdominal Exam II: Percussion<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Chick: Gallus gallus domesticus |

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| | | • An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Anterograde Amnesia<br>• Auscultation<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Color Afterimages<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Development of the Chick<br>• Drosophila Maintenance<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Inattentional Blindness<br>• Le Châtelier's Principle<br>• Making a Geologic Cross Section<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Motion-induced Blindness<br>• Object Substitution Masking<br>• Percussion<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Rotary Evaporation to Remove Solvent<br>• Spatial Cueing<br>• The Attentional Blink<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Yeast Transformation and Cloning |
| ELEMENT | SCSh7.d. | Hypotheses often cause scientists to develop new experiments that produce additional data.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology |

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| | | • An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Reward and Addiction<br>• An Introduction to Stem Cell Biology<br>• An Overview of Epigenetics<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Color Afterimages<br>• Crowding<br>• Fear Conditioning<br>• Inattentional Blindness<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Neuronal Transfection Methods<br>• Object Substitution Masking<br>• Primary Neuronal Cultures<br>• Self-administration Studies<br>• Spatial Cueing<br>• The Attentional Blink<br>• The Multi-group Experiment<br>• The Rubber Hand Illusion<br>• The Simple Experiment: Two-group Design<br>• The Transwell Migration Assay |
| ELEMENT | SCSh7.e. | Testing, revising, and occasionally rejecting new and old theories never ends.<br><br>JoVE<br>• Abdominal Exam II: Percussion<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis |

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| | | • An Introduction to Learning and Memory<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Anterograde Amnesia<br>• Auscultation<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Color Afterimages<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Development of the Chick<br>• Drosophila Maintenance<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Inattentional Blindness<br>• Le Châtelier's Principle<br>• Making a Geologic Cross Section<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Motion-induced Blindness<br>• Object Substitution Masking<br>• Percussion<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Rotary Evaporation to Remove Solvent<br>• Spatial Cueing<br>• The Attentional Blink<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Yeast Transformation and Cloning |
| **STRAND/TOPIC** | **GA.SCSh.** | **Characteristics of Science** |
| **STANDARD / DESCRIPTION** | **SCSh8.** | **The Nature of Science: Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:** |

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| **ELEMENT** | **SCSh8.a.** | **Scientific investigators control the conditions of their experiments in order to produce valuable data.**<br><br>**JoVE**<br>**• Calibration Curves**<br>**• Ethics in Psychology Research**<br>**• Experimentation using a Confederate**<br>**• From Theory to Design: The Role of Creativity in Designing Experiments**<br>**• Manipulating an Independent Variable through Embodiment**<br>**• Observational Research**<br>**• Pilot Testing**<br>**• Placebos in Research**<br>**• Realism in Experimentation**<br>**• Reliability in Psychology Experiments**<br>**• The Factorial Experiment**<br>**• The Multi-group Experiment**<br>**• The Simple Experiment: Two-group Design**<br>**• Within-subjects Repeated-measures Design** |
| **ELEMENT** | **SCSh8.b.** | **Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations' hypotheses, observations, data analyses, and interpretations.**<br><br>**JoVE**<br>**• Calibration Curves**<br>**• Capillary Electrophoresis (CE)**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Cyclic Voltammetry (CV)**<br>**• Density Gradient Ultracentrifugation**<br>**• Dialysis: Diffusion Based Separation**<br>**• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat**<br>**• Ethics in Psychology Research**<br>**• Experimentation using a Confederate**<br>**• From Theory to Design: The Role of Creativity in Designing Experiments**<br>**• Gas Chromatography (GC) with Flame-Ionization Detection**<br>**• High-Performance Liquid Chromatography (HPLC)**<br>**• Internal Standards**<br>**• Introduction to Mass Spectrometry**<br>**• Ion-Exchange Chromatography**<br>**• Manipulating an Independent Variable through Embodiment**<br>**• Method of Standard Addition**<br>**• Observational Research**<br>**• Pilot Testing**<br>**• Preparing Anhydrous Reagents and Equipment** |

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| | | • Protein Crystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Reliability in Psychology Experiments<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Self-report vs. Behavioral Measures of Recycling<br>• The Factorial Experiment<br>• The Multi-group Experiment<br>• The Simple Experiment: Two-group Design<br>• Two-Dimensional Gel Electrophoresis<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SCSh8.f. | Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Neuronal Transfection Methods<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Primary Neuronal Cultures<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry<br>• Using Topographic Maps to Generate Topographic Profiles |
| STRAND/TOPIC | GA.SCSh. | Characteristics of Science |
| STANDARD / DESCRIPTION | SCSh9. | The Nature of Science: Students will enhance reading in all curriculum areas by: |
| ELEMENT | SCSh9.c. | Building vocabulary knowledge |

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| **ELEMENT/GLE** | **SCSh9.c.1.** | **Demonstrate an understanding of contextual vocabulary in various subjects.**<br><br>**<u>JoVE</u>**<br>**• Abdominal Exam I: Inspection and Auscultation**<br>**• Abdominal Exam II: Percussion**<br>**• Abdominal Exam III: Palpation**<br>**• Abdominal Exam IV: Acute Abdominal Pain Assessment**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Introduction to Aging and Regeneration**<br>**• An Introduction to Behavioral Neuroscience**<br>**• An Introduction to Caenorhabditis elegans**<br>**• An Introduction to Cell Death**<br>**• An Introduction to Cell Division**<br>**• An Introduction to Cell Metabolism**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Cellular and Molecular Neuroscience**<br>**• An Introduction to Cognition**<br>**• An Introduction to Developmental Genetics**<br>**• An Introduction to Developmental Neurobiology**<br>**• An Introduction to Drosophila melanogaster**<br>**• An Introduction to Endocytosis and Exocytosis**<br>**• An Introduction to Learning and Memory**<br>**• An Introduction to Modeling Behavioral Disorders and Stress**<br>**• An Introduction to Molecular Developmental Biology**<br>**• An Introduction to Motor Control**<br>**• An Introduction to Neuroanatomy**<br>**• An Introduction to Neurophysiology**<br>**• An Introduction to Organogenesis**<br>**• An Introduction to Reward and Addiction**<br>**• An Introduction to Saccharomyces cerevisiae**<br>**• An Introduction to Stem Cell Biology**<br>**• An Introduction to Transfection**<br>**• An Introduction to Working in the Hood**<br>**• An Introduction to the Centrifuge**<br>**• An Introduction to the Chick: Gallus gallus domesticus**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Introduction to the Micropipettor**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of Epigenetics**<br>**• An Overview of Gene Expression**<br>**• An Overview of Genetic Analysis**<br>**• An Overview of Genetic Engineering**<br>**• An Overview of Genetics and Disease**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Analysis of Earthworm Populations in Soil** |

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

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

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

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

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

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

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

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| | | • Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT/GLE | SCSh9.c.2. | Use content vocabulary in writing and speaking.<br><br><u>JoVE</u><br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration |

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

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

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

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

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

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

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

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

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| | | • Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT/GLE | SCSh9.c.3. | Explore understanding of new words found in subject area texts.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and |

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| | | **Stress**<br>**• An Introduction to Molecular Developmental Biology**<br>**• An Introduction to Motor Control**<br>**• An Introduction to Neuroanatomy**<br>**• An Introduction to Neurophysiology**<br>**• An Introduction to Organogenesis**<br>**• An Introduction to Reward and Addiction**<br>**• An Introduction to Saccharomyces cerevisiae**<br>**• An Introduction to Stem Cell Biology**<br>**• An Introduction to Transfection**<br>**• An Introduction to Working in the Hood**<br>**• An Introduction to the Centrifuge**<br>**• An Introduction to the Chick: Gallus gallus domesticus**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Introduction to the Micropipettor**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of Epigenetics**<br>**• An Overview of Gene Expression**<br>**• An Overview of Genetic Analysis**<br>**• An Overview of Genetic Engineering**<br>**• An Overview of Genetics and Disease**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Analysis of Earthworm Populations in Soil**<br>**• Anesthesia Induction and Maintenance**<br>**• Ankle Exam**<br>**• Annexin V and Propidium Iodide Labeling**<br>**• Anterograde Amnesia**<br>**• Anxiety Testing**<br>**• Approximate Number Sense Test**<br>**• Are You Smart or Hardworking? How Praise Influences Children's Motivation**<br>**• Arterial Line Placement**<br>**• Aseptic Technique in Environmental Science**<br>**• Assembly of a Reflux System for Heated Chemical Reactions**<br>**• Assessing Dexterity with Reaching Tasks**<br>**• Auscultation**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Bacterial Transformation: Electroporation**<br>**• Bacterial Transformation: The Heat Shock Method**<br>**• Balance and Coordination Testing**<br>**• Basic Care Procedures**<br>**• Basic Chick Care and Maintenance**<br>**• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation**<br>**• Basic Life Support: Cardiopulmonary Resuscitation and** |

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| | | **Defibrillation**<br>**• Basic Mouse Care and Maintenance**<br>**• Binocular Rivalry**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Blood Pressure Measurement**<br>**• Blood Withdrawal I**<br>**• Blood Withdrawal II**<br>**• C. elegans Chemotaxis Assay**<br>**• C. elegans Development and Reproduction**<br>**• C. elegans Maintenance**<br>**• Calcium Imaging in Neurons**<br>**• Calibration Curves**<br>**• Capillary Electrophoresis (CE)**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Cardiac Exam I: Inspection and Palpation**<br>**• Cardiac Exam II: Auscultation**<br>**• Cardiac Exam III: Abnormal Heart Sounds**<br>**• Categories and Inductive Inferences**<br>**• Cell Cycle Analysis**<br>**• Cell-surface Biotinylation Assay**<br>**• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Subclavian Vein**<br>**• Chick ex ovo Culture**<br>**• Children's Reliance on Artist Intentions When Identifying Pictures**<br>**• Chromatin Immunoprecipitation**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Co-Immunoprecipitation and Pull-Down Assays**<br>**• Color Afterimages**<br>**• Column Chromatography**<br>**• Common Lab Glassware and Uses**<br>**• Community DNA Extraction from Bacterial Colonies**<br>**• Compound Administration I**<br>**• Compound Administration II**<br>**• Compound Administration III**<br>**• Compound Administration IV**<br>**• Comprehensive Breast Exam**<br>**• Conducting Reactions Below Room Temperature**<br>**• Considerations for Rodent Surgery**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Coordination Chemistry Complexes**<br>**• Cranial Nerves Exam I (I-VI)**<br>**• Cranial Nerves Exam II (VII-XII)**<br>**• Crowding**<br>**• Culturing and Enumerating Bacteria from Soil Samples** |

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| | | • Cyclic Voltammetry (CV)<br>• Cytogenetics<br>• DNA Gel Electrophoresis<br>• DNA Ligation Reactions<br>• DNA Methylation Analysis<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Dialysis: Diffusion Based Separation<br>• Dichotic Listening<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Enzyme Assays and Kinetics<br>• Ethics in Psychology Research<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card |

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| | | **Sort Task**<br>**• Executive Function in Autism Spectrum Disorder**<br>**• Experimentation using a Confederate**<br>**• Explant Culture for Developmental Studies**<br>**• Explant Culture of Neural Tissue**<br>**• Expression Profiling with Microarrays**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Eye Exam**<br>**• Eye Tracking in Cognitive Experiments**<br>**• FM Dyes in Vesicle Recycling**<br>**• Fate Mapping**<br>**• Fear Conditioning**<br>**• Filamentous Fungi**<br>**• Finding Your Blind Spot and Perceptual Filling-in**<br>**• Foot Exam**<br>**• Fractional Distillation**<br>**• Freezing-Point Depression to Determine an Unknown Compound**<br>**• From Theory to Design: The Role of Creativity in Designing Experiments**<br>**• Fundamentals of Breeding and Weaning**<br>**• Förster Resonance Energy Transfer (FRET)**<br>**• Gas Chromatography (GC) with Flame-Ionization Detection**<br>**• Gel Purification**<br>**• Gene Silencing with Morpholinos**<br>**• General Approach to the Physical Exam**<br>**• Genetic Crosses**<br>**• Genetic Engineering of Model Organisms**<br>**• Genetic Screens**<br>**• Genome Editing**<br>**• Gram Staining of Bacteria from Environmental Sources**<br>**• Growing Crystals for X-ray Diffraction Analysis**<br>**• Habituation: Studying Infants Before They Can Talk**<br>**• Hand and Wrist Exam**<br>**• High-Performance Liquid Chromatography (HPLC)**<br>**• Hip Exam**<br>**• Histological Sample Preparation for Light Microscopy**<br>**• Histological Staining of Neural Tissue**<br>**• How Children Solve Problems Using Causal Reasoning**<br>**• Ideal Gas Law**<br>**• Igneous Intrusive Rock**<br>**• Igneous Volcanic Rock**<br>**• In ovo Electroporation of Chicken Embryos**<br>**• Inattentional Blindness**<br>**• Incidental Encoding**<br>**• Induced Pluripotency**<br>**• Internal Standards**<br>**• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation** |

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| | | • Intraosseous Needle Placement<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Catalysis<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Mass Spectrometry<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Ion-Exchange Chromatography<br>• Isolating Nucleic Acids from Yeast<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• Live Cell Imaging of Mitosis<br>• Lower Back Exam<br>• Lymph Node Exam<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Making a Geologic Cross Section<br>• Male Rectal Exam<br>• Manipulating an Independent Variable through Embodiment<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Mass in the Laboratory<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Molecular Cloning |

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| | | • Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Mouse Genotyping<br>• Multiple Object Tracking<br>• Murine In Utero Electroporation<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Neuronal Transfection Methods<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• Observation and Inspection<br>• Observational Research<br>• Ophthalmoscopic Examination<br>• PCR: The Polymerase Chain Reaction<br>• Palpation<br>• Passaging Cells<br>• Patch Clamp Electrophysiology<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Sensation and Perception<br>• Photometric Protein Determination<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Pilot Testing<br>• Placebos in Research<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Preparing Anhydrous Reagents and Equipment<br>• Primary Neuronal Cultures |

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| | | • Proper Adjustment of Patient Attire during the Physical Exam<br>• Prospect Theory<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Recombineering and Gene Targeting<br>• Reconstitution of Membrane Proteins<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Reliability in Psychology Experiments<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Restriction Enzyme Digests<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Rodent Stereotaxic Surgery<br>• Rotary Evaporation to Remove Solvent<br>• SNP Genotyping<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Self-administration Studies<br>• Self-report vs. Behavioral Measures of Recycling<br>• Sensory Exam<br>• Separating Protein with SDS-PAGE<br>• Separation of Mixtures via Precipitation<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes |

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| | | • Spectrophotometric Determination of an Equilibrium Constant<br>• Sterile Tissue Harvest<br>• Surface Plasmon Resonance (SPR)<br>• Surgical Cricothyrotomy<br>• Tandem Mass Spectrometry<br>• Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The Ames Room<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Factorial Experiment<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Morris Water Maze<br>• The Multi-group Experiment<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Rubber Hand Illusion<br>• The Simple Experiment: Two-group Design<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming |

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| | | • Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| **STRAND/TOPIC** | **GA.SAST.** | **Astronomy** |
| **STANDARD / DESCRIPTION** | **SAST1.** | **Students will explain the tools used by astronomers to study electromagnetic radiation to determine composition, motions, and other physical attributes of astronomical objects.** |
| **ELEMENT** | **SAST1.a.** | **Explain the challenges faced by astronomers due to the properties of light and the vast distances in the cosmos.**<br><br>**JoVE**<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Coordination Chemistry Complexes<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determining the Empirical Formula<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Internal Standards<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to the Spectrophotometer<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• MALDI-TOF Mass Spectrometry<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Nutrients in Aquatic Ecosystems<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Purifying Compounds by Recrystallization |

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| | | • Raman Spectroscopy for Chemical Analysis<br>• Solid-Liquid Extraction<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Tandem Mass Spectrometry<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance |
| ELEMENT | SAST1.d. | Discuss how spectroscopy provides information about the inherent properties and motions of objects.<br><br>JoVE<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Coordination Chemistry Complexes<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determining the Empirical Formula<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Internal Standards<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to the Spectrophotometer<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• MALDI-TOF Mass Spectrometry<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Nutrients in Aquatic Ecosystems<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Purifying Compounds by Recrystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Solid-Liquid Extraction<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Tandem Mass Spectrometry<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance |
| ELEMENT | SAST1.e. | Quantitatively analyze data from telescopes (e.g. spectra, multi-wavelength photometry, and images) and/or other astronomical sources (e.g. tide tables, sky charts).<br><br>JoVE<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature |

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| | | • Coordination Chemistry Complexes<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determining the Empirical Formula<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Internal Standards<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to the Spectrophotometer<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• MALDI-TOF Mass Spectrometry<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Nutrients in Aquatic Ecosystems<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Purifying Compounds by Recrystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Solid-Liquid Extraction<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Tandem Mass Spectrometry<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance |
| **STRAND/TOPIC** | **GA.SAST.** | **Astronomy** |
| **STANDARD / DESCRIPTION** | **SAST6.** | **Students will explore connections between cosmic phenomena and conditions necessary for life.** |
| ELEMENT | SAST6.c. | Describe signatures of life on other worlds and early Earth.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from |

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| | | Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment |
| **STRAND/TOPIC** | **GA.SB.** | **Biology** |
| **STANDARD / DESCRIPTION** | **SB1.** | **Students will analyze the nature of the relationships between structures and functions in living cells.** |
| ELEMENT | SB1.a. | Explain the role of cell organelles for both prokaryotic and eukaryotic cells, including the cell membrane, in maintaining homeostasis and cell reproduction.<br><br><u>JoVE</u><br>• An Introduction to Aging and Regeneration<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Neurophysiology<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to Transfection<br>• An Overview of Gene Expression<br>• An Overview of Genetic Engineering<br>• Annexin V and Propidium Iodide Labeling<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Balance and Coordination Testing<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• C. elegans Development and Reproduction<br>• Calcium Imaging in Neurons<br>• Cell Cycle Analysis<br>• Cell-surface Biotinylation Assay<br>• Cytogenetics<br>• DNA Ligation Reactions<br>• Density Gradient Ultracentrifugation<br>• Detecting Reactive Oxygen Species<br>• Electro-encephalography (EEG)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Enzyme Assays and Kinetics<br>• Explant Culture of Neural Tissue<br>• FM Dyes in Vesicle Recycling<br>• Förster Resonance Energy Transfer (FRET)<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Histological Staining of Neural Tissue<br>• In ovo Electroporation of Chicken Embryos |

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| | | • Induced Pluripotency<br>• Invasion Assay Using 3D Matrices<br>• Isolating Nucleic Acids from Yeast<br>• Live Cell Imaging of Mitosis<br>• Metabolic Labeling<br>• Molecular Cloning<br>• Mouse Genotyping<br>• Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• Passaging Cells<br>• Patch Clamp Electrophysiology<br>• Plasmid Purification<br>• Primary Neuronal Cultures<br>• Protein Crystallization<br>• Recombineering and Gene Targeting<br>• Reconstitution of Membrane Proteins<br>• Restriction Enzyme Digests<br>• Rodent Stereotaxic Surgery<br>• Surface Plasmon Resonance (SPR)<br>• Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Tissue Regeneration with Somatic Stem Cells<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning |
| ELEMENT | SB1.b. | Explain how enzymes function as catalysts.<br><br>JoVE<br>• An Introduction to Cell Death<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• DNA Ligation Reactions<br>• Enzyme Assays and Kinetics<br>• Introduction to Catalysis<br>• Live Cell Imaging of Mitosis<br>• Molecular Cloning<br>• PCR: The Polymerase Chain Reaction<br>• Restriction Enzyme Digests<br>• The ELISA Method<br>• The TUNEL Assay |
| ELEMENT | SB1.c. | Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic acids).<br><br>JoVE<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division |

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

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

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| | | • The Transwell Migration Assay<br>• The Western Blot<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SB1.d. | Explain the impact of water on life processes (i.e., osmosis, diffusion).<br><br>JoVE<br>• Determination of Moisture Content in Soil<br>• Dissolved Oxygen in Surface Water<br>• Nutrients in Aquatic Ecosystems<br>• Turbidity and Total Solids in Surface Water<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Water Quality Analysis via Indicator Organisms |
| STRAND/TOPIC | GA.SB. | Biology |
| STANDARD / DESCRIPTION | SB2. | Students will analyze how biological traits are passed on to successive generations. |
| ELEMENT | SB2.a. | Distinguish between DNA and RNA.<br><br>JoVE<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Developmental Genetics<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Transfection<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Annexin V and Propidium Iodide Labeling<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Chromatin Immunoprecipitation<br>• Community DNA Extraction from Bacterial Colonies<br>• Cytogenetics<br>• DNA Gel Electrophoresis<br>• DNA Ligation Reactions |

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| | | • DNA Methylation Analysis<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Enzyme Assays and Kinetics<br>• Explant Culture for Developmental Studies<br>• Expression Profiling with Microarrays<br>• Förster Resonance Energy Transfer (FRET)<br>• Gel Purification<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• In ovo Electroporation of Chicken Embryos<br>• Induced Pluripotency<br>• Invertebrate Lifespan Quantification<br>• Isolating Nucleic Acids from Yeast<br>• Live Cell Imaging of Mitosis<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Molecular Cloning<br>• Mouse Genotyping<br>• PCR: The Polymerase Chain Reaction<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Recombineering and Gene Targeting<br>• Restriction Enzyme Digests<br>• Rodent Stereotaxic Surgery<br>• SNP Genotyping<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Testing For Genetically Modified Foods<br>• The TUNEL Assay<br>• Two-Dimensional Gel Electrophoresis<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance |

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| | | • Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SB2.b. | Explain the role of DNA in storing and transmitting cellular information.<br><br><u>JoVE</u><br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Developmental Genetics<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Transfection<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Annexin V and Propidium Iodide Labeling<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Chromatin Immunoprecipitation<br>• Community DNA Extraction from Bacterial Colonies<br>• Cytogenetics<br>• DNA Gel Electrophoresis<br>• DNA Ligation Reactions<br>• DNA Methylation Analysis<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Development and Reproduction of the Laboratory Mouse<br>• Drosophila Development and Reproduction<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Enzyme Assays and Kinetics<br>• Explant Culture for Developmental Studies<br>• Expression Profiling with Microarrays<br>• Fundamentals of Breeding and Weaning<br>• Förster Resonance Energy Transfer (FRET) |

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| | | • Gel Purification<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• In ovo Electroporation of Chicken Embryos<br>• Induced Pluripotency<br>• Isolating Nucleic Acids from Yeast<br>• Live Cell Imaging of Mitosis<br>• Method of Standard Addition<br>• Molecular Cloning<br>• Mouse Genotyping<br>• PCR: The Polymerase Chain Reaction<br>• Photometric Protein Determination<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Recombineering and Gene Targeting<br>• Restriction Enzyme Digests<br>• SNP Genotyping<br>• Testing For Genetically Modified Foods<br>• The TUNEL Assay<br>• Two-Dimensional Gel Electrophoresis<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry |
| ELEMENT | SB2.c. | Using Mendel's laws, explain the role of meiosis in reproductive variability.<br><br>JoVE<br>• An Introduction to Cell Division<br>• An Introduction to Developmental Genetics<br>• Genetic Crosses<br>• Recombineering and Gene Targeting<br>• Yeast Reproduction |
| ELEMENT | SB2.d. | Describe the relationships between changes in DNA and potential appearance of new traits including: Alterations during replication; Insertions; Deletions; Substitutions; Mutagenic factors that can alter DNA; High energy radiation (x-rays and ultraviolet); Chemical.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans |

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| | | • An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Developmental Genetics<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to Transfection<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Chick Care and Maintenance<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Cell Cycle Analysis<br>• Chick ex ovo Culture<br>• DNA Ligation Reactions<br>• DNA Methylation Analysis<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Embryonic Stem Cell Culture and Differentiation<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Fate Mapping<br>• Fundamentals of Breeding and Weaning<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• In ovo Electroporation of Chicken Embryos<br>• Induced Pluripotency<br>• Invertebrate Lifespan Quantification<br>• Isolating Nucleic Acids from Yeast<br>• Live Cell Imaging of Mitosis |

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| | | • Method of Standard Addition<br>• Molecular Cloning<br>• Mouse Genotyping<br>• Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• PCR: The Polymerase Chain Reaction<br>• Passaging Cells<br>• Plasmid Purification<br>• Primary Neuronal Cultures<br>• RNAi in C. elegans<br>• Recombineering and Gene Targeting<br>• Restriction Enzyme Digests<br>• Rodent Stereotaxic Surgery<br>• SNP Genotyping<br>• Solid-Liquid Extraction<br>• Testing For Genetically Modified Foods<br>• The TUNEL Assay<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Whole-Mount In Situ Hybridization<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SB2.e. | Compare the advantages of sexual reproduction and asexual reproduction in different situations.<br><br>JoVE<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Zebrafish: Danio rerio<br>• C. elegans Development and Reproduction<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Fundamentals of Breeding and Weaning<br>• Genetic Crosses<br>• Genetic Screens<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Reproduction and Development |
| ELEMENT | SB2.f. | Examine the use of DNA technology in forensics, medicine, and agriculture. |

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| | | **JoVE**<br>**• An Introduction to Aging and Regeneration**<br>**• An Introduction to Caenorhabditis elegans**<br>**• An Introduction to Drosophila melanogaster**<br>**• An Introduction to Molecular Developmental Biology**<br>**• An Introduction to Organogenesis**<br>**• An Introduction to Saccharomyces cerevisiae**<br>**• An Introduction to Stem Cell Biology**<br>**• An Introduction to Transfection**<br>**• An Introduction to the Chick: Gallus gallus domesticus**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• An Overview of Gene Expression**<br>**• An Overview of Genetic Engineering**<br>**• An Overview of Genetics and Disease**<br>**• Bacterial Transformation: Electroporation**<br>**• Bacterial Transformation: The Heat Shock Method**<br>**• C. elegans Development and Reproduction**<br>**• Capillary Electrophoresis (CE)**<br>**• Chick ex ovo Culture**<br>**• Chromatin Immunoprecipitation**<br>**• Community DNA Extraction from Bacterial Colonies**<br>**• Cytogenetics**<br>**• DNA Ligation Reactions**<br>**• DNA Methylation Analysis**<br>**• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**<br>**• Development and Reproduction of the Laboratory Mouse**<br>**• Development of the Chick**<br>**• Embryonic Stem Cell Culture and Differentiation**<br>**• Explant Culture for Developmental Studies**<br>**• Explant Culture of Neural Tissue**<br>**• Expression Profiling with Microarrays**<br>**• Fate Mapping**<br>**• Fundamentals of Breeding and Weaning**<br>**• Gene Silencing with Morpholinos**<br>**• Genetic Engineering of Model Organisms**<br>**• Genetic Screens**<br>**• Genome Editing**<br>**• In ovo Electroporation of Chicken Embryos**<br>**• Induced Pluripotency**<br>**• Introduction to Catalysis**<br>**• Invertebrate Lifespan Quantification**<br>**• Isolating Nucleic Acids from Yeast**<br>**• Molecular Cloning**<br>**• Mouse Genotyping**<br>**• Murine In Utero Electroporation**<br>**• Neuronal Transfection Methods** |

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| | | • PCR: The Polymerase Chain Reaction<br>• Plasmid Purification<br>• Primary Neuronal Cultures<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Recombineering and Gene Targeting<br>• Restriction Enzyme Digests<br>• Rodent Stereotaxic Surgery<br>• SNP Genotyping<br>• Solid-Liquid Extraction<br>• Testing For Genetically Modified Foods<br>• The TUNEL Assay<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Whole-Mount In Situ Hybridization<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| **STRAND/TOPIC** | **GA.SB.** | **Biology** |
| **STANDARD / DESCRIPTION** | **SB3.** | **Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.** |
| **ELEMENT** | **SB3.a.** | **Explain the cycling of energy through the processes of photosynthesis and respiration.**<br><br>**JoVE**<br>• An Introduction to Cell Metabolism<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Detecting Reactive Oxygen Species<br>• The ATP Bioluminescence Assay |
| **ELEMENT** | **SB3.b.** | **Compare how structures and function vary between the six kingdoms (archaebacteria, eubacteria, protists, fungi, plants, and animals).**<br><br>**JoVE**<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental |

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| | | **Applications**<br>**• Basic Chick Care and Maintenance**<br>**• Basic Mouse Care and Maintenance**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• C. elegans Chemotaxis Assay**<br>**• C. elegans Development and Reproduction**<br>**• C. elegans Maintenance**<br>**• Chick ex ovo Culture**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**<br>**• Determination of Moisture Content in Soil**<br>**• Development and Reproduction of the Laboratory Mouse**<br>**• Development of the Chick**<br>**• Drosophila Development and Reproduction**<br>**• Drosophila Larval IHC**<br>**• Drosophila Maintenance**<br>**• Drosophila melanogaster Embryo and Larva Harvesting and Preparation**<br>**• Filamentous Fungi**<br>**• Genetic Crosses**<br>**• Genetic Engineering of Model Organisms**<br>**• Gram Staining of Bacteria from Environmental Sources**<br>**• In ovo Electroporation of Chicken Embryos**<br>**• Introducing Experimental Agents into the Mouse**<br>**• Isolating Nucleic Acids from Yeast**<br>**• Mouse Genotyping**<br>**• RNAi in C. elegans**<br>**• Recombineering and Gene Targeting**<br>**• Sonication Extraction of Lipid Biomarkers from Sediment**<br>**• Tree Identification: How To Use a Dichotomous Key**<br>**• Tree Survey: Point-Centered Quarter Sampling Method**<br>**• Using GIS to Investigate Urban Forestry**<br>**• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy**<br>**• Yeast Maintenance**<br>**• Yeast Reproduction**<br>**• Yeast Transformation and Cloning**<br>**• Zebrafish Breeding and Embryo Handling**<br>**• Zebrafish Maintenance and Husbandry**<br>**• Zebrafish Microinjection Techniques**<br>**• Zebrafish Reproduction and Development** |
| **ELEMENT** | **SB3.c.** | **Examine the evolutionary basis of modern classification systems (archaebacteria, eubacteria, protists, fungi, plants, and animals).**<br><br>**JoVE**<br>**• An Introduction to Caenorhabditis elegans**<br>**• An Introduction to Drosophila melanogaster** |

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| | | • An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Drosophila Development and Reproduction<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Tree Identification: How To Use a Dichotomous Key |
| ELEMENT | SB3.d. | Compare and contrast viruses with living organisms.<br><br>JoVE<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Detection of Bacteriophages in Environmental Samples<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR |
| STRAND/TOPIC | GA.SB. | Biology |
| STANDARD / DESCRIPTION | SB4. | Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems. |
| ELEMENT | SB4.a. | Investigate the relationships among organisms, populations, communities, ecosystems, and biomes.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by |

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| | | **Filtration**<br>**• Passaging Cells**<br>**• Plasmid Purification**<br>**• Quantifying Environmental Microorganisms and Viruses Using qPCR**<br>**• Tree Identification: How To Use a Dichotomous Key**<br>**• Tree Survey: Point-Centered Quarter Sampling Method**<br>**• Using GIS to Investigate Urban Forestry**<br>**• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy**<br>**• Yeast Maintenance**<br>**• Yeast Reproduction** |
| **ELEMENT** | **SB4.b.** | **Explain the flow of matter and energy through ecosystems by: Arranging components of a food chain according to energy flow; Comparing the quantity of energy in the steps of an energy pyramid; Explaining the need for cycling of major nutrients (C, O, H, N, P).**<br><br>**JoVE**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Analysis of Earthworm Populations in Soil**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Filamentous Fungi**<br>**• Fundamentals of Breeding and Weaning**<br>**• Metabolic Labeling**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Purification of a Total Lipid Extract with Column Chromatography**<br>**• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry**<br>**• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium**<br>**• Sonication Extraction of Lipid Biomarkers from Sediment**<br>**• Soxhlet Extraction of Lipid Biomarkers from Sediment**<br>**• Using GIS to Investigate Urban Forestry** |

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| **ELEMENT** | **SB4.d.** | **Assess and explain human activities that influence and modify the environment such as global warming, population growth, pesticide use, and water and power consumption.**<br><br>**JoVE**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Lead Analysis of Soil Using Atomic Absorption Spectroscopy**<br>**• Measuring Tropospheric Ozone**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Self-report vs. Behavioral Measures of Recycling**<br>**• Tree Identification: How To Use a Dichotomous Key**<br>**• Tree Survey: Point-Centered Quarter Sampling Method**<br>**• Turbidity and Total Solids in Surface Water**<br>**• Water Quality Analysis via Indicator Organisms** |
| **ELEMENT** | **SB4.e.** | **Relate plant adaptations, including tropisms, to the ability to survive stressful environmental conditions.**<br><br>**JoVE**<br>**• Tree Identification: How To Use a Dichotomous Key** |
| **ELEMENT** | **SB4.f.** | **Relate animal adaptations, including behaviors, to the ability to survive stressful environmental conditions.**<br><br>**JoVE**<br>**• An Introduction to Caenorhabditis elegans**<br>**• An Introduction to Drosophila melanogaster**<br>**• An Introduction to Learning and Memory**<br>**• An Introduction to Modeling Behavioral Disorders and Stress**<br>**• An Introduction to Motor Control**<br>**• An Introduction to Reward and Addiction**<br>**• An Introduction to the Chick: Gallus gallus domesticus**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• Anesthesia Induction and Maintenance**<br>**• Anxiety Testing**<br>**• Assessing Dexterity with Reaching Tasks**<br>**• Balance and Coordination Testing**<br>**• Basic Care Procedures**<br>**• Basic Chick Care and Maintenance**<br>**• Basic Mouse Care and Maintenance**<br>**• Blood Withdrawal I**<br>**• Blood Withdrawal II**<br>**• C. elegans Chemotaxis Assay**<br>**• Compound Administration I**<br>**• Compound Administration II** |

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| | | • Compound Administration III<br>• Compound Administration IV<br>• Considerations for Rodent Surgery<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Drosophila Development and Reproduction<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Fear Conditioning<br>• Fundamentals of Breeding and Weaning<br>• Modeling Social Stress<br>• Positive Reinforcement Studies<br>• RNAi in C. elegans<br>• Rodent Handling and Restraint Techniques<br>• Self-administration Studies<br>• Spatial Memory Testing Using Mazes<br>• Sterile Tissue Harvest<br>• The Morris Water Maze<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| **STRAND/TOPIC** | **GA.SB.** | **Biology** |
| **STANDARD / DESCRIPTION** | **SB5.** | **Students will evaluate the role of natural selection in the development of the theory of evolution.** |
| ELEMENT | SB5.a. | Trace the history of the theory.<br><br>JoVE<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Overview of Genetic Analysis |
| ELEMENT | SB5.b. | Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution.<br><br>JoVE<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Overview of Genetic Analysis |
| ELEMENT | SB5.c. | Explain how fossil and biochemical evidence support the theory.<br><br>JoVE<br>• An Overview of Genetic Analysis<br>• High-Performance Liquid Chromatography (HPLC) |
| ELEMENT | SB5.d. | Relate natural selection to changes in organisms. |

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| | | JoVE<br>• An Overview of Genetic Analysis |
| ELEMENT | SB5.e. | Recognize the role of evolution to biological resistance (pesticide and antibiotic resistance).<br><br>JoVE<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• Tree Identification: How To Use a Dichotomous Key |
| STRAND/TOPIC | GA.SBO. | Botany |
| STANDARD / DESCRIPTION | SBO1. | Students will use current plant phylogenetic principles and describe the structural changes used to delineate the plant divisions. |
| ELEMENT | SBO1.a. | Describe the major structures and evolutionary changes of major organs, tissues, cells, and organelle types in nonvascular/seedless and vascular/seed plants.<br><br>JoVE<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO1.b. | Identify and evaluate plant structures in relation to their functions.<br><br>JoVE<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO1.c. | Use, compare, and contrast the methods and purposes of plant classification.<br><br>JoVE<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| STRAND/TOPIC | GA.SBO. | Botany |
| STANDARD / DESCRIPTION | SBO2. | Students will be able to identify and describe Georgia's major physiographic provinces and their natural plant communities. |
| ELEMENT | SBO2.a. | Identify and describe four major regions (mountain, piedmont, coastal plain, salt marsh), the aquatic systems [freshwater, estuaries, and marine]) systems, and their natural plant (oak-hickory-pine, oak-pine, long leaf pine-wire grass, cord grass, algal) communities of Georgia.<br><br>JoVE<br>• Dissolved Oxygen in Surface Water<br>• Nutrients in Aquatic Ecosystems<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method |

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| | | • Turbidity and Total Solids in Surface Water<br>• Using GIS to Investigate Urban Forestry<br>• Water Quality Analysis via Indicator Organisms<br>• Zebrafish Maintenance and Husbandry |
| ELEMENT | SBO2.b. | Use taxonomic keys to identify local flora and recognize major representative groups of the southeast.<br><br>JoVE<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO2.c. | Explore the effects of nonnative invasive plants on natural communities.<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Tree Survey: Point-Centered Quarter Sampling Method |
| STRAND/TOPIC | GA.SBO. | Botany |
| STANDARD / DESCRIPTION | SBO3. | Students will explore the structures and processes necessary for the mutual survival of plants and animals. |
| ELEMENT | SBO3.a. | Describe and relate plant structures (organs, tissues, cells, organelles) to plant processes (photosynthesis, respiration, transport, growth, reproduction, dispersal).<br><br>JoVE<br>• An Introduction to Cell Metabolism |
| STRAND/TOPIC | GA.SBO. | Botany |
| STANDARD / DESCRIPTION | SBO4. | Students will explore the defense systems of plants and recognize the impact of plant diseases on the biosphere. |
| ELEMENT | SBO4.a. | Identify plant diseases and management strategies.<br><br>JoVE<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO4.b. | Examine how plant diseases affect humans and animals.<br><br>JoVE<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO4.c. | Examine how plants respond to diseases caused by pathogens (i.e. insects, fungi, bacteria, viruses) and attempt to protect themselves from those disease causing agents.<br><br>JoVE<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |

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| ELEMENT | SBO4.d. | Examine the economic and social impact of plant diseases.<br><br>JoVE<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |
| STRAND/TOPIC | GA.SBO. | Botany |
| STANDARD / DESCRIPTION | SBO5. | Students will analyze the diversity of plant adaptations and responses to environmental extremes. |
| ELEMENT | SBO5.a. | Describe the diversity of plants and their adaptations in relation to differing ecosystems and changing environments, both long term (climate) and short term (seasonal and diurnal).<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO5.d. | Analyze how human activities impact plants and the sustainability of plant communities.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Testing For Genetically Modified Foods<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SBO5.e. | Explain the role of plant processes in the biosphere (i.e. energy and cycling of major nutrients (C, O, H, N, and P).<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Cell Metabolism<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water |

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| | | • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Filamentous Fungi<br>• Fundamentals of Breeding and Weaning<br>• Metabolic Labeling<br>• Nutrients in Aquatic Ecosystems<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry |
| **STRAND/TOPIC** | **GA.SBO.** | **Botany** |
| **STANDARD / DESCRIPTION** | **SBO6.** | **Students will analyze the economic and ecological importance of plants in society.** |
| ELEMENT | SBO6.a. | Explain the uses and values of plants in different societies (agriculture, horticulture, industry, medicine, biotechnology).<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Solid-Liquid Extraction<br>• Testing For Genetically Modified Foods |
| ELEMENT | SBO6.b. | Explain how plants impact the environment providing diverse habitats for birds, insects, and other wildlife in ecosystems.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| ELEMENT | SBO6.c. | Investigate ethical issues related to genetic engineering of plants.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Solid-Liquid Extraction<br>• Testing For Genetically Modified Foods |
| **STRAND/TOPIC** | **GA.SC.** | **Chemistry** |
| **STANDARD / DESCRIPTION** | **SC1.** | **Students will analyze the nature of matter and its classifications.** |
| ELEMENT | SC1.b. | Identify substances based on chemical and physical properties.<br><br>JoVE |

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| | | • Common Lab Glassware and Uses<br>• Cyclic Voltammetry (CV)<br>• Determining the Density of a Solid and Liquid<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Introduction to Titration<br>• Using a pH Meter |
| ELEMENT | SC1.c. | Predict formulas for stable ionic compounds (binary and tertiary) based on balance of charges.<br><br>JoVE<br>• Determining the Empirical Formula |
| ELEMENT | SC1.d. | Use IUPAC nomenclature for both chemical names and formulas: Ionic compounds (Binary and tertiary); Covalent compounds (Binary and tertiary); Acidic compounds (Binary and tertiary).<br><br>JoVE<br>• Determining the Empirical Formula |
| STRAND/TOPIC | GA.SC. | Chemistry |
| STANDARD / DESCRIPTION | SC2. | Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions. |
| ELEMENT | SC2.a. | Identify and balance the following types of chemical equations: Synthesis; Decomposition; Single Replacement; Double Replacement; Combustion.<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Conducting Reactions Below Room Temperature<br>• Coordination Chemistry Complexes<br>• Cyclic Voltammetry (CV)<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Empirical Formula<br>• Determining the Solubility Rules of Ionic Compounds<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Enzyme Assays and Kinetics<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Introduction to Catalysis<br>• Introduction to Titration<br>• Le Châtelier's Principle<br>• Photometric Protein Determination<br>• Preparing Anhydrous Reagents and Equipment<br>• Proton Exchange Membrane Fuel Cells<br>• Purifying Compounds by Recrystallization |

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| | | • Rotary Evaporation to Remove Solvent<br>• Separation of Mixtures via Precipitation<br>• Solutions and Concentrations<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using a pH Meter |
| ELEMENT | SC2.b. | Experimentally determine indicators of a chemical reaction specifically precipitation, gas evolution, water production, and changes in energy to the system.<br><br>JoVE<br>• Conducting Reactions Below Room Temperature<br>• Determining Rate Laws and the Order of Reaction<br>• Introduction to Titration<br>• Le Châtelier's Principle<br>• Passaging Cells<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• The ELISA Method<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| ELEMENT | SC2.c. | Apply concepts of the mole and Avogadro's number to conceptualize and calculate: Empirical/molecular formulas; Mass, moles and molecules relationships; Molar volumes of gases.<br><br>JoVE<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• High-Performance Liquid Chromatography (HPLC)<br>• Ideal Gas Law<br>• Internal Standards<br>• Introduction to Mass Spectrometry<br>• Introduction to Titration<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Le Châtelier's Principle<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory |

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| | | • Photometric Protein Determination<br>• Sample Preparation for Analytical Preparation<br>• Solutions and Concentrations<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Tandem Mass Spectrometry<br>• The Ideal Gas Law<br>• Understanding Concentration and Measuring Volumes |
| ELEMENT | SC2.d. | Identify and solve different types of stoichiometry problems, specifically relating mass to moles and mass to mass.<br><br>JoVE<br>• Calibration Curves<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Introduction to Titration<br>• Method of Standard Addition<br>• Solutions and Concentrations<br>• Spectrophotometric Determination of an Equilibrium Constant |
| ELEMENT | SC2.e. | Demonstrate the conceptual principle of limiting reactants.<br><br>JoVE<br>• Cyclic Voltammetry (CV)<br>• Spectrophotometric Determination of an Equilibrium Constant |
| ELEMENT | SC2.f. | Explain the role of equilibrium in chemical reactions.<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Le Châtelier's Principle<br>• Separation of Mixtures via Precipitation<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Using a pH Meter |
| STRAND/TOPIC | GA.SC. | Chemistry |
| STANDARD / DESCRIPTION | SC3. | Students will use the modern atomic theory to explain the characteristics of atoms. |
| ELEMENT | SC3.a. | Discriminate between the relative size, charge, and position of protons, neutrons, and electrons in the atom.<br><br>JoVE<br>• Coordination Chemistry Complexes<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Raman Spectroscopy for Chemical Analysis |

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| | | • Scanning Electron Microscopy (SEM)<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SC3.d. | Explain the relationship of isotopes to the relative abundance of atoms of a particular element.<br><br>JoVE<br>• Metabolic Labeling |
| ELEMENT | SC3.e. | Compare and contrast types of chemical bonds (i.e. ionic, covalent).<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Chromatography-Based Biomolecule Purification Methods<br>• Column Chromatography<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Determining the Solubility Rules of Ionic Compounds<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• High-Performance Liquid Chromatography (HPLC)<br>• Ion-Exchange Chromatography<br>• Performing 1D Thin Layer Chromatography<br>• Preparing Anhydrous Reagents and Equipment<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Reconstitution of Membrane Proteins<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SC3.f. | Relate light emission and the movement of electrons to element identification. |

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| | | JoVE<br>• Coordination Chemistry Complexes<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Introduction to Fluorescence Microscopy<br>• Introduction to the Microplate Reader<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• MALDI-TOF Mass Spectrometry<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Raman Spectroscopy for Chemical Analysis<br>• Tandem Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| **STRAND/TOPIC** | **GA.SC.** | **Chemistry** |
| **STANDARD / DESCRIPTION** | **SC4.** | **Students will use the organization of the Periodic Table to predict properties of elements.** |
| ELEMENT | SC4.b. | Compare and contrast trends in the chemical and physical properties of elements and their placement on the Periodic Table.<br><br>JoVE<br>• Chromatography-Based Biomolecule Purification Methods<br>• Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Mass Spectrometry<br>• Surface Plasmon Resonance (SPR)<br>• X-ray Fluorescence (XRF) |
| **STRAND/TOPIC** | **GA.SC.** | **Chemistry** |
| **STANDARD / DESCRIPTION** | **SC5.** | **Students will understand that the rate at which a chemical reaction occurs can be affected by changing concentration, temperature, or pressure and the addition of a catalyst.** |
| ELEMENT | SC5.a. | Demonstrate the effects of changing concentration, temperature, and pressure on chemical reactions.<br><br>JoVE<br>• Conducting Reactions Below Room Temperature<br>• Determining Rate Laws and the Order of Reaction<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Enzyme Assays and Kinetics<br>• Introduction to Catalysis |
| ELEMENT | SC5.b. | Investigate the effects of a catalyst on chemical reactions and apply it to everyday examples. |

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| | | JoVE<br>• Coordination Chemistry Complexes<br>• Determining Rate Laws and the Order of Reaction<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Enzyme Assays and Kinetics<br>• Introduction to Catalysis |
| ELEMENT | SC5.c. | Explain the role of activation energy and degree of randomness in chemical reactions.<br><br>JoVE<br>• Conducting Reactions Below Room Temperature<br>• Enzyme Assays and Kinetics<br>• Introduction to Catalysis |
| STRAND/TOPIC | GA.SC. | Chemistry |
| STANDARD / DESCRIPTION | SC6. | Students will understand the effects motion of atoms and molecules in chemical and physical processes. |
| ELEMENT | SC6.a. | Compare and contrast atomic/molecular motion in solids, liquids, gases, and plasmas.<br><br>JoVE<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Fractional Distillation<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Ideal Gas Law<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Protein Crystallization<br>• Purifying Compounds by Recrystallization<br>• Schlenk Lines Transfer of Solvents<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• The Ideal Gas Law |
| ELEMENT | SC6.b. | Collect data and calculate the amount of heat given off or taken in by chemical or physical processes.<br><br>JoVE<br>• Conducting Reactions Below Room Temperature<br>• Determining Rate Laws and the Order of Reaction<br>• Le Châtelier's Principle<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| ELEMENT | SC6.c. | Analyzing (both conceptually and quantitatively) flow of energy during change of state (phase).<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical |

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| | | Reactions<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Determining Rate Laws and the Order of Reaction<br>• Fractional Distillation<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Ideal Gas Law<br>• Le Châtelier's Principle<br>• Preparing Anhydrous Reagents and Equipment<br>• Purifying Compounds by Recrystallization<br>• Rotary Evaporation to Remove Solvent<br>• Schlenk Lines Transfer of Solvents<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• The Ideal Gas Law<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| **STRAND/TOPIC** | **GA.SC.** | **Chemistry** |
| **STANDARD / DESCRIPTION** | **SC7.** | **Students will characterize the properties that describe solutions and the nature of acids and bases.** |
| ELEMENT | SC7.a. | Explain the process of dissolving in terms of solute/solvent interactions: Observe factors that effect the rate at which a solute dissolves in a specific solvent; Express concentrations as molarities; Prepare and properly label solutions of specified molar concentration; Relate molality to colligative properties.<br><br>JoVE<br>• An Introduction to the Micropipettor<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Column Chromatography<br>• Conducting Reactions Below Room Temperature<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Cyclic Voltammetry (CV)<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Dialysis: Diffusion Based Separation |

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| | | • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• High-Performance Liquid Chromatography (HPLC)<br>• Internal Standards<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Ion-Exchange Chromatography<br>• Le Châtelier's Principle<br>• Making Solutions in the Laboratory<br>• Method of Standard Addition<br>• Performing 1D Thin Layer Chromatography<br>• Photometric Protein Determination<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Rotary Evaporation to Remove Solvent<br>• Sample Preparation for Analytical Preparation<br>• Schlenk Lines Transfer of Solvents<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Understanding Concentration and Measuring Volumes |
| ELEMENT | SC7.b. | Compare, contrast, and evaluate the nature of acids and bases: Arrhenius, Bronsted-Lowry Acid/Bases; Strong vs. weak acids/bases in terms of percent dissociation; Hydronium ion concentration; pH; Acid-Base neutralization.<br><br><u>JoVE</u><br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Introduction to Titration<br>• Ion-Exchange Chromatography<br>• Le Châtelier's Principle |

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| | | • Two-Dimensional Gel Electrophoresis<br>• Using a pH Meter |
| **STRAND/TOPIC** | **GA.SES.** | **Earth Systems** |
| **STANDARD / DESCRIPTION** | **SES1.** | **Students will investigate the composition and formation of Earth systems, including the Earth's relationship to the solar system.** |
| ELEMENT | SES1.a. | Describe the early evolution of the Earth and solar system, including the formation of Earth's solid layers (core, mantle, crust), the distribution of major elements, the origin of internal heat sources, and the mechanism by which heat transfer drives plate tectonics.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SES1.b. | Explain how the composition of the Earth's crust, mantle and core is determined and compare it to that of other solar system objects.<br><br>JoVE<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SES1.d. | Describe how the Earth acquired its initial oceans and atmosphere.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Removal of Branched and Cyclic Compounds by Urea |

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| | | Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment |
| ELEMENT | SES1.e. | Identify the transformations and major reservoirs that make up the rock cycle, hydrologic cycle, carbon cycle, and other important geochemical cycles.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry |
| STRAND/TOPIC | GA.SES. | Earth Systems |
| STANDARD / DESCRIPTION | SES2. | Students will understand how plate tectonics creates certain geologic features, materials, and hazards. |
| ELEMENT | SES2.a. | Distinguish among types of plate tectonic settings produced by plates diverging, converging, and sliding past each other.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SES2.b. | Relate modern and ancient geologic features to each kind of plate tectonic setting.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock |

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| | | • Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SES2.e. | Explain how plate tectonics creates and destroys sedimentary basins through time.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| STRAND/TOPIC | GA.SES. | Earth Systems |
| STANDARD / DESCRIPTION | SES3. | Students will explore the actions of water, wind, ice, and gravity that create landforms and systems of landforms (landscapes). |
| ELEMENT | SES3.d. | Relate the past and present actions of ice, wind, and water to landform distribution and landscape evolution.<br><br>JoVE<br>• Turbidity and Total Solids in Surface Water |
| STRAND/TOPIC | GA.SES. | Earth Systems |
| STANDARD / DESCRIPTION | SES4. | Students will understand how rock relationships and fossils are used to reconstruct the Earth's past. |
| ELEMENT | SES4.a. | Describe and apply principles of relative age (superposition, original horizontality, cross-cutting relations, and original lateral continuity) and describe how unconformities form.<br><br>JoVE<br>• Making a Geologic Cross Section |
| ELEMENT | SES4.b. | Interpret the geologic history of a succession of rocks and unconformities.<br><br>JoVE<br>• Making a Geologic Cross Section |
| ELEMENT | SES4.d. | Explain how sedimentary rock units are correlated within and across regions by a variety of methods (e.g., geologic map relationships, the principle of fossil succession, radiometric dating, and paleomagnetism).<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Making a Geologic Cross Section |

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| | | • Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SES4.e. | Use geologic maps and stratigraphic relationships to interpret major events in Earth history (e.g., mass extinction, major climatic change, tectonic events).<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| STRAND/TOPIC | GA.SES. | Earth Systems |
| STANDARD / DESCRIPTION | SES5. | Students will investigate the interaction of insolation and Earth systems to produce weather and climate. |
| ELEMENT | SES5.e. | Describe the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Nino/La Nina, global warming).<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| ELEMENT | SES5.f. | Relate changes in global climate to variation in Earth/Sun relationships and to natural and anthropogenic modification of atmospheric composition.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| STRAND/TOPIC | GA.SES. | Earth Systems |
| STANDARD / DESCRIPTION | SES6. | Students will explain how life on Earth responds to and shapes Earth systems. |
| ELEMENT | SES6.a. | Relate the nature and distribution of life on Earth, including humans, to the chemistry and availability of water.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Making a Geologic Cross Section<br>• Nutrients in Aquatic Ecosystems<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea |

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| | | **Adduction for Uk'37 Paleothermometry**<br>**• Sonication Extraction of Lipid Biomarkers from Sediment**<br>**• Soxhlet Extraction of Lipid Biomarkers from Sediment**<br>**• Turbidity and Total Solids in Surface Water**<br>**• Water Quality Analysis via Indicator Organisms** |
| **ELEMENT** | **SES6.c.** | **Explain how geological and ecological processes interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion).**<br><br>**JoVE**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Purification of a Total Lipid Extract with Column Chromatography**<br>**• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry**<br>**• Sonication Extraction of Lipid Biomarkers from Sediment**<br>**• Soxhlet Extraction of Lipid Biomarkers from Sediment**<br>**• Using GIS to Investigate Urban Forestry** |
| **ELEMENT** | **SES6.e.** | **Identify the evolutionary innovations that most profoundly shaped Earth systems: photosynthetic prokaryotes and the atmosphere; multicellular animals and marine environments; land plants and terrestrial environments.**<br><br>**JoVE**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry**<br>**• Sonication Extraction of Lipid Biomarkers from** |

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| | | Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment |
| STRAND/TOPIC | GA.SEC. | Ecology |
| STANDARD / DESCRIPTION | SEC1. | Students will analyze how biotic and abiotic factors interact to affect the distribution of species and the diversity of life on Earth. |
| ELEMENT | SEC1.a. | Characterize the biotic and abiotic components that define various biomes and aquatic life zones.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy |
| ELEMENT | SEC1.c. | Investigate factors that lead to the species richness of an ecosystem and describe the importance of biodiversity.<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method |
| ELEMENT | SEC1.d. | Relate the role of natural selection to organismal adaptations that are specific to their habitats and describe some examples of coevolution.<br><br>JoVE<br>• An Overview of Genetic Analysis |
| STRAND/TOPIC | GA.SEC. | Ecology |
| STANDARD / DESCRIPTION | SEC2. | Students will investigate factors influencing population density, dispersion, and demographics. |
| ELEMENT | SEC2.a. | Evaluate factors that regulate population growth to include intraspecific competition in population growth and population density.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology |

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| | | • An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Passaging Cells<br>• Plasmid Purification<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Yeast Maintenance<br>• Yeast Reproduction |
| **ELEMENT** | **SEC2.b.** | **Analyze models that predict population growth.**<br><br>**JoVE**<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting |

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| | | and Preparation<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Passaging Cells<br>• Plasmid Purification<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Yeast Maintenance<br>• Yeast Reproduction |
| ELEMENT | SEC2.c. | Describe the different life history and reproductive strategies that have evolved in organisms.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Division<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Fundamentals of Breeding and Weaning<br>• Genetic Crosses<br>• Genetic Screens<br>• Invertebrate Lifespan Quantification<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SEC2.d. | Relate the rapid growth of human population to environmental problems.<br><br>JoVE<br>• Nutrients in Aquatic Ecosystems |
| STRAND/TOPIC | GA.SEC. | Ecology |

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| **STANDARD / DESCRIPTION** | **SEC3.** | **Students will explore and analyze community interactions.** |
| ELEMENT | SEC3.a. | Compare and contrast species interactions (e.g. predation, parasitism, mutualism, commensalism, and competition) and adaptations that have evolved in response to interspecific selective pressures.<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• C. elegans Development and Reproduction<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Dissolved Oxygen in Surface Water<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Recombineering and Gene Targeting<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Zebrafish Maintenance and Husbandry |
| ELEMENT | SEC3.b. | Explore ecological niches and resource partitioning.<br><br>JoVE<br>• Filamentous Fungi |
| ELEMENT | SEC3.c. | Identify dominant, keystone, foundation, and endangered species and their roles in ecosystems and communities, locally and globally.<br><br>JoVE<br>• Filamentous Fungi |
| **STRAND/TOPIC** | **GA.SEC.** | **Ecology** |
| **STANDARD / DESCRIPTION** | **SEC4.** | **Students will analyze biogeochemical cycles and the flow of energy in ecosystems.** |
| ELEMENT | SEC4.a. | Compare and contrast the carbon, water, oxygen, phosphorus, nitrogen, and sulfur cycles, describing their flow through biotic and abiotic pools, including human influences.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples |

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| | | • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Filamentous Fungi<br>• Metabolic Labeling<br>• Nutrients in Aquatic Ecosystems<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SEC4.b. | Apply the first and second laws of thermodynamics and the law of conservation of matter to the flow of energy and matter in ecosystems.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Filamentous Fungi<br>• Fundamentals of Breeding and Weaning<br>• Nutrients in Aquatic Ecosystems<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SEC4.d. | Explore the importance of primary productivity in ecosystems.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology |
| STRAND/TOPIC | GA.SEC. | Ecology |
| STANDARD / DESCRIPTION | SEC5. | Students will assess the impact of human activities on the natural world, and research how ecological theory |

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| | | **can address current issues facing our society, locally and globally.** |
| **ELEMENT** | **SEC5.a.** | **Describe the sources, environmental impacts, and mitigation measures for major primary and secondary pollutants.**<br><br>**JoVE**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Introduction to Mass Spectrometry**<br>**• Lead Analysis of Soil Using Atomic Absorption Spectroscopy**<br>**• Making a Geologic Cross Section**<br>**• Measuring Tropospheric Ozone**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Turbidity and Total Solids in Surface Water**<br>**• Water Quality Analysis via Indicator Organisms** |
| **ELEMENT** | **SEC5.b.** | **Compare and contrast the ecological impact of sustainable and non-sustainable use of resources, including soil, timber, fish and wild game, mineral resources, and nonrenewable energy.**<br><br>**JoVE**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Fractional Distillation**<br>**• Proton Exchange Membrane Fuel Cells**<br>**• Raman Spectroscopy for Chemical Analysis**<br>**• Tree Identification: How To Use a Dichotomous Key**<br>**• Tree Survey: Point-Centered Quarter Sampling Method**<br>**• Using GIS to Investigate Urban Forestry** |
| **ELEMENT** | **SEC5.c.** | **Evaluate the causes and impacts on ecosystems of natural and anthropogenic climate change.**<br><br>**JoVE**<br>**• Biofuels: Producing Ethanol from Cellulosic Material** |
| **ELEMENT** | **SEC5.e.** | **Research the ecological impact of agriculture (historical and modern) in the environment and its implications for feeding the world's population.**<br><br>**JoVE**<br>**• An Overview of Genetic Engineering**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Determination of Moisture Content in Soil** |

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| | | • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Testing For Genetically Modified Foods |
| **STRAND/TOPIC** | **GA.SEN.** | **Entomology** |
| **STANDARD / DESCRIPTION** | **SEN1.** | **Students will identify and analyze the roles of insects in ecosystems.** |
| ELEMENT | SEN1.a. | Illustrate the important function(s) of insects in diverse terrestrial and freshwater food webs (i.e., as herbivores, predators, and scavengers).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN1.b. | Explain the role of insects in various niches.<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN1.c. | Compare species diversity and biomass in different terrestrial habitats and evaluate why insects are the dominant organisms worldwide by either measure.<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN1.d. | Analyze the numerous ways that insects affect ecosystems (e.g., plant pollination, decomposers/recyclers of organic matter).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction |

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| | | • Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN1.e. | Discuss the importance of coevolution/coadaptation relationships between various insects and plants (e.g., how insects serve as pollen vectors of plants).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN1.f. | Explain how some groups of insects are used as water quality indicators because they are sensitive to habitat change.<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Water Quality Analysis via Indicator Organisms |
| STRAND/TOPIC | GA.SEN. | Entomology |
| STANDARD / DESCRIPTION | SEN2. | Students will investigate the reasons for insect success. |
| ELEMENT | SEN2.a. | Investigate the insect body plan and compare and contrast to other arthropods (e.g., Arachnida, Crustacea).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN2.b. | Explain advantages of different insect life cycles (e.g., complete vs. incomplete). |

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| | | JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification |
| ELEMENT | SEN2.c. | Use morphological characteristics (e.g., wing structure) to recognize major insect orders.<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN2.d. | Compare and contrast how insect structure and function are integrated and reflect evolved adaptations to different environments.<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| STRAND/TOPIC | GA.SEN. | Entomology |
| STANDARD / DESCRIPTION | SEN3. | Students will investigate the impact of insects on the production of food and other products. |
| ELEMENT | SEN3.a. | Explain how humans use insect biology to make commercial products (e.g., silk, honey, lacquer, and dyes).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation |

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| | | • Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN3.b. | Evaluate the benefits of insects to ecosystem functioning for food production (e.g., pollinators of agricultural crops).<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Invertebrate Lifespan Quantification<br>• Whole-Mount In Situ Hybridization |
| STRAND/TOPIC | GA.SEN. | Entomology |
| STANDARD / DESCRIPTION | SEN4. | Students will investigate the impact of insects on human and animal health. |
| ELEMENT | SEN4.a. | Relate the impact of insects that transmit serious diseases (e.g., malaria, yellow fever, plague, dengue fever, and West Nile virus) on public health.<br><br>JoVE<br>• Genetic Crosses<br>• RNA-Seq<br>• Whole-Mount In Situ Hybridization |
| ELEMENT | SEN4.b. | Illustrate how insect-carried diseases have changed the course of human history (e.g., the Black Plague during the Middle Ages, and malaria in world history including Georgia).<br><br>JoVE<br>• Genetic Crosses<br>• RNA-Seq<br>• Whole-Mount In Situ Hybridization |
| STRAND/TOPIC | GA.SEN. | Entomology |
| STANDARD / DESCRIPTION | SEN5. | Students will evaluate methods for the management of insect populations for the benefit of humans. |
| ELEMENT | SEN5.d. | Evaluate the benefits and risks of using genetically modified crops to manage insect pests.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Solid-Liquid Extraction<br>• Testing For Genetically Modified Foods |
| STRAND/TOPIC | GA.SEV. | Environmental Science |
| STANDARD / DESCRIPTION | SEV1. | Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society. |

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| **ELEMENT** | **SEV1.a.** | **Interpret biogeochemical cycles including hydrologic, nitrogen, phosphorus, oxygen, and carbon cycles. Recognize that energy is not recycled in ecosystems.**<br><br>**JoVE**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Analysis of Earthworm Populations in Soil**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction**<br>**• Filamentous Fungi**<br>**• Fundamentals of Breeding and Weaning**<br>**• Metabolic Labeling**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Purification of a Total Lipid Extract with Column Chromatography**<br>**• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry**<br>**• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium**<br>**• Sonication Extraction of Lipid Biomarkers from Sediment**<br>**• Soxhlet Extraction of Lipid Biomarkers from Sediment**<br>**• Using GIS to Investigate Urban Forestry** |
| **ELEMENT** | **SEV1.c.** | **Relate food production and quality of nutrition to population growth and the trophic levels**<br><br>**JoVE**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Introduction to the Chick: Gallus gallus domesticus**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• Analysis of Earthworm Populations in Soil**<br>**• Aseptic Technique in Environmental Science**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Bacterial Transformation: Electroporation** |

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| | | • Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Passaging Cells<br>• Plasmid Purification<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Yeast Maintenance<br>• Yeast Reproduction |
| ELEMENT | SEV1.d. | Relate the cycling of matter and the flow of energy to the Laws of Conservation of matter and energy. Identify the role and importance of decomposers in the recycling process.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• C. elegans Maintenance<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Filamentous Fungi<br>• Fundamentals of Breeding and Weaning<br>• Nutrients in Aquatic Ecosystems<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SEV1.e. | Distinguish between abiotic and biotic factors in an ecosystem and describe how matter and energy move between these.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Alkenone Biomarker Analysis for |

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| | | Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Filamentous Fungi<br>• Fundamentals of Breeding and Weaning<br>• Nutrients in Aquatic Ecosystems<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy |
| **STRAND/TOPIC** | **GA.SEV.** | **Environmental Science** |
| **STANDARD / DESCRIPTION** | **SEV2.** | **Students will demonstrate an understanding that the Earth is one interconnected system.** |
| ELEMENT | SEV2.a. | Describe how the abiotic components (water, air, and energy) affect the biosphere.<br><br><u>JoVE</u><br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy |

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| | | • Determination of Moisture Content in Soil<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Filamentous Fungi<br>• Fundamentals of Breeding and Weaning<br>• Nutrients in Aquatic Ecosystems<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Turbidity and Total Solids in Surface Water<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SEV2.b. | Recognize and give examples of the hierarchy of the biological entities of the biosphere (organisms, populations, communities, ecosystems, and biosphere).<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation |

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| | | • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Passaging Cells<br>• Plasmid Purification<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Yeast Maintenance<br>• Yeast Reproduction |
| ELEMENT | SEV2.c. | Characterize the components that define a Biome (Abiotic Factors - to include precipitation, temperature and soils; Biotic Factors - plant and animal adaptations that create success in that biome).<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy |
| ELEMENT | SEV2.d. | Characterize the components that define fresh-water and marine systems (Abiotic Factors - to include light, dissolved oxygen, phosphorus, nitrogen, pH and |

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| | | substrate; Biotic Factors - plant and animal adaptations characteristic to that system).<br><br>JoVE<br>• Dissolved Oxygen in Surface Water<br>• Nutrients in Aquatic Ecosystems<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms<br>• Zebrafish Maintenance and Husbandry |
| STRAND/TOPIC | GA.SEV. | Environmental Science |
| STANDARD / DESCRIPTION | SEV3. | Students will describe stability and change in ecosystems. |
| ELEMENT | SEV3.a. | Describe interconnections between abiotic and biotic factors, including normal cyclic fluctuations and changes associated with climatic change (i.e. ice ages).<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment |
| ELEMENT | SEV3.d. | Explain how biotic and abiotic factors influence populations.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment |

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| | | • Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy |
| ELEMENT | SEV3.e. | Describe interactions between individuals (i.e. mutualism, commensalisms, parasitism, predation, and competition).<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• C. elegans Development and Reproduction<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Dissolved Oxygen in Surface Water<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Recombineering and Gene Targeting<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Zebrafish Maintenance and Husbandry |
| STRAND/TOPIC | GA.SEV. | Environmental Science |
| STANDARD / DESCRIPTION | SEV4. | Students will understand and describe availability, allocation and conservation of energy and other resources |
| ELEMENT | SEV4.a. | Differentiate between renewable and nonrenewable resources including how different resources are produced, rates of use, renewal rates, and limitations of sources. Distinguish between natural and produced resources.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Proton Exchange Membrane Fuel Cells |
| ELEMENT | SEV4.b. | Describe how technology is increasing the efficiency of utilization and accessibility of resources.<br><br>JoVE<br>• An Introduction to Saccharomyces cerevisiae<br>• Coordination Chemistry Complexes<br>• Cyclic Voltammetry (CV)<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Determining the Solubility Rules of Ionic Compounds<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Fractional Distillation<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis |

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| | | • High-Performance Liquid Chromatography (HPLC)<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to Titration<br>• Le Châtelier's Principle<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Preparing Anhydrous Reagents and Equipment<br>• Purifying Compounds by Recrystallization<br>• Raman Spectroscopy for Chemical Analysis<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SEV4.c. | Describe how energy and other resource utilization impact the environment and recognize that individuals as well as larger entities (businesses, governments, etc.) have impact on energy efficiency.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Introduction to Mass Spectrometry<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Making a Geologic Cross Section<br>• Measuring Tropospheric Ozone<br>• Nutrients in Aquatic Ecosystems<br>• Proton Exchange Membrane Fuel Cells<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SEV4.d. | Describe the relationship of energy consumption and the living standards of societies.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Proton Exchange Membrane Fuel Cells |
| ELEMENT | SEV4.e. | Describe the commonly used fuels (e.g. fossil fuels, nuclear fuels, etc.) and some alternative fuels (e.g. wind, solar, ethanol, etc.) including the required technology, availability, pollution problems and implementation problems. Recognize the origin of fossil fuels and the problems associated with our dependence on this energy source. |

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| | | JoVE<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• C. elegans Maintenance<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Fractional Distillation<br>• Passaging Cells<br>• Plasmid Purification<br>• Proton Exchange Membrane Fuel Cells<br>• Raman Spectroscopy for Chemical Analysis<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Yeast Maintenance<br>• Yeast Reproduction |
| ELEMENT | SEV4.f. | Describe the need for informed decision making of resource utilization. (i.e. energy and water usage allocation, conservation, food and land, and long-term depletion)<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Introduction to Mass Spectrometry<br>• Self-report vs. Behavioral Measures of Recycling |
| STRAND/TOPIC | GA.SEV. | Environmental Science |
| STANDARD / DESCRIPTION | SEV5. | Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems. |
| ELEMENT | SEV5.a. | Describe factors affecting population growth of all organisms, including humans. Relate these to factors affecting growth rates and carrying capacity of the environment.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus |

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| | | • An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Basic Mouse Care and Maintenance<br>• C. elegans Maintenance<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Filamentous Fungi<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Passaging Cells<br>• Plasmid Purification<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Yeast Maintenance<br>• Yeast Reproduction |
| ELEMENT | SEV5.b. | Describe the effects of population growth, demographic transitions, cultural differences, emergent diseases, etc. on societal stability.<br><br>JoVE<br>• Nutrients in Aquatic Ecosystems |
| ELEMENT | SEV5.c. | Explain how human activities affect global and local sustainability.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Measuring Tropospheric Ozone<br>• Nutrients in Aquatic Ecosystems<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SEV5.d. | Describe the actual and potential effects of habitat destruction, erosion, and depletion of soil fertility associated with human activities. |

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| | | **JoVE**<br>**• Algae Enumeration via Culturable Methodology**<br>**• Determining the Solubility Rules of Ionic Compounds**<br>**• Dissolved Oxygen in Surface Water**<br>**• Le Châtelier's Principle**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium**<br>**• Turbidity and Total Solids in Surface Water**<br>**• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy**<br>**• Water Quality Analysis via Indicator Organisms** |
| **ELEMENT** | **SEV5.e.** | **Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels (e.g. air and water pollution, solid waste disposal, depletion of the stratospheric ozone, global warming, and land uses).**<br><br>**JoVE**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Introduction to Mass Spectrometry**<br>**• Isolation of Fecal Bacteria from Water Samples by Filtration**<br>**• Lead Analysis of Soil Using Atomic Absorption Spectroscopy**<br>**• Making a Geologic Cross Section**<br>**• Measuring Tropospheric Ozone**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Proton Exchange Membrane Fuel Cells**<br>**• Self-report vs. Behavioral Measures of Recycling**<br>**• Turbidity and Total Solids in Surface Water**<br>**• Water Quality Analysis via Indicator Organisms** |
| **ELEMENT** | **SEV5.f.** | **Describe how political, legal, social, and economic decisions may affect global and local ecosystems.**<br><br>**JoVE**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy**<br>**• Dissolved Oxygen in Surface Water**<br>**• Electrophoretic Mobility Shift Assay (EMSA)**<br>**• Lead Analysis of Soil Using Atomic Absorption Spectroscopy**<br>**• Measuring Tropospheric Ozone**<br>**• Nutrients in Aquatic Ecosystems**<br>**• Proton Exchange Membrane Fuel Cells**<br>**• Tree Identification: How To Use a Dichotomous Key**<br>**• Tree Survey: Point-Centered Quarter Sampling Method** |

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| | | • Turbidity and Total Solids in Surface Water<br>• Using GIS to Investigate Urban Forestry<br>• Water Quality Analysis via Indicator Organisms |
| **STRAND/TOPIC** | **GA.SFS.** | **Forensic Science** |
| **STANDARD / DESCRIPTION** | **SFS1.** | **Students will recognize and classify various types of evidence in relation to the definition and scope of Forensic Science.** |
| ELEMENT | SFS1.a. | Compare and contrast the history of scientific forensic techniques used in collecting and submitting evidence for admissibility in court (e.g. Locard's Exchange Principle, Frye standard, Daubert ruling).<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SFS1.b. | Distinguish and categorize physical and trace evidence (e.g. ballistics, drugs, fibers, fingerprints, glass, hair, metal, lip prints, soil, and toxins).<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SFS1.c. | Determine the proper techniques to search, isolate, collect, and record physical and trace evidence.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SFS1.d. | Evaluate the relevance of possible evidence at the site of an investigation.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SFS1.e. | Organize relevant information to accurately develop and submit both scene and analysis reports.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry |

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| | | • PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| **STRAND/TOPIC** | **GA.SFS.** | **Forensic Science** |
| **STANDARD / DESCRIPTION** | **SFS2.** | **Students will use various scientific techniques to analyze physical and trace evidence.** |
| ELEMENT | SFS2.b. | Analyze the morphology and types of hair, fibers, soil and glass.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SFS2.e. | Determine the appropriate uses of chromatography and spectroscopy in evidence analysis.<br><br>JoVE<br>• PCR: The Polymerase Chain Reaction<br>• X-ray Fluorescence (XRF) |
| **STRAND/TOPIC** | **GA.SFS.** | **Forensic Science** |
| **STANDARD / DESCRIPTION** | **SFS3.** | **Students will analyze the use of toxicology, serology, and DNA technology in forensic investigations.** |
| ELEMENT | SFS3.a. | Classify toxins and their effects on the body.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry |
| ELEMENT | SFS3.b. | Compare the effects of alcohol on blood alcohol levels with regard to gender, and according to the law.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry |
| ELEMENT | SFS3.c. | Evaluate forensic techniques used to isolate toxins in the body.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Introduction to Mass Spectrometry |
| ELEMENT | SFS3.f. | Compare short tandem repeat patterns (STR) and relate to identifying the DNA of an individual.<br><br>JoVE<br>• PCR: The Polymerase Chain Reaction |
| ELEMENT | SFS3.g. | Explain the use of the DNA database for DNA profiling.<br><br>JoVE<br>• PCR: The Polymerase Chain Reaction |

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| **STRAND/TOPIC** | **GA.SFS.** | **Forensic Science** |
| **STANDARD / DESCRIPTION** | **SFS5.** | **Students will evaluate the role of Forensics as it pertains to Medicolegal Death Investigation.** |
| **ELEMENT** | **SFS5.a.** | **Identify various causes of death (blunt force trauma, heart attack, bleeding, etc.).**<br><br>**JoVE**<br>**• Determining the Empirical Formula**<br>**• Introduction to Mass Spectrometry**<br>**• PCR: The Polymerase Chain Reaction** |
| **ELEMENT** | **SFS5.b.** | **Analyze evidence that pertains to the manner of death (natural, homicide, suicide, accidental, or undetermined).**<br><br>**JoVE**<br>**• Determining the Empirical Formula**<br>**• Introduction to Mass Spectrometry**<br>**• PCR: The Polymerase Chain Reaction** |
| **STRAND/TOPIC** | **GA.SG.** | **Geology** |
| **STANDARD / DESCRIPTION** | **SG1.** | **Students will interpret the geologic history of the Earth.** |
| **ELEMENT** | **SG1.a.** | **Describe the formation and evolution of the Earth including the lithosphere, hydrosphere, and atmosphere as driven by internal/external energy sources (i.e. solar, radioactive, gravitational).**<br><br>**JoVE**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Igneous Intrusive Rock**<br>**• Making a Geologic Cross Section**<br>**• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry** |
| **ELEMENT** | **SG1.b.** | **Use fossils, radiometric dating and stratigraphic relationships and geologic maps (e.g. cross cutting, superposition, uniformitarianism) to interpret Earth's history.**<br><br>**JoVE**<br>**• Making a Geologic Cross Section** |
| **STRAND/TOPIC** | **GA.SG.** | **Geology** |
| **STANDARD / DESCRIPTION** | **SG2.** | **Students will interpret the geologic conditions and processes that form different rocks and minerals.** |
| **ELEMENT** | **SG2.a.** | **Describe how minerals form under diverse geological conditions.** |

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| | | JoVE<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Purification of a Total Lipid Extract with Column Chromatography |
| ELEMENT | SG2.b. | Distinguish between the processes that form plutonic (intrusive) and volcanic (extrusive) igneous rocks of differing compositions, including magmatic differentiation.<br><br>JoVE<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock |
| STRAND/TOPIC | GA.SG. | Geology |
| STANDARD / DESCRIPTION | SG3. | Students will investigate the evidence for plate tectonics; evaluate the importance of Earth's internal processes and assess the relationship between plate tectonic boundary type and certain disasters such as earthquakes and volcanic eruptions. |
| ELEMENT | SG3.a. | Analyze the mechanisms that drive plate motion, the different types of plate boundaries, and how boundary type relates to mountain building, earthquakes, volcanism, and features such as island arcs, hot spots, and mid ocean ridges.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SG3.c. | Analyze cross-sectional diagrams to differentiate between types of folds and faults and the landforms they produce.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SG3.d. | Classify volcanoes, using their interior/exterior features, magma composition and their plate tectonic settings and assess current volcanic hazards in the United States.<br><br>JoVE |

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| | | • Igneous Intrusive Rock<br>• Igneous Volcanic Rock |
| ELEMENT | SG3.e. | Research current technology that improves our ability to predict natural disasters and mitigate their effects.<br><br>JoVE<br>• Igneous Volcanic Rock |
| STRAND/TOPIC | GA.SG. | Geology |
| STANDARD / DESCRIPTION | SG4. | Students will evaluate how climate systems affect landforms on the surface of the Earth. |
| ELEMENT | SG4.c. | Distinguish specific landforms and geologic features on topographic maps.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SG4.e. | Investigate the characteristics, geologic processes, and human impacts associated with surface and groundwater as a natural resource in Georgia.<br><br>JoVE<br>• Dissolved Oxygen in Surface Water<br>• Introduction to Mass Spectrometry<br>• Making a Geologic Cross Section<br>• Nutrients in Aquatic Ecosystems<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SG4.f. | Discuss how changes in greenhouse gases have affected Earth's climate history.<br><br>JoVE<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Measuring Tropospheric Ozone |
| STRAND/TOPIC | GA.SG. | Geology |
| STANDARD / DESCRIPTION | SG5. | Students will apply geologic knowledge to the use of resources in the Earth and the control of human impacts on Earth's systems. |
| ELEMENT | SG5.b. | Compare and contrast the types and origins of gemstones and their occurrence in Georgia.<br><br>JoVE<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis |

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| | | • Purification of a Total Lipid Extract with Column Chromatography |
| ELEMENT | SG5.c. | Research current controversies regarding the extraction and use of geologic resources (e.g. causes of global warming, drilling for oil, safety and environmental impact of mining).<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Fractional Distillation<br>• Proton Exchange Membrane Fuel Cells |
| ELEMENT | SG5.d. | Compare and contrast the impacts of using energy resources obtained from the Earth, with those of energy alternatives.<br><br>JoVE<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Fractional Distillation<br>• Proton Exchange Membrane Fuel Cells<br>• Raman Spectroscopy for Chemical Analysis |
| STRAND/TOPIC | GA.SAP. | Human Anatomy and Physiology |
| STANDARD / DESCRIPTION | SAP1. | Students will analyze anatomical structures in relationship to their physiological functions. |
| ELEMENT | SAP1.a. | Apply correct terminology when explaining the orientation of body parts and regions.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Anxiety Testing |

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| | | • Arterial Line Placement<br>• Assessing Dexterity with Reaching Tasks<br>• Auscultation<br>• Balance and Coordination Testing<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation<br>• Blood Pressure Measurement<br>• Cardiac Exam I: Inspection and Palpation<br>• Cardiac Exam II: Auscultation<br>• Cardiac Exam III: Abnormal Heart Sounds<br>• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance<br>• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance<br>• Central Venous Catheter Insertion: Subclavian Vein<br>• Color Afterimages<br>• Comprehensive Breast Exam<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Event-related Potentials and the Oddball Task<br>• Executive Function in Autism Spectrum Disorder<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• Fear Conditioning<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• General Approach to the Physical Exam<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Inattentional Blindness<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Learning and Memory: The Remember-Know Task<br>• Lower Back Exam<br>• Lymph Node Exam<br>• Male Rectal Exam |

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| | | • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Vital Signs<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Maps<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Neuronal Transfection Methods<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Object Substitution Masking<br>• Observation and Inspection<br>• Ophthalmoscopic Examination<br>• Palpation<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Neuropsychology<br>• Perspectives on Sensation and Perception<br>• Physiological Correlates of Emotion Recognition<br>• Primary Neuronal Cultures<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Self-administration Studies<br>• Sensory Exam<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Surgical Cricothyrotomy<br>• The Ames Room<br>• The Attentional Blink<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Morris Water Maze<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• Thyroid Exam |

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| | | • Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SAP1.b. | Investigate the interdependence of the various body systems to each other and to the body as a whole.<br><br>JoVE<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Learning and Memory<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Assessing Dexterity with Reaching Tasks<br>• Balance and Coordination Testing<br>• Calcium Imaging in Neurons<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Elbow Exam<br>• Foot Exam<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Histological Staining of Neural Tissue<br>• Knee Exam<br>• Learning and Memory: The Remember-Know Task<br>• Lower Back Exam<br>• Modeling Social Stress<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Neck Exam<br>• Patch Clamp Electrophysiology<br>• Physiological Correlates of Emotion Recognition<br>• Rodent Stereotaxic Surgery<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• The Split Brain<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SAP1.c. | Explain the role of homeostasis and its mechanisms as these relate to the body as a whole and predict the consequences of the failure to maintain homeostasis.<br><br>JoVE |

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| | | • Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Reward and Addiction<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Arterial Line Placement<br>• Assessing Dexterity with Reaching Tasks<br>• Auscultation<br>• Balance and Coordination Testing<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation<br>• Blood Pressure Measurement<br>• C. elegans Chemotaxis Assay<br>• C. elegans Development and Reproduction<br>• Cardiac Exam I: Inspection and Palpation<br>• Cardiac Exam II: Auscultation<br>• Cardiac Exam III: Abnormal Heart Sounds<br>• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance |

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| | | • Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance<br>• Central Venous Catheter Insertion: Subclavian Vein<br>• Chick ex ovo Culture<br>• Chromatin Immunoprecipitation<br>• Chromatography-Based Biomolecule Purification Methods<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Comprehensive Breast Exam<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cytogenetics<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Detecting Reactive Oxygen Species<br>• Detection of Bacteriophages in Environmental Samples<br>• Dichotic Listening<br>• Ear Exam<br>• Elbow Exam<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• Fear Conditioning<br>• Foot Exam<br>• Gene Silencing with Morpholinos<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Incidental Encoding<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Knee Exam<br>• Learning and Memory: The Remember-Know Task<br>• Lower Back Exam<br>• Lymph Node Exam<br>• Male Rectal Exam |

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| | | • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Modeling Social Stress<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Maps<br>• Mouse Genotyping<br>• Multiple Object Tracking<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Observation and Inspection<br>• Ophthalmoscopic Examination<br>• Palpation<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Physiological Correlates of Emotion Recognition<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Prospect Theory<br>• Protein Crystallization<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• Recombineering and Gene Targeting<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• SNP Genotyping<br>• Self-administration Studies<br>• Sensory Exam<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Spatial Memory Testing Using Mazes<br>• Surgical Cricothyrotomy<br>• The ATP Bioluminescence Assay<br>• The Inverted-face Effect<br>• The Morris Water Maze<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual |

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| | | **Threshold**<br>**• Thyroid Exam**<br>**• Tissue Regeneration with Somatic Stem Cells**<br>**• Using Diffusion Tensor Imaging in Traumatic Brain Injury**<br>**• Using a pH Meter**<br>**• Verbal Priming**<br>**• Visual Search for Features and Conjunctions**<br>**• Whole-Mount In Situ Hybridization**<br>**• fMRI: Functional Magnetic Resonance Imaging** |
| **ELEMENT** | **SAP1.d.** | **Relate cellular metabolism and transport to homeostasis and cellular reproduction.**<br><br>**JoVE**<br>**• An Introduction to Cell Death**<br>**• An Introduction to Cell Division**<br>**• An Introduction to Cell Metabolism**<br>**• An Introduction to Cellular and Molecular Neuroscience**<br>**• An Introduction to Developmental Neurobiology**<br>**• An Introduction to Endocytosis and Exocytosis**<br>**• An Introduction to Molecular Developmental Biology**<br>**• An Introduction to Saccharomyces cerevisiae**<br>**• An Introduction to Stem Cell Biology**<br>**• Annexin V and Propidium Iodide Labeling**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• C. elegans Development and Reproduction**<br>**• Calcium Imaging in Neurons**<br>**• Cell Cycle Analysis**<br>**• Cell-surface Biotinylation Assay**<br>**• Detecting Reactive Oxygen Species**<br>**• Electro-encephalography (EEG)**<br>**• Embryonic Stem Cell Culture and Differentiation**<br>**• Explant Culture of Neural Tissue**<br>**• FM Dyes in Vesicle Recycling**<br>**• Histological Staining of Neural Tissue**<br>**• In ovo Electroporation of Chicken Embryos**<br>**• Induced Pluripotency**<br>**• Isolating Nucleic Acids from Yeast**<br>**• Live Cell Imaging of Mitosis**<br>**• Murine In Utero Electroporation**<br>**• Neuronal Transfection Methods**<br>**• Patch Clamp Electrophysiology**<br>**• Primary Neuronal Cultures**<br>**• Reconstitution of Membrane Proteins**<br>**• The ATP Bioluminescence Assay**<br>**• The TUNEL Assay**<br>**• Tissue Regeneration with Somatic Stem Cells**<br>**• Yeast Maintenance**<br>**• Yeast Reproduction**<br>**• Yeast Transformation and Cloning** |

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| ELEMENT | SAP1.e. | Describe how structure and function are related in terms of cell and tissue types.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Organogenesis<br>• An Introduction to Stem Cell Biology<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• C. elegans Development and Reproduction<br>• Calcium Imaging in Neurons<br>• DNA Methylation Analysis<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Larval IHC<br>• Embryonic Stem Cell Culture and Differentiation<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Expression Profiling with Microarrays<br>• Fate Mapping<br>• Gene Silencing with Morpholinos<br>• Genetic Engineering of Model Organisms<br>• Histological Staining of Neural Tissue<br>• Induced Pluripotency<br>• Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• Patch Clamp Electrophysiology<br>• Primary Neuronal Cultures<br>• RNA-Seq<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Whole-Mount In Situ Hybridization<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Reproduction and Development |
| STRAND/TOPIC | GA.SAP. | Human Anatomy and Physiology |
| STANDARD / DESCRIPTION | SAP2. | Students will analyze the interdependence of the integumentary, skeletal, and muscular systems as these relate to the protection, support and movement of the human body. |
| ELEMENT | SAP2.a. | Relate the structure of the integumentary system to its functional role in protecting the body and maintaining homeostasis.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation |

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| | | • Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• Observation and Inspection<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Sensory Exam<br>• The Rubber Hand Illusion |
| ELEMENT | SAP2.b. | Explain how the skeletal structures provide support and protection for tissues, and function together with the muscular system to make movements possible.<br><br>JoVE<br>• An Introduction to Motor Control<br>• Ankle Exam<br>• Assessing Dexterity with Reaching Tasks<br>• Balance and Coordination Testing<br>• Elbow Exam<br>• Foot Exam<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Knee Exam<br>• Lower Back Exam<br>• Motor Exam I<br>• Motor Exam II<br>• Neck Exam<br>• Shoulder Exam I<br>• Shoulder Exam II |
| STRAND/TOPIC | GA.SAP. | Human Anatomy and Physiology |
| STANDARD / DESCRIPTION | SAP3. | Students will assess the integration and coordination of body functions and their dependence on the endocrine and nervous systems to regulate physiological activities. |
| ELEMENT | SAP3.a. | Interpret interactions among hormones, senses, and nerves which make possible the coordination of functions of the body.<br><br>JoVE<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology |

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| | | • An Introduction to Reward and Addiction<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Assessing Dexterity with Reaching Tasks<br>• Balance and Coordination Testing<br>• Binocular Rivalry<br>• Calcium Imaging in Neurons<br>• Color Afterimages<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Detecting Reactive Oxygen Species<br>• Development and Reproduction of the Laboratory Mouse<br>• Dichotic Listening<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Explant Culture of Neural Tissue<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fear Conditioning<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Histological Staining of Neural Tissue<br>• Inattentional Blindness<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Learning and Memory: The Remember-Know Task<br>• Lower Back Exam<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II |

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| | | • Motor Maps<br>• Murine In Utero Electroporation<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neck Exam<br>• Neuronal Transfection Methods<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Object Substitution Masking<br>• Ophthalmoscopic Examination<br>• Patch Clamp Electrophysiology<br>• Perspectives on Sensation and Perception<br>• Physiological Correlates of Emotion Recognition<br>• Primary Neuronal Cultures<br>• Rodent Stereotaxic Surgery<br>• Self-administration Studies<br>• Sensory Exam<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• The Ames Room<br>• The Attentional Blink<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Within-subjects Repeated-measures Design<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SAP3.b. | Investigate the physiology of electrochemical impulses and neural integration and trace the pathway of an impulse, relating biochemical changes involved in the conduction of the impulse.<br><br>JoVE<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition |

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| | | • An Introduction to Developmental Neurobiology<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Balance and Coordination Testing<br>• Calcium Imaging in Neurons<br>• Color Afterimages<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Detecting Reactive Oxygen Species<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Event-related Potentials and the Oddball Task<br>• Explant Culture of Neural Tissue<br>• Eye Exam<br>• FM Dyes in Vesicle Recycling<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Histological Staining of Neural Tissue<br>• Inattentional Blindness<br>• Invasion Assay Using 3D Matrices<br>• Just-noticeable Differences<br>• Knee Exam<br>• Lower Back Exam<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Murine In Utero Electroporation<br>• Neck Exam<br>• Neuronal Transfection Methods<br>• Object Substitution Masking<br>• Ophthalmoscopic Examination<br>• Patch Clamp Electrophysiology<br>• Physiological Correlates of Emotion Recognition<br>• Primary Neuronal Cultures<br>• Rodent Stereotaxic Surgery<br>• Self-administration Studies<br>• Sensory Exam |

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| | | • Shoulder Exam I<br>• Shoulder Exam II<br>• Spatial Cueing<br>• The Ames Room<br>• The Attentional Blink<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The Transwell Migration Assay<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SAP3.c. | Describe how the body perceives internal and external stimuli and responds to maintain a stable internal environment, as it relates to biofeedback.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• An Introduction to Cognition<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• Ankle Exam<br>• Anxiety Testing<br>• Arterial Line Placement<br>• Assessing Dexterity with Reaching Tasks<br>• Auscultation<br>• Balance and Coordination Testing<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation<br>• Binocular Rivalry<br>• Blood Pressure Measurement<br>• Calcium Imaging in Neurons<br>• Cardiac Exam I: Inspection and Palpation<br>• Cardiac Exam II: Auscultation<br>• Cardiac Exam III: Abnormal Heart Sounds<br>• Central Venous Catheter Insertion: Femoral Vein with |

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| | | **Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Subclavian Vein**<br>**• Color Afterimages**<br>**• Comprehensive Breast Exam**<br>**• Cranial Nerves Exam I (I-VI)**<br>**• Cranial Nerves Exam II (VII-XII)**<br>**• Crowding**<br>**• Decoding Auditory Imagery with Multivoxel Pattern Analysis**<br>**• Dichotic Listening**<br>**• Ear Exam**<br>**• Elbow Exam**<br>**• Emergency Tube Thoracostomy (Chest Tube Placement)**<br>**• Emergent Lateral Canthotomy and Inferior Catholysis**<br>**• Event-related Potentials and the Oddball Task**<br>**• Eye Exam**<br>**• Eye Tracking in Cognitive Experiments**<br>**• Fear Conditioning**<br>**• Finding Your Blind Spot and Perceptual Filling-in**<br>**• Foot Exam**<br>**• General Approach to the Physical Exam**<br>**• Hand and Wrist Exam**<br>**• Hip Exam**<br>**• Inattentional Blindness**<br>**• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation**<br>**• Intraosseous Needle Placement**<br>**• Just-noticeable Differences**<br>**• Knee Exam**<br>**• Lower Back Exam**<br>**• Lymph Node Exam**<br>**• Male Rectal Exam**<br>**• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain**<br>**• Measuring Reaction Time and Donders' Method of Subtraction**<br>**• Measuring Vital Signs**<br>**• Modeling Social Stress**<br>**• Motion-induced Blindness**<br>**• Motor Exam I**<br>**• Motor Exam II**<br>**• Motor Maps**<br>**• Neck Exam**<br>**• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment**<br>**• Nose, Sinuses, Oral Cavity and Pharynx Exam**<br>**• Object Substitution Masking**<br>**• Observation and Inspection** |

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| | | • Ophthalmoscopic Examination<br>• Palpation<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Sensation and Perception<br>• Physiological Correlates of Emotion Recognition<br>• Pilot Testing<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Self-administration Studies<br>• Sensory Exam<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Solutions and Concentrations<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Surgical Cricothyrotomy<br>• The Ames Room<br>• The Attentional Blink<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Rubber Hand Illusion<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• Thyroid Exam<br>• Using a pH Meter<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning |
| **STRAND/TOPIC** | **GA.SAP.** | **Human Anatomy and Physiology** |
| **STANDARD / DESCRIPTION** | **SAP4.** | **Students will analyze the physical, chemical, and biological properties of process systems as these relate to transportation, absorption and excretion, including the cardiovascular, respiratory, digestive, excretory and immune systems.** |
| **ELEMENT** | **SAP4.a.** | **Describe the chemical and physical mechanisms of digestion, elimination, transportation, and absorption within the body to change food and derive energy.** |

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| | | **JoVE**<br>**• Abdominal Exam I: Inspection and Auscultation**<br>**• Abdominal Exam II: Percussion**<br>**• Abdominal Exam III: Palpation**<br>**• Abdominal Exam IV: Acute Abdominal Pain Assessment**<br>**• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation**<br>**• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation**<br>**• Blood Pressure Measurement**<br>**• Cardiac Exam I: Inspection and Palpation**<br>**• Cardiac Exam II: Auscultation**<br>**• Cardiac Exam III: Abnormal Heart Sounds**<br>**• Eye Exam**<br>**• Male Rectal Exam**<br>**• Measuring Vital Signs**<br>**• Ophthalmoscopic Examination**<br>**• Pericardiocentesis**<br>**• Peripheral Vascular Exam**<br>**• Peripheral Vascular Exam Using a Continuous Wave Doppler**<br>**• Physiological Correlates of Emotion Recognition** |
| **ELEMENT** | **SAP4.b.** | **Analyze, and explain the relationships between the respiratory and cardiovascular systems as they obtain oxygen needed for the oxidation of nutrients and removal of carbon dioxide.**<br><br>**JoVE**<br>**• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation**<br>**• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation**<br>**• Blood Pressure Measurement**<br>**• Cardiac Exam I: Inspection and Palpation**<br>**• Cardiac Exam II: Auscultation**<br>**• Cardiac Exam III: Abnormal Heart Sounds**<br>**• Emergency Tube Thoracostomy (Chest Tube Placement)**<br>**• Eye Exam**<br>**• Measuring Vital Signs**<br>**• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment**<br>**• Ophthalmoscopic Examination**<br>**• Percutaneous Cricothyrotomy (Seldinger Technique)**<br>**• Pericardiocentesis**<br>**• Peripheral Vascular Exam**<br>**• Peripheral Vascular Exam Using a Continuous Wave Doppler**<br>**• Physiological Correlates of Emotion Recognition**<br>**• Respiratory Exam I: Inspection and Palpation** |

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| | | • Respiratory Exam II: Percussion and Auscultation<br>• Surgical Cricothyrotomy |
| ELEMENT | SAP4.c. | Relate the role of the urinary system to regulation of body wastes (i.e. water-electrolyte balance, volume of body fluids).<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment |
| ELEMENT | SAP4.d. | Examine various conditions that change normal body functions (e.g. tissue rejection, allergies, injury, diseases and disorders) and how the body responds.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Genetic Analysis<br>• An Overview of Genetics and Disease<br>• Ankle Exam<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Assessing Dexterity with Reaching Tasks<br>• Balance and Coordination Testing<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation<br>• Blood Pressure Measurement<br>• C. elegans Chemotaxis Assay |

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| | | • C. elegans Development and Reproduction<br>• Cardiac Exam I: Inspection and Palpation<br>• Cardiac Exam II: Auscultation<br>• Cardiac Exam III: Abnormal Heart Sounds<br>• Chick ex ovo Culture<br>• Chromatin Immunoprecipitation<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Detecting Reactive Oxygen Species<br>• Detection of Bacteriophages in Environmental Samples<br>• Dichotic Listening<br>• Ear Exam<br>• Elbow Exam<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• Fear Conditioning<br>• Foot Exam<br>• Gene Silencing with Morpholinos<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Hand and Wrist Exam<br>• Hip Exam<br>• Incidental Encoding<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Knee Exam<br>• Learning and Memory: The Remember-Know Task<br>• Lower Back Exam<br>• Lymph Node Exam<br>• Male Rectal Exam<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Verbal Working Memory Span<br>• Modeling Social Stress<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Maps<br>• Mouse Genotyping<br>• Multiple Object Tracking<br>• Neck Exam<br>• Ophthalmoscopic Examination<br>• Pelvic Exam II: Speculum Exam |

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| | | • Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Physiological Correlates of Emotion Recognition<br>• Prospect Theory<br>• Protein Crystallization<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• Recombineering and Gene Targeting<br>• Respiratory Exam I: Inspection and Palpation<br>• Self-administration Studies<br>• Sensory Exam<br>• Shoulder Exam I<br>• Spatial Memory Testing Using Mazes<br>• The ATP Bioluminescence Assay<br>• The Inverted-face Effect<br>• The Morris Water Maze<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Search for Features and Conjunctions<br>• Whole-Mount In Situ Hybridization<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SAP4.e. | Describe the effects of aging on body systems.<br><br>JoVE<br>• Chromatin Immunoprecipitation |
| **STRAND/TOPIC** | **GA.SAP.** | **Human Anatomy and Physiology** |
| **STANDARD / DESCRIPTION** | **SAP5.** | **Students will analyze the role of the reproductive system as it pertains to the growth and development of humans.** |
| ELEMENT | SAP5.a. | Explain how the functions of the reproductive organs are regulated by hormonal interactions.<br><br>JoVE<br>• Comprehensive Breast Exam<br>• Male Rectal Exam<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam |

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| **ELEMENT** | **SAP5.b.** | **Describe the stages of human embryology and gestation including investigation of gestational and congenital disorders (e.g. ectopic pregnancy, miscarriage, cleft palate, hydrocephaly, fetal alcohol syndrome).**<br><br>**JoVE**<br>**• An Introduction to Aging and Regeneration**<br>**• An Introduction to Cell Division**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Endocytosis and Exocytosis**<br>**• An Introduction to Modeling Behavioral Disorders and Stress**<br>**• An Introduction to Motor Control**<br>**• An Introduction to Organogenesis**<br>**• An Introduction to Saccharomyces cerevisiae**<br>**• An Introduction to Stem Cell Biology**<br>**• An Overview of Gene Expression**<br>**• An Overview of Genetic Analysis**<br>**• An Overview of Genetic Engineering**<br>**• An Overview of Genetics and Disease**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Cytogenetics**<br>**• Embryonic Stem Cell Culture and Differentiation**<br>**• Fate Mapping**<br>**• Gene Silencing with Morpholinos**<br>**• Passaging Cells**<br>**• SNP Genotyping**<br>**• Tissue Regeneration with Somatic Stem Cells**<br>**• Transplantation Studies**<br>**• Whole-Mount In Situ Hybridization** |
| **ELEMENT** | **SAP5.c.** | **Describe the stages of development from birth to adulthood (i.e. neonatal period, infancy, childhood, adolescence and puberty, and maturity).**<br><br>**JoVE**<br>**• An Introduction to Aging and Regeneration**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Cognition**<br>**• An Introduction to Learning and Memory**<br>**• An Introduction to Organogenesis**<br>**• An Introduction to Stem Cell Biology**<br>**• Are You Smart or Hardworking? How Praise Influences Children's Motivation**<br>**• Balance and Coordination Testing**<br>**• Categories and Inductive Inferences**<br>**• Children's Reliance on Artist Intentions When Identifying Pictures**<br>**• Cytogenetics**<br>**• Embryonic Stem Cell Culture and Differentiation**<br>**• Executive Function and the Dimensional Change Card** |

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| | | **Sort Task**<br>**• Eye Tracking in Cognitive Experiments**<br>**• Fate Mapping**<br>**• Habituation: Studying Infants Before They Can Talk**<br>**• How Children Solve Problems Using Causal Reasoning**<br>**• Language: The N400 in Semantic Incongruity**<br>**• Measuring Children's Trust in Testimony**<br>**• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories**<br>**• Metacognitive Development: How Children Estimate Their Memory**<br>**• Mutual Exclusivity: How Children Learn the Meanings of Words**<br>**• Numerical Cognition: More or Less**<br>**• Passaging Cells**<br>**• Piaget's Conservation Task and the Influence of Task Demands**<br>**• The Costs and Benefits of Natural Pedagogy**<br>**• The Rouge Test: Searching for a Sense of Self**<br>**• Tissue Regeneration with Somatic Stem Cells**<br>**• Transplantation Studies**<br>**• Using Your Head: Measuring Infants' Rational Imitation of Actions** |

Grade: **9** - Adopted: **2013**

| **STRAND/TOPIC** | **GA.SMS.** | **Materials Chemistry** |
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| **STANDARD / DESCRIPTION** | **SMS1.** | **Students will examine the role of chemistry, physics, and engineering in the field of materials science.** |
| **ELEMENT** | **SMS1.a.** | **Analyze the proper classifications of materials (i.e., polymers, ceramics, metals and alloys, and composites) by identifying the similarities and differences between them.**<br><br>**JoVE**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Coordination Chemistry Complexes**<br>**• Determining the Solubility Rules of Ionic Compounds**<br>**• Introduction to Catalysis**<br>**• Introduction to Mass Spectrometry**<br>**• Le Châtelier's Principle**<br>**• X-ray Fluorescence (XRF)** |
| **ELEMENT** | **SMS1.b.** | **Relate materials science to other areas including physics, biology, chemistry, medicine, engineering, manufacturing, and business.**<br><br>**JoVE**<br>**• Calibration Curves**<br>**• Capillary Electrophoresis (CE)**<br>**• Chromatography-Based Biomolecule Purification Methods** |

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| | | • Co-Immunoprecipitation and Pull-Down Assays<br>• Cyclic Voltammetry (CV)<br>• Density Gradient Ultracentrifugation<br>• Dialysis: Diffusion Based Separation<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Enzyme Assays and Kinetics<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• High-Performance Liquid Chromatography (HPLC)<br>• Internal Standards<br>• Introduction to Mass Spectrometry<br>• Ion-Exchange Chromatography<br>• MALDI-TOF Mass Spectrometry<br>• Metabolic Labeling<br>• Method of Standard Addition<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Photometric Protein Determination<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells<br>• Raman Spectroscopy for Chemical Analysis<br>• Reconstitution of Membrane Proteins<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Surface Plasmon Resonance (SPR)<br>• Tandem Mass Spectrometry<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SMS1.c. | Describe different approaches that can be used to design new materials and their uses.<br><br>JoVE<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Introduction to Catalysis<br>• Le Châtelier's Principle<br>• Schlenk Lines Transfer of Solvents<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| STRAND/TOPIC | GA.SMS. | Materials Chemistry |
| STANDARD / DESCRIPTION | SMS2. | Students will examine the chemistry and composition of metals and alloys and their use in society. |
| ELEMENT | SMS2.a. | Differentiate between metals and alloy types and the effects of impurities on their crystal structure.<br><br>JoVE<br>• Chromatography-Based Biomolecule Purification Methods |

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| | | • Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SMS2.b. | Describe the types of strengthening mechanisms for metals including diffusion, heat treating, superheating, supercooling, and their effects on crystal structure (microstructures)<br><br>JoVE<br>• Chromatography-Based Biomolecule Purification Methods<br>• Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SMS2.c. | Analyze simple phase diagrams to determine what phase(s) is/are present, the composition(s) of the phase(s), and the mass fraction(s) of the phase(s) present.<br><br>JoVE<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| ELEMENT | SMS2.d. | Calculate the composition (in weight percent) for two or more elements in an alloy, determine the atomic percent of each element, the average alloy density, and the average atomic weight for each element in the alloy.<br><br>JoVE<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Introduction to Mass Spectrometry<br>• MALDI-TOF Mass Spectrometry<br>• Tandem Mass Spectrometry |
| ELEMENT | SMS2.e. | Examine how metals are characterized using American Society for Testing and Materials (ASTM) standards and other methods (i.e., microscope, spectra).<br><br>JoVE<br>• Chromatography-Based Biomolecule Purification Methods<br>• Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SMS2.f. | Examine the use of metals and alloys in society, such as high temperature super alloys, and their impact on the environment. |

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| | | JoVE<br>• Chromatography-Based Biomolecule Purification Methods<br>• Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| **STRAND/TOPIC** | **GA.SMS.** | **Materials Chemistry** |
| **STANDARD / DESCRIPTION** | **SMS3.** | **Students will examine the chemistry and composition of polymers and their use in society.** |
| ELEMENT | SMS3.a. | Classify polymers as synthetic or naturally occurring, including DNA, Proteins, Polyvinyl chloride, polyethylene, polystyrene, Polypropylene, and polyethylene terephthalate.<br><br>JoVE<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |
| ELEMENT | SMS3.b. | Describe the properties and nomenclature of the five major structural classes of polymers (i.e., linear, classical cross-linked, branched, dendritic, and megamers).<br><br>JoVE<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |
| ELEMENT | SMS3.c. | Differentiate types of polymerization mechanisms including step-growth (condensation), chain (addition) polymerization, and free radical polymerization.<br><br>JoVE<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |
| ELEMENT | SMS3.d. | Explore how molecular structures of polymers (crystalline, semicrystalline, amorphous) significantly influence their properties, such as elastomeric behavior.<br><br>JoVE<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |
| ELEMENT | SMS3.e. | Interpret stress/strain diagrams and identify common additives that impact properties of polymers including stabilizers, nucleating/clarifying agents, curatives, plasticizers, coloring agents, and flame retard ants.<br><br>JoVE<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |

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| | | • Schlenk Lines Transfer of Solvents<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| ELEMENT | SMS3.f. | Examine how polymers are characterized using American Society for Testing and Materials (ASTM) standards and other methods (i.e., microscope, spectra, diffraction, angle measurements).<br><br>JoVE<br>• Introduction to Catalysis<br>• Le Châtelier's Principle |
| ELEMENT | SMS3.g. | Examine the use of polymers in society, such surgical devices, and their impact on the environment<br><br>JoVE<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Introduction to Catalysis<br>• Schlenk Lines Transfer of Solvents<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |

Grade: **9** - Adopted: **2009**

| STRAND/TOPIC | GA.SM. | Meteorology |
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| STANDARD / DESCRIPTION | SM1. | Students will relate the formation, structure and composition of Earth's atmosphere to the processes that cause weather. |
| ELEMENT | SM1.b. | Examine the chemical composition, location and characteristics of the layers of Earth's present day atmosphere.<br><br>JoVE<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Measuring Tropospheric Ozone |
| STRAND/TOPIC | GA.SM. | Meteorology |
| STANDARD / DESCRIPTION | SM4. | Students will analyze the relationship of weather and society. |
| ELEMENT | SM4.b. | Interpret the relationship between weather and pollution (smog, ground level ozone, acid rain, etc.) and the impact of pollution on the economy, health, and the environment.<br><br>JoVE<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Introduction to Mass Spectrometry<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Making a Geologic Cross Section |

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| | | • Measuring Tropospheric Ozone<br>• Nutrients in Aquatic Ecosystems<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SM4.d. | Compare and contrast the reasons for decreasing stratospheric ozone and its implications to humans.<br><br>JoVE<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Measuring Tropospheric Ozone |
| ELEMENT | SM4.e. | Evaluate political, social, and economic decisions and their relationship to the development and/or reduction of acid rain, smog, and the urban heat island effect.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Measuring Tropospheric Ozone<br>• Proton Exchange Membrane Fuel Cells<br>• Using GIS to Investigate Urban Forestry |
| STRAND/TOPIC | GA.SM. | Meteorology |
| STANDARD / DESCRIPTION | SM5. | Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change. |
| ELEMENT | SM5.b. | Demonstrate knowledge of the reasons for continual climate change.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| ELEMENT | SM5.d. | Analyze current methods of climate prediction. (Predictions of ENSO, NAO, long-range outlooks, etc.)<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| ELEMENT | SM5.e. | Explore radiative equilibrium and demonstrate the differences between the greenhouse effect and global warming.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| ELEMENT | SM5.f. | Judge the current theories explaining global warming and argue the potential implications of global warming on global weather patterns and severe weather events.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| STRAND/TOPIC | GA.SMI. | Microbiology |

| STANDARD / DESCRIPTION | SMI1. | Students will analyze different types of microorganisms and their defining characteristics. |
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| ELEMENT | SMI1.a. | Distinguish between different kinds of microorganisms based on cellular structure, molecular biology and biochemical composition.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Transfection<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI1.b. | Describe how viruses differ from other parasitic microorganisms.<br><br>JoVE<br>• An Introduction to the Laboratory Mouse: Mus musculus |

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| | | • An Overview of Genetic Engineering<br>• C. elegans Development and Reproduction<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Detection of Bacteriophages in Environmental Samples<br>• Genetic Crosses<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting |
| ELEMENT | SMI1.c. | Compare relative sizes of microorganisms, different types of cell shapes, and various methods used to visualize microorganisms.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Transfection<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide |

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| | | Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| **STRAND/TOPIC** | **GA.SMI.** | **Microbiology** |
| **STANDARD / DESCRIPTION** | **SMI2.** | **Students will examine structural components of microbes and their functions.** |
| ELEMENT | SMI2.a. | Investigate structural properties of microbial membranes and functions associated with these membranes.<br><br><u>JoVE</u><br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Transfection<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Invasion Assay Using 3D Matrices<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• The Transwell Migration Assay<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |

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| **ELEMENT** | **SMI2.b.** | **Compare structures of prokaryotic cell envelope (e.g., cell membrane, wall and capsule and S-layers) and virus envelopes and their functions in providing support and protection.**<br><br>**JoVE**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Transfection**<br>**• An Overview of Genetic Engineering**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Bacterial Transformation: Electroporation**<br>**• Bacterial Transformation: The Heat Shock Method**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Detection of Bacteriophages in Environmental Samples**<br>**• Genetic Engineering of Model Organisms**<br>**• Invasion Assay Using 3D Matrices**<br>**• Molecular Cloning**<br>**• Plasmid Purification**<br>**• Recombineering and Gene Targeting**<br>**• The Transwell Migration Assay** |
| **ELEMENT** | **SMI2.c.** | **Examine intracellular organization in microbes and explain how these structures play roles in energy generation, transcription, translation, DNA replication and cellular locomotion.**<br><br>**JoVE**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Transfection**<br>**• An Introduction to the Laboratory Mouse: Mus musculus**<br>**• An Overview of Genetic Engineering**<br>**• Aseptic Technique in Environmental Science**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Bacterial Transformation: Electroporation**<br>**• Bacterial Transformation: The Heat Shock Method**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Co-Immunoprecipitation and Pull-Down Assays**<br>**• Community DNA Extraction from Bacterial Colonies**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Cyclic Voltammetry (CV)**<br>**• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**<br>**• Detection of Bacteriophages in Environmental Samples**<br>**• Determination of Moisture Content in Soil**<br>**• Filamentous Fungi**<br>**• Genetic Crosses** |

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| | | • Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Invasion Assay Using 3D Matrices<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• The Transwell Migration Assay<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| **STRAND/TOPIC** | **GA.SMI.** | **Microbiology** |
| **STANDARD / DESCRIPTION** | **SMI3.** | **Students will examine different ways in which microbial cells generate energy for growth and reproduction.** |
| ELEMENT | SMI3.a. | Explain different types of energy generation used by microbes, including respiration, photosynthesis, and lithotrophy.<br><br><u>JoVE</u><br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |

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| ELEMENT | SMI3.b. | Describe how microorganisms differ with respect to their nutritional requirements for growth.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Transfection<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| STRAND/TOPIC | GA.SMI. | Microbiology |
| STANDARD / DESCRIPTION | SMI4. | Students will investigate molecular mechanisms involved in gene expression in microbes. |
| ELEMENT | SMI4.a. | Investigate molecular basis for transcription, translation, and DNA replication in prokaryotes and eukaryotes.<br><br>JoVE<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Transfection |

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| | | • Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Plasmid Purification<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning |
| ELEMENT | SMI4.b. | Examine how DNA rearrangements occur in bacteria.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Transfection<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Invasion Assay Using 3D Matrices<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• Recombineering and Gene Targeting<br>• The Transwell Migration Assay<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI4.c. | Describe how genetic information is transferred between cells.<br><br>JoVE<br>• Cyclic Voltammetry (CV)<br>• Detection of Bacteriophages in Environmental Samples |

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| ELEMENT | SMI4.d. | Describe how genetic transfer impacts microbial evolution and how it can be utilized in biotechnological applications.<br><br>JoVE<br>• An Introduction to Saccharomyces cerevisiae<br>• An Overview of Gene Expression<br>• An Overview of Genetic Engineering<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• DNA Ligation Reactions<br>• Explant Culture of Neural Tissue<br>• Genetic Engineering of Model Organisms<br>• In ovo Electroporation of Chicken Embryos<br>• Molecular Cloning<br>• Mouse Genotyping<br>• Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• Primary Neuronal Cultures<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Restriction Enzyme Digests<br>• Rodent Stereotaxic Surgery<br>• Testing For Genetically Modified Foods<br>• Yeast Transformation and Cloning |
| STRAND/TOPIC | GA.SMI. | Microbiology |
| STANDARD / DESCRIPTION | SMI5. | Students will compare and contrast parameters affecting microbial growth, ways of controlling growth of microorganisms, and examine the effects that physicochemical factors can have on microbes. |
| ELEMENT | SMI5.a. | Explain different growth phases of microbial in a batch cultures and the factors that influence these phases.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Cyclic Voltammetry (CV)<br>• Detection of Bacteriophages in Environmental Samples<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting |
| ELEMENT | SMI5.b. | Describe environmental factors that influence microbial growth and how these factors vary for different species.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science |

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| | | • Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI5.c. | Compare various physical and chemical methods used to control or prevent microbial growth.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting |
| ELEMENT | SMI5.d. | Explain the various modes of action of specific antibiotics in preventing the growth of microorganisms.<br><br>JoVE<br>• An Introduction to Reward and Addiction<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Cell-surface Biotinylation Assay<br>• Chick ex ovo Culture<br>• Coordination Chemistry Complexes<br>• FM Dyes in Vesicle Recycling |

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| | | • Gram Staining of Bacteria from Environmental Sources<br>• Introducing Experimental Agents into the Mouse<br>• Protein Crystallization<br>• SNP Genotyping<br>• Self-administration Studies |
| ELEMENT | SMI5.e. | Describe how exposure to certain chemicals or radiation increase rates of heritable mutations in microorganisms.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI5.f. | Examine the evolution and spread of antibiotic resistant pathogens.<br><br>JoVE<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Analysis<br>• Aseptic Technique in Environmental Science<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detection of Bacteriophages in Environmental Samples<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by |

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| | | Filtration<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Water Quality Analysis via Indicator Organisms |
| **STRAND/TOPIC** | **GA.SMI.** | **Microbiology** |
| **STANDARD / DESCRIPTION** | **SMI6.** | **Students will analyze the impact of microorganisms in the environment and the use of microbes in biotechnology, agriculture, and industry.** |
| ELEMENT | SMI6.a. | Explain the prevalence and diversity of microbes in various environments (e.g., hot springs, arctic ice, hypersaline environments, alkaline soils, acid mine drainage.)<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI6.b. | Relate biotic and abiotic factors to the development of microbial populations and diversity.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Transfection |

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| | | • An Introduction to the Laboratory Mouse: Mus musculus<br>• An Overview of Genetic Engineering<br>• Aseptic Technique in Environmental Science<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination of Moisture Content in Soil<br>• Filamentous Fungi<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Molecular Cloning<br>• Plasmid Purification<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI6.c. | Describe the importance of microorganisms in global nutrient cycling within both soil, freshwater, and marine habitats.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Analysis of Earthworm Populations in Soil<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• C. elegans Maintenance<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy |

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| | | • Dissolved Oxygen in Surface Water<br>• Filamentous Fungi<br>• Metabolic Labeling<br>• Nutrients in Aquatic Ecosystems<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium |
| ELEMENT | SMI6.d. | Describe applications of microbes in industry, biotechnology and food processing.<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting |
| ELEMENT | SMI6.e. | Relate water and soil quality to microbial contamination and its impact on human populations.<br><br>JoVE<br>• Algae Enumeration via Culturable Methodology<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Community DNA Extraction from Bacterial Colonies<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detection of Bacteriophages in Environmental Samples<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |
| STRAND/TOPIC | GA.SMI. | Microbiology |
| STANDARD / DESCRIPTION | SMI7. | Students will analyze symbiotic and pathogenic relationships in host-microbe interactions. |
| ELEMENT | SMI7.b. | Describe examples of pathogenic microorganisms and how they cause disease in plants and animals.<br><br>JoVE<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• Aseptic Technique in Environmental Science |

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| | | • Basic Care Procedures<br>• Basic Mouse Care and Maintenance<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Detection of Bacteriophages in Environmental Samples<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Protein Crystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• Recombineering and Gene Targeting<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SMI7.c. | Compare mechanisms of how communicable diseases are spread among individuals within a population and how genetic changes in pathogenic microbes (such as influenza virus) result in new outbreaks of disease.<br><br>JoVE<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Genetic Analysis<br>• Basic Care Procedures<br>• Basic Mouse Care and Maintenance<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Detection of Bacteriophages in Environmental Samples<br>• Genetic Crosses<br>• Genetic Screens<br>• Gram Staining of Bacteria from Environmental Sources<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Protein Crystallization<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• Recombineering and Gene Targeting<br>• Respiratory Exam I: Inspection and Palpation<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |

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| ELEMENT | SMI7.d. | Explain animal host defense mechanisms for combating microbial invaders, including both adaptive and innate immune systems.<br><br>JoVE<br>• Basic Care Procedures<br>• Drosophila Larval IHC |
| ELEMENT | SMI7.e. | Describe plant-host defense mechanisms in response to microbial invasion.<br><br>JoVE<br>• Testing For Genetically Modified Foods<br>• Using GIS to Investigate Urban Forestry |
| ELEMENT | SMI7.f. | Describe symbiotic relationships between plants or animals and microorganisms and the importance of these relationships to both partners.<br><br>JoVE<br>• C. elegans Development and Reproduction<br>• Genetic Crosses<br>• Recombineering and Gene Targeting |
| STRAND/TOPIC | GA.SO. | Oceanography |
| STANDARD / DESCRIPTION | SO1. | Students will identify characteristics, physical features, and boundaries of the oceans. |
| ELEMENT | SO1.a. | Trace the development of the theory of plate tectonics.<br><br>JoVE<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Using Topographic Maps to Generate Topographic Profiles |
| ELEMENT | SO1.b. | Explain how the dynamic events at plate boundaries influence oceans and continents.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Making a Geologic Cross Section<br>• Using Topographic Maps to Generate Topographic Profiles |
| STRAND/TOPIC | GA.SO. | Oceanography |
| STANDARD / DESCRIPTION | SO2. | Students will relate how the oceans are integral to all life on earth and how biogeochemical processes in the oceans influence the entire planet. |
| ELEMENT | SO2.b. | Identify the role of the oceans in global biogeochemical cycles. |

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| | | JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Using GIS to Investigate Urban Forestry |
| **STRAND/TOPIC** | **GA.SO.** | **Oceanography** |
| **STANDARD / DESCRIPTION** | **SO3.** | **Students will analyze how weather and climate are influenced by the oceans.** |
| ELEMENT | SO3.d. | Explain relationships between climate change, the greenhouse effect, and the consequences of global warming on the ocean.<br><br>JoVE<br>• Biofuels: Producing Ethanol from Cellulosic Material |
| **STRAND/TOPIC** | **GA.SO.** | **Oceanography** |
| **STANDARD / DESCRIPTION** | **SO5.** | **Students will analyze how the unique attributes of seawater determine the types of marine organisms and the ecology of marine food webs.** |
| ELEMENT | SO5.a. | Compare and contrast the physical and chemical structure of pure water and seawater.<br><br>JoVE<br>• Determination of Moisture Content in Soil<br>• Dissolved Oxygen in Surface Water<br>• Nutrients in Aquatic Ecosystems<br>• Proton Exchange Membrane Fuel Cells<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SO5.b. | Identify adaptations of marine organisms that allow them to live in seawater rather than on land.<br><br>JoVE<br>• An Introduction to the Zebrafish: Danio rerio<br>• Zebrafish Breeding and Embryo Handling |

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| | | • Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| **STRAND/TOPIC** | **GA.SPS.** | **Physical Science** |
| **STANDARD / DESCRIPTION** | **SPS1.** | **Students will investigate our current understanding of the atom.** |
| ELEMENT | SPS1.a. | Examine the structure of the atom in terms of: proton, electron, and neutron locations; atomic mass and atomic number; atoms with different numbers of neutrons (isotopes); explain the relationship of the proton number to the element's identity.<br><br>JoVE<br>• Coordination Chemistry Complexes<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Introduction to Mass Spectrometry<br>• MALDI-TOF Mass Spectrometry<br>• Metabolic Labeling<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Raman Spectroscopy for Chemical Analysis<br>• Tandem Mass Spectrometry<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SPS1.b. | Compare and contrast ionic and covalent bonds in terms of electron position.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determining the Solubility Rules of Ionic Compounds<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy |
| **STRAND/TOPIC** | **GA.SPS.** | **Physical Science** |
| **STANDARD / DESCRIPTION** | **SPS2.** | **Students will explore the nature of matter, its classifications, and the system for naming types of matter.** |

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| ELEMENT | SPS2.a. | Calculate density when given a means to determine a substance's mass and volume.<br><br>JoVE<br>• Determining the Density of a Solid and Liquid<br>• Solid-Liquid Extraction |
| ELEMENT | SPS2.b. | Predict formulas for stable binary ionic compounds based on balance of charges.<br><br>JoVE<br>• Determining the Empirical Formula |
| ELEMENT | SPS2.c. | Use IUPAC nomenclature for transition between chemical names and chemical formulas of: binary ionic compounds (containing representative elements); binary covalent compounds (i.e. carbon dioxide, carbon tetrachloride).<br><br>JoVE<br>• Determining the Empirical Formula |
| ELEMENT | SPS2.d. | Demonstrate the Law of Conservation of Matter in a chemical reaction.<br><br>JoVE<br>• Determining the Empirical Formula |
| ELEMENT | SPS2.e. | Apply the Law of Conservation of Matter by balancing the following types of chemical equations: Synthesis; Decomposition; Single Replacement; Double Replacement.<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Conducting Reactions Below Room Temperature<br>• Coordination Chemistry Complexes<br>• Determining Rate Laws and the Order of Reaction<br>• Determining the Empirical Formula<br>• Determining the Solubility Rules of Ionic Compounds<br>• Introduction to Catalysis<br>• Introduction to Titration<br>• Preparing Anhydrous Reagents and Equipment<br>• Proton Exchange Membrane Fuel Cells<br>• Solutions and Concentrations<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS3. | Students will distinguish the characteristics and components of radioactivity. |

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| ELEMENT | SPS3.c. | Explain the process half-life as related to radioactive decay.<br><br>JoVE<br>• Determining Rate Laws and the Order of Reaction |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS4. | Students will investigate the arrangement of the Periodic Table. |
| ELEMENT | SPS4.a. | Determine the trends of the following: Number of valence electrons; Types of ions formed by representative elements; Location of metals, nonmetals, and metalloids; Phases at room temperature.<br><br>JoVE<br>• Capillary Electrophoresis (CE)<br>• Chromatography-Based Biomolecule Purification Methods<br>• Coordination Chemistry Complexes<br>• Determining the Solubility Rules of Ionic Compounds<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Introduction to Mass Spectrometry<br>• Ion-Exchange Chromatography<br>• MALDI-TOF Mass Spectrometry<br>• Surface Plasmon Resonance (SPR)<br>• Tandem Mass Spectrometry<br>• Two-Dimensional Gel Electrophoresis<br>• X-ray Fluorescence (XRF) |
| ELEMENT | SPS4.b. | Use the Periodic Table to predict the above properties for representative elements.<br><br>JoVE<br>• Surface Plasmon Resonance (SPR) |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS5. | Students will compare and contrast the phases of matter as they relate to atomic and molecular motion. |
| ELEMENT | SPS5.a. | Compare and contrast the atomic/molecular motion of solids, liquids, gases and plasmas.<br><br>JoVE<br>• Fractional Distillation<br>• Ideal Gas Law<br>• The Ideal Gas Law |
| ELEMENT | SPS5.b. | Relate temperature, pressure, and volume of gases to the behavior of gases.<br><br>JoVE<br>• Determining Rate Laws and the Order of Reaction |

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| | | • Ideal Gas Law<br>• The Ideal Gas Law |
| **STRAND/TOPIC** | **GA.SPS.** | **Physical Science** |
| **STANDARD / DESCRIPTION** | **SPS6.** | **Students will investigate the properties of solutions.** |
| ELEMENT | SPS6.a. | Describe solutions in terms of: solute/solvent; conductivity; concentration.<br><br><u>JoVE</u><br>• An Introduction to the Micropipettor<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Column Chromatography<br>• Conducting Reactions Below Room Temperature<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Cyclic Voltammetry (CV)<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Dialysis: Diffusion Based Separation<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Growing Crystals for X-ray Diffraction Analysis<br>• High-Performance Liquid Chromatography (HPLC)<br>• Internal Standards<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Ion-Exchange Chromatography<br>• Le Châtelier's Principle<br>• Making Solutions in the Laboratory<br>• Method of Standard Addition<br>• Performing 1D Thin Layer Chromatography<br>• Photometric Protein Determination<br>• Preparing Anhydrous Reagents and Equipment |

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| | | • Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Rotary Evaporation to Remove Solvent<br>• Sample Preparation for Analytical Preparation<br>• Schlenk Lines Transfer of Solvents<br>• Separation of Mixtures via Precipitation<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Two-Dimensional Gel Electrophoresis<br>• Understanding Concentration and Measuring Volumes<br>• Using a pH Meter |
| ELEMENT | SPS6.b. | Observe factors affecting the rate a solute dissolves in a specific solvent.<br><br>JoVE<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Determining the Solubility Rules of Ionic Compounds<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Sample Preparation for Analytical Preparation<br>• Separation of Mixtures via Precipitation<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment |
| ELEMENT | SPS6.d. | Compare and contrast the components and properties of acids and bases.<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Electrochemical Measurements of Supported Catalysts |

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| | | Using a Potentiostat/Galvanostat<br>• High-Performance Liquid Chromatography (HPLC)<br>• Introduction to Titration<br>• Ion-Exchange Chromatography<br>• Le Châtelier's Principle<br>• Passaging Cells<br>• Two-Dimensional Gel Electrophoresis<br>• Using a pH Meter |
| ELEMENT | SPS6.e. | Determine whether common household substances are acidic, basic, or neutral.<br><br>JoVE<br>• High-Performance Liquid Chromatography (HPLC)<br>• Introduction to Titration<br>• Le Châtelier's Principle<br>• Passaging Cells<br>• Using a pH Meter |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS7. | Students will relate transformations and flow of energy within a system. |
| ELEMENT | SPS7.a. | Identify energy transformations within a system (e.g. lighting of a match).<br><br>JoVE<br>• Conducting Reactions Below Room Temperature<br>• Determining Rate Laws and the Order of Reaction<br>• Le Châtelier's Principle<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | SPS7.c. | Determine the heat capacity of a substance using mass, specific heat, and temperature.<br><br>JoVE<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| ELEMENT | SPS7.d. | Explain the flow of energy in phase changes through the use of a phase diagram.<br><br>JoVE<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS8. | Students will determine relationships among force, mass, and motion. |
| ELEMENT | SPS8.d. | Explain the difference in mass and weight.<br><br>JoVE |

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| | | • Determining the Density of a Solid and Liquid<br>• Measuring Mass in the Laboratory |
| **STRAND/TOPIC** | **GA.SPS.** | **Physical Science** |
| **STANDARD / DESCRIPTION** | **SPS9.** | **Students will investigate the properties of waves.** |
| ELEMENT | SPS9.a. | Recognize that all waves transfer energy.<br><br>JoVE<br>• Raman Spectroscopy for Chemical Analysis |
| ELEMENT | SPS9.b. | Relate frequency and wavelength to the energy of different types of electromagnetic waves and mechanical waves.<br><br>JoVE<br>• Raman Spectroscopy for Chemical Analysis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy |
| ELEMENT | SPS9.c. | Compare and contrast the characteristics of electromagnetic and mechanical (sound) waves.<br><br>JoVE<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Raman Spectroscopy for Chemical Analysis |
| ELEMENT | SPS9.d. | Investigate the phenomena of reflection, refraction, interference, and diffraction.<br><br>JoVE<br>• Abdominal Exam II: Percussion<br>• Auscultation<br>• Color Afterimages<br>• Crowding<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Histological Sample Preparation for Light Microscopy<br>• Inattentional Blindness<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Just-noticeable Differences<br>• Motion-induced Blindness<br>• Object Substitution Masking<br>• Percussion<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Raman Spectroscopy for Chemical Analysis<br>• Spatial Cueing<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Surface Plasmon Resonance (SPR)<br>• The Ames Room<br>• The Attentional Blink<br>• The Inverted-face Effect |

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| ELEMENT | SPS9.e. | Relate the speed of sound to different mediums.<br><br>JoVE<br>• Abdominal Exam II: Percussion<br>• Auscultation<br>• Percussion |
| ELEMENT | SPS9.f. | Explain the Doppler Effect in terms of everyday interactions.<br><br>JoVE<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler |
| STRAND/TOPIC | GA.SPS. | Physical Science |
| STANDARD / DESCRIPTION | SPS10. | Students will investigate the properties of electricity and magnetism. |
| ELEMENT | SPS10.a. | Investigate static electricity in terms of: friction; induction; conduction.<br><br>JoVE<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Testing For Genetically Modified Foods |
| ELEMENT | SPS10.b. | Explain the flow of electrons in terms of: alternating and direct current; the relationship among voltage, resistance and current; simple series and parallel circuits.<br><br>JoVE<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy |
| ELEMENT | SPS10.c. | Investigate applications of magnetism and/or its relationship to the movement of electrical charge as it relates to: electromagnets; simple motors; permanent magnets.<br><br>JoVE<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Introduction to Mass Spectrometry<br>• MALDI-TOF Mass Spectrometry<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Object Substitution Masking<br>• Tandem Mass Spectrometry<br>• fMRI: Functional Magnetic Resonance Imaging |
| STRAND/TOPIC | GA.SP. | Physics |
| STANDARD / DESCRIPTION | SP1. | Students will analyze the relationships between force, mass, gravity, and the motion of objects. |
| ELEMENT | SP1.g. | Measure and calculate centripetal force. |

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| | | JoVE<br>• An Introduction to the Centrifuge |
| ELEMENT | SP1.h. | Determine the conditions required to maintain a body in a state of static equilibrium.<br><br>JoVE<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Dialysis: Diffusion Based Separation<br>• Le Châtelier's Principle<br>• Separation of Mixtures via Precipitation<br>• Spectrophotometric Determination of an Equilibrium Constant |
| STRAND/TOPIC | GA.SP. | Physics |
| STANDARD / DESCRIPTION | SP2. | Students will evaluate the significance of energy in understanding the structure of matter and the universe. |
| ELEMENT | SP2.b. | Explain how the instability of radioactive isotopes results in spontaneous nuclear reactions.<br><br>JoVE<br>• Column Chromatography<br>• Determining Rate Laws and the Order of Reaction |
| STRAND/TOPIC | GA.SP. | Physics |
| STANDARD / DESCRIPTION | SP3. | Students will evaluate the forms and transformations of energy. |
| ELEMENT | SP3.d. | Compare and contrast elastic and inelastic collisions.<br><br>JoVE<br>• Raman Spectroscopy for Chemical Analysis |
| STRAND/TOPIC | GA.SP. | Physics |
| STANDARD / DESCRIPTION | SP4. | Students will analyze the properties and applications of waves. |
| ELEMENT | SP4.a. | Explain the processes that results in the production and energy transfer of electromagnetic waves.<br><br>JoVE<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Raman Spectroscopy for Chemical Analysis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy |
| ELEMENT | SP4.b. | Experimentally determine the behavior of waves in various media in terms of reflection, refraction, and diffraction of waves.<br><br>JoVE<br>• Raman Spectroscopy for Chemical Analysis |
| ELEMENT | SP4.c. | Explain the relationship between the phenomena of interference and the principle of superposition. |

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| | | JoVE<br>• Raman Spectroscopy for Chemical Analysis |
| STRAND/TOPIC | GA.SP. | Physics |
| STANDARD / DESCRIPTION | SP5. | Students will evaluate relationships between electrical and magnetic forces. |
| ELEMENT | SP5.b. | Determine the relationship among potential difference, current, and resistance in a direct current circuit.<br><br>JoVE<br>• Cyclic Voltammetry (CV)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat |
| ELEMENT | SP5.d. | Determine the relationship between moving electric charges and magnetic fields.<br><br>JoVE<br>• Introduction to Mass Spectrometry<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy |
| STRAND/TOPIC | GA.SZ. | Zoology |
| STANDARD / DESCRIPTION | SZ1. | Students will derive the phylogeny of animal taxa (monophyletic clades in a cladogram) using informative characteristics. |
| ELEMENT | SZ1.a. | Construct a classification of representative animal taxa including: Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Rotifera, Mollusca, Arthropoda (Mandibulata, Chelicerata, and Crustacea), Bryozoa, Brachiopoda, Echinodermata, Hemichordata, Urochordata, Cephalochordata, and Vertebrata.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Analysis of Earthworm Populations in Soil<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• C. elegans Chemotaxis Assay<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Chick ex ovo Culture<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC |

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| | | • Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Genetic Screens<br>• In ovo Electroporation of Chicken Embryos<br>• Introducing Experimental Agents into the Mouse<br>• Invertebrate Lifespan Quantification<br>• Mouse Genotyping<br>• RNAi in C. elegans<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| **STRAND/TOPIC** | **GA.SZ.** | **Zoology** |
| **STANDARD / DESCRIPTION** | **SZ2.** | **Students will explain the evolutionary history of animals over the geological history of Earth.** |
| **ELEMENT** | **SZ2.a.** | **Outline the geological history of Earth and discuss the major environmental changes that have occurred over time.**<br><br>**JoVE**<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry |
| **ELEMENT** | **SZ2.b.** | **Explain the concepts evolution, adaptation, natural selection, convergence, and speciation.**<br><br>**JoVE**<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cognition<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Learning and Memory<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Genetic Analysis<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• C. elegans Chemotaxis Assay<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila Maintenance |

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| | | • Fear Conditioning<br>• Positive Reinforcement Studies<br>• Spatial Memory Testing Using Mazes<br>• Yeast Maintenance |
| **STRAND/TOPIC** | **GA.SZ.** | **Zoology** |
| **STANDARD / DESCRIPTION** | **SZ3.** | **Students will compare form and function relationships within animal groups (clades) and across key taxa.** |
| **ELEMENT** | **SZ3.a.** | **Explain the similarities and differences among major body plans (e.g., asymmetry, radial and bilateral symmetry).**<br><br>**JoVE**<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Anesthesia Induction and Maintenance<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• Blood Withdrawal I<br>• Blood Withdrawal II<br>• C. elegans Chemotaxis Assay<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Chick ex ovo Culture<br>• Compound Administration I<br>• Compound Administration II<br>• Compound Administration III<br>• Compound Administration IV<br>• Considerations for Rodent Surgery<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Fundamentals of Breeding and Weaning<br>• Gene Silencing with Morpholinos<br>• Genetic Engineering of Model Organisms<br>• In ovo Electroporation of Chicken Embryos<br>• Introducing Experimental Agents into the Mouse<br>• Invertebrate Lifespan Quantification<br>• Mouse Genotyping |

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| | | • Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• Primary Neuronal Cultures<br>• RNAi in C. elegans<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Sterile Tissue Harvest<br>• The Morris Water Maze<br>• Whole-Mount In Situ Hybridization<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SZ3.b. | Compare and contrast taxa based on morphological and genetic characters.<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Organogenesis<br>• An Introduction to Stem Cell Biology<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Anesthesia Induction and Maintenance<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• Blood Withdrawal I<br>• Blood Withdrawal II<br>• C. elegans Chemotaxis Assay<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Chick ex ovo Culture<br>• Compound Administration I<br>• Compound Administration II<br>• Compound Administration III<br>• Compound Administration IV<br>• Considerations for Rodent Surgery<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Drosophila Development and Reproduction |

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| | | • Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Embryonic Stem Cell Culture and Differentiation<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Fate Mapping<br>• Fundamentals of Breeding and Weaning<br>• Gene Silencing with Morpholinos<br>• Genetic Engineering of Model Organisms<br>• Genome Editing<br>• In ovo Electroporation of Chicken Embryos<br>• Induced Pluripotency<br>• Introducing Experimental Agents into the Mouse<br>• Invertebrate Lifespan Quantification<br>• Mouse Genotyping<br>• Murine In Utero Electroporation<br>• Neuronal Transfection Methods<br>• Primary Neuronal Cultures<br>• RNAi in C. elegans<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Sterile Tissue Harvest<br>• The Morris Water Maze<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Whole-Mount In Situ Hybridization<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| ELEMENT | SZ3.c. | Relate important structural changes to key functional transitions.<br><br>JoVE<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Genetic Analysis<br>• Tree Identification: How To Use a Dichotomous Key |
| ELEMENT | SZ3.d. | Dissect representative taxa and describe their internal anatomy and the function of major organ systems and organs and relate to cell specializations.<br><br>JoVE<br>• Drosophila Larval IHC |
| STRAND/TOPIC | GA.SZ. | Zoology |

| STANDARD / DESCRIPTION | SZ4. | Students will assess how animals interact with their environment including key adaptations found within animal taxa. |
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| ELEMENT | SZ4.a. | Discuss morphological and physiological adaptations relative to ecological roles.<br><br>JoVE<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance<br>• C. elegans Chemotaxis Assay<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila Maintenance |
| ELEMENT | SZ4.b. | Relate animal adaptations, including behaviors, to the ecological roles of animals.<br><br>JoVE<br>• Filamentous Fungi |
| ELEMENT | SZ4.c. | Explain various life cycles found among animals (e.g., polyp and medusa in cnidarians; multiple hosts and stages in the platyhelminthe life cycle; arthropod metamorphosis; egg, tadpole, adult stages in the amphibian life cycle).<br><br>JoVE<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Zebrafish: Danio rerio<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Fundamentals of Breeding and Weaning<br>• Invertebrate Lifespan Quantification<br>• Zebrafish Breeding and Embryo Handling |

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| | | • Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development |
| **STRAND/TOPIC** | **GA.SZ.** | **Zoology** |
| **STANDARD / DESCRIPTION** | **SZ5.** | **Students will evaluate the relationships between humans and other animals.** |
| ELEMENT | SZ5.a. | Describe the effects of human activities such as habitat destruction, over hunting, introduced species, and pollution on animal biodiversity.<br><br>JoVE<br>• Analysis of Earthworm Populations in Soil<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Dissolved Oxygen in Surface Water<br>• Introduction to Mass Spectrometry<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Measuring Tropospheric Ozone<br>• Nutrients in Aquatic Ecosystems<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Water Quality Analysis via Indicator Organisms |
| ELEMENT | SZ5.b. | Explain the importance of species diversity to the biological resources needed by human populations including food, medicine, and natural aesthetics<br><br>JoVE<br>• An Overview of Genetic Engineering<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Dissolved Oxygen in Surface Water<br>• Testing For Genetically Modified Foods<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Using GIS to Investigate Urban Forestry<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy |
| ELEMENT | SZ5.c. | Compare and contrast how humans can preserve animal diversity in captive and natural environments with regard to habitat creation and conservation, research, legislation, animal enrichment, diet, medical, breeding programs and management of genetic diversity at local and global levels.<br><br>JoVE<br>• An Introduction to Drosophila melanogaster<br>• Basic Care Procedures<br>• Basic Chick Care and Maintenance<br>• Basic Mouse Care and Maintenance |

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| | | • C. elegans Maintenance<br>• Chick ex ovo Culture<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Drosophila Maintenance<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Yeast Maintenance<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Reproduction and Development |
| ELEMENT | SZ5.d. | Investigate how moral, legal, societal, political, and economic decisions impact animal diversity with short-term and long-term effects.<br><br>JoVE<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy |

Grade: **9** - Adopted: **2010**

| STRAND/TOPIC | GA.CC.L9-10RST. | Reading Standards for Literacy in Science and Technical Subjects |
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| STANDARD / DESCRIPTION | | Craft and Structure |
| ELEMENT | L9-10RST4. | 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.<br><br>JoVE<br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory |

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| | | • An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Reward and Addiction<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to Transfection<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Micropipettor<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Anesthesia Induction and Maintenance<br>• Ankle Exam<br>• Annexin V and Propidium Iodide Labeling<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Approximate Number Sense Test<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Arterial Line Placement<br>• Aseptic Technique in Environmental Science<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Assessing Dexterity with Reaching Tasks<br>• Auscultation<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Balance and Coordination Testing<br>• Basic Care Procedures<br>• Basic Chick Care and Maintenance<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and |

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| | | **Defibrillation**<br>**• Basic Mouse Care and Maintenance**<br>**• Binocular Rivalry**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Blood Pressure Measurement**<br>**• Blood Withdrawal I**<br>**• Blood Withdrawal II**<br>**• C. elegans Chemotaxis Assay**<br>**• C. elegans Development and Reproduction**<br>**• C. elegans Maintenance**<br>**• Calcium Imaging in Neurons**<br>**• Calibration Curves**<br>**• Capillary Electrophoresis (CE)**<br>**• Carbon and Nitrogen Analysis of Environmental Samples**<br>**• Cardiac Exam I: Inspection and Palpation**<br>**• Cardiac Exam II: Auscultation**<br>**• Cardiac Exam III: Abnormal Heart Sounds**<br>**• Categories and Inductive Inferences**<br>**• Cell Cycle Analysis**<br>**• Cell-surface Biotinylation Assay**<br>**• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Subclavian Vein**<br>**• Chick ex ovo Culture**<br>**• Children's Reliance on Artist Intentions When Identifying Pictures**<br>**• Chromatin Immunoprecipitation**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Co-Immunoprecipitation and Pull-Down Assays**<br>**• Color Afterimages**<br>**• Column Chromatography**<br>**• Common Lab Glassware and Uses**<br>**• Community DNA Extraction from Bacterial Colonies**<br>**• Compound Administration I**<br>**• Compound Administration II**<br>**• Compound Administration III**<br>**• Compound Administration IV**<br>**• Comprehensive Breast Exam**<br>**• Conducting Reactions Below Room Temperature**<br>**• Considerations for Rodent Surgery**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Coordination Chemistry Complexes**<br>**• Cranial Nerves Exam I (I-VI)**<br>**• Cranial Nerves Exam II (VII-XII)**<br>**• Crowding**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Cyclic Voltammetry (CV)** |

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| | | • Cytogenetics<br>• DNA Gel Electrophoresis<br>• DNA Ligation Reactions<br>• DNA Methylation Analysis<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Dialysis: Diffusion Based Separation<br>• Dichotic Listening<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Enzyme Assays and Kinetics<br>• Ethics in Psychology Research<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder |

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| | | • Experimentation using a Confederate<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Expression Profiling with Microarrays<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fate Mapping<br>• Fear Conditioning<br>• Filamentous Fungi<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• Fractional Distillation<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Fundamentals of Breeding and Weaning<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gel Purification<br>• Gene Silencing with Morpholinos<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• Gram Staining of Bacteria from Environmental Sources<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Habituation: Studying Infants Before They Can Talk<br>• Hand and Wrist Exam<br>• High-Performance Liquid Chromatography (HPLC)<br>• Hip Exam<br>• Histological Sample Preparation for Light Microscopy<br>• Histological Staining of Neural Tissue<br>• How Children Solve Problems Using Causal Reasoning<br>• Ideal Gas Law<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• In ovo Electroporation of Chicken Embryos<br>• Inattentional Blindness<br>• Incidental Encoding<br>• Induced Pluripotency<br>• Internal Standards<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Catalysis |

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| | | • Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Mass Spectrometry<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Ion-Exchange Chromatography<br>• Isolating Nucleic Acids from Yeast<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• Live Cell Imaging of Mitosis<br>• Lower Back Exam<br>• Lymph Node Exam<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Making a Geologic Cross Section<br>• Male Rectal Exam<br>• Manipulating an Independent Variable through Embodiment<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Mass in the Laboratory<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Molecular Cloning<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Learning in Mirror Drawing |

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| | | • Motor Maps<br>• Mouse Genotyping<br>• Multiple Object Tracking<br>• Murine In Utero Electroporation<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Neuronal Transfection Methods<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• Observation and Inspection<br>• Observational Research<br>• Ophthalmoscopic Examination<br>• PCR: The Polymerase Chain Reaction<br>• Palpation<br>• Passaging Cells<br>• Patch Clamp Electrophysiology<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Sensation and Perception<br>• Photometric Protein Determination<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Pilot Testing<br>• Placebos in Research<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Preparing Anhydrous Reagents and Equipment<br>• Primary Neuronal Cultures<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Prospect Theory<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells |

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| | | • Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Recombineering and Gene Targeting<br>• Reconstitution of Membrane Proteins<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Reliability in Psychology Experiments<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Restriction Enzyme Digests<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Rodent Stereotaxic Surgery<br>• Rotary Evaporation to Remove Solvent<br>• SNP Genotyping<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Self-administration Studies<br>• Self-report vs. Behavioral Measures of Recycling<br>• Sensory Exam<br>• Separating Protein with SDS-PAGE<br>• Separation of Mixtures via Precipitation<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Sterile Tissue Harvest<br>• Surface Plasmon Resonance (SPR)<br>• Surgical Cricothyrotomy<br>• Tandem Mass Spectrometry |

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| | | • Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The Ames Room<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Factorial Experiment<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Morris Water Maze<br>• The Multi-group Experiment<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Rubber Hand Illusion<br>• The Simple Experiment: Two-group Design<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms |

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| | | • Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| ELEMENT | L9-10RST5. | Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br><br><u>JoVE</u><br>• Abdominal Exam I: Inspection and Auscultation<br>• Abdominal Exam II: Percussion<br>• Abdominal Exam III: Palpation<br>• Abdominal Exam IV: Acute Abdominal Pain Assessment<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Death<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cell Motility and Migration<br>• An Introduction to Cellular and Molecular Neuroscience<br>• An Introduction to Cognition<br>• An Introduction to Developmental Genetics<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Molecular Developmental Biology<br>• An Introduction to Motor Control<br>• An Introduction to Neuroanatomy<br>• An Introduction to Neurophysiology<br>• An Introduction to Organogenesis<br>• An Introduction to Reward and Addiction<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to Transfection<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus |

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| | | **musculus**<br>**• An Introduction to the Micropipettor**<br>**• An Introduction to the Zebrafish: Danio rerio**<br>**• An Overview of Alkenone Biomarker Analysis for Paleothermometry**<br>**• An Overview of Epigenetics**<br>**• An Overview of Gene Expression**<br>**• An Overview of Genetic Analysis**<br>**• An Overview of Genetic Engineering**<br>**• An Overview of Genetics and Disease**<br>**• An Overview of bGDGT Biomarker Analysis for Paleoclimatology**<br>**• Analysis of Earthworm Populations in Soil**<br>**• Anesthesia Induction and Maintenance**<br>**• Ankle Exam**<br>**• Annexin V and Propidium Iodide Labeling**<br>**• Anterograde Amnesia**<br>**• Anxiety Testing**<br>**• Approximate Number Sense Test**<br>**• Are You Smart or Hardworking? How Praise Influences Children's Motivation**<br>**• Arterial Line Placement**<br>**• Aseptic Technique in Environmental Science**<br>**• Assembly of a Reflux System for Heated Chemical Reactions**<br>**• Assessing Dexterity with Reaching Tasks**<br>**• Auscultation**<br>**• Bacterial Growth Curve Analysis and its Environmental Applications**<br>**• Bacterial Transformation: Electroporation**<br>**• Bacterial Transformation: The Heat Shock Method**<br>**• Balance and Coordination Testing**<br>**• Basic Care Procedures**<br>**• Basic Chick Care and Maintenance**<br>**• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation**<br>**• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation**<br>**• Basic Mouse Care and Maintenance**<br>**• Binocular Rivalry**<br>**• Biofuels: Producing Ethanol from Cellulosic Material**<br>**• Blood Pressure Measurement**<br>**• Blood Withdrawal I**<br>**• Blood Withdrawal II**<br>**• C. elegans Chemotaxis Assay**<br>**• C. elegans Development and Reproduction**<br>**• C. elegans Maintenance**<br>**• Calcium Imaging in Neurons**<br>**• Calibration Curves**<br>**• Capillary Electrophoresis (CE)**<br>**• Carbon and Nitrogen Analysis of Environmental** |

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| | | **Samples**<br>**• Cardiac Exam I: Inspection and Palpation**<br>**• Cardiac Exam II: Auscultation**<br>**• Cardiac Exam III: Abnormal Heart Sounds**<br>**• Categories and Inductive Inferences**<br>**• Cell Cycle Analysis**<br>**• Cell-surface Biotinylation Assay**<br>**• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance**<br>**• Central Venous Catheter Insertion: Subclavian Vein**<br>**• Chick ex ovo Culture**<br>**• Children's Reliance on Artist Intentions When Identifying Pictures**<br>**• Chromatin Immunoprecipitation**<br>**• Chromatography-Based Biomolecule Purification Methods**<br>**• Co-Immunoprecipitation and Pull-Down Assays**<br>**• Color Afterimages**<br>**• Column Chromatography**<br>**• Common Lab Glassware and Uses**<br>**• Community DNA Extraction from Bacterial Colonies**<br>**• Compound Administration I**<br>**• Compound Administration II**<br>**• Compound Administration III**<br>**• Compound Administration IV**<br>**• Comprehensive Breast Exam**<br>**• Conducting Reactions Below Room Temperature**<br>**• Considerations for Rodent Surgery**<br>**• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry**<br>**• Coordination Chemistry Complexes**<br>**• Cranial Nerves Exam I (I-VI)**<br>**• Cranial Nerves Exam II (VII-XII)**<br>**• Crowding**<br>**• Culturing and Enumerating Bacteria from Soil Samples**<br>**• Cyclic Voltammetry (CV)**<br>**• Cytogenetics**<br>**• DNA Gel Electrophoresis**<br>**• DNA Ligation Reactions**<br>**• DNA Methylation Analysis**<br>**• Decision-making and the Iowa Gambling Task**<br>**• Decoding Auditory Imagery with Multivoxel Pattern Analysis**<br>**• Degassing Liquids with Freeze-Pump-Thaw Cycling**<br>**• Density Gradient Ultracentrifugation**<br>**• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis**<br>**• Detecting Reactive Oxygen Species**<br>**• Detection of Bacteriophages in Environmental Samples** |

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| | | • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Dialysis: Diffusion Based Separation<br>• Dichotic Listening<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Enzyme Assays and Kinetics<br>• Ethics in Psychology Research<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Experimentation using a Confederate<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue<br>• Expression Profiling with Microarrays<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fate Mapping<br>• Fear Conditioning<br>• Filamentous Fungi |

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| | | • Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• Fractional Distillation<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Fundamentals of Breeding and Weaning<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gel Purification<br>• Gene Silencing with Morpholinos<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• Gram Staining of Bacteria from Environmental Sources<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Habituation: Studying Infants Before They Can Talk<br>• Hand and Wrist Exam<br>• High-Performance Liquid Chromatography (HPLC)<br>• Hip Exam<br>• Histological Sample Preparation for Light Microscopy<br>• Histological Staining of Neural Tissue<br>• How Children Solve Problems Using Causal Reasoning<br>• Ideal Gas Law<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• In ovo Electroporation of Chicken Embryos<br>• Inattentional Blindness<br>• Incidental Encoding<br>• Induced Pluripotency<br>• Internal Standards<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Catalysis<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy<br>• Introduction to Mass Spectrometry<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Ion-Exchange Chromatography |

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| | | • Isolating Nucleic Acids from Yeast<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• Live Cell Imaging of Mitosis<br>• Lower Back Exam<br>• Lymph Node Exam<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Making a Geologic Cross Section<br>• Male Rectal Exam<br>• Manipulating an Independent Variable through Embodiment<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Mass in the Laboratory<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Molecular Cloning<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Mouse Genotyping<br>• Multiple Object Tracking<br>• Murine In Utero Electroporation<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Neuronal Transfection Methods |

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| | | • Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• Observation and Inspection<br>• Observational Research<br>• Ophthalmoscopic Examination<br>• PCR: The Polymerase Chain Reaction<br>• Palpation<br>• Passaging Cells<br>• Patch Clamp Electrophysiology<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Sensation and Perception<br>• Photometric Protein Determination<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Pilot Testing<br>• Placebos in Research<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Preparing Anhydrous Reagents and Equipment<br>• Primary Neuronal Cultures<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Prospect Theory<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis |

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| | | • Realism in Experimentation<br>• Recombineering and Gene Targeting<br>• Reconstitution of Membrane Proteins<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Reliability in Psychology Experiments<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Restriction Enzyme Digests<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Rodent Stereotaxic Surgery<br>• Rotary Evaporation to Remove Solvent<br>• SNP Genotyping<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Self-administration Studies<br>• Self-report vs. Behavioral Measures of Recycling<br>• Sensory Exam<br>• Separating Protein with SDS-PAGE<br>• Separation of Mixtures via Precipitation<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Sterile Tissue Harvest<br>• Surface Plasmon Resonance (SPR)<br>• Surgical Cricothyrotomy<br>• Tandem Mass Spectrometry<br>• Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The Ames Room<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Factorial Experiment<br>• The Ideal Gas Law |

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| | | • The Inverted-face Effect<br>• The McGurk Effect<br>• The Morris Water Maze<br>• The Multi-group Experiment<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Rubber Hand Illusion<br>• The Simple Experiment: Two-group Design<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling |

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| | | • Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| **STRAND/TOPIC** | **GA.CC.L9-10RST.** | **Reading Standards for Literacy in Science and Technical Subjects** |
| **STANDARD / DESCRIPTION** | | **Integration of Knowledge and Ideas** |
| **ELEMENT** | **L9-10RST7.** | **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.**<br><br>**JoVE**<br>• Algae Enumeration via Culturable Methodology<br>• An Introduction to Aging and Regeneration<br>• An Introduction to Behavioral Neuroscience<br>• An Introduction to Caenorhabditis elegans<br>• An Introduction to Cell Division<br>• An Introduction to Cell Metabolism<br>• An Introduction to Cognition<br>• An Introduction to Developmental Neurobiology<br>• An Introduction to Drosophila melanogaster<br>• An Introduction to Endocytosis and Exocytosis<br>• An Introduction to Learning and Memory<br>• An Introduction to Modeling Behavioral Disorders and Stress<br>• An Introduction to Motor Control<br>• An Introduction to Neurophysiology<br>• An Introduction to Reward and Addiction<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of Genetic Analysis<br>• An Overview of Genetics and Disease<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Annexin V and Propidium Iodide Labeling<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Approximate Number Sense Test<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Assessing Dexterity with Reaching Tasks<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Balance and Coordination Testing<br>• Basic Mouse Care and Maintenance<br>• Binocular Rivalry |

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| | | • Biofuels: Producing Ethanol from Cellulosic Material<br>• Blood Pressure Measurement<br>• C. elegans Chemotaxis Assay<br>• Calcium Imaging in Neurons<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Categories and Inductive Inferences<br>• Cell Cycle Analysis<br>• Cell-surface Biotinylation Assay<br>• Children's Reliance on Artist Intentions When Identifying Pictures<br>• Chromatin Immunoprecipitation<br>• Chromatography-Based Biomolecule Purification Methods<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Column Chromatography<br>• Community DNA Extraction from Bacterial Colonies<br>• Conducting Reactions Below Room Temperature<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Coordination Chemistry Complexes<br>• Crowding<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• DNA Methylation Analysis<br>• Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Development and Reproduction of the Laboratory Mouse<br>• Dialysis: Diffusion Based Separation<br>• Dichotic Listening<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Development and Reproduction |

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| | | • Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Enzyme Assays and Kinetics<br>• Ethics in Psychology Research<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Experimentation using a Confederate<br>• Expression Profiling with Microarrays<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fate Mapping<br>• Fear Conditioning<br>• Fractional Distillation<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gene Silencing with Morpholinos<br>• Genetic Crosses<br>• Genetic Screens<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Habituation: Studying Infants Before They Can Talk<br>• High-Performance Liquid Chromatography (HPLC)<br>• How Children Solve Problems Using Causal Reasoning<br>• Ideal Gas Law<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• Inattentional Blindness<br>• Incidental Encoding<br>• Internal Standards<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Catalysis<br>• Introduction to Mass Spectrometry<br>• Introduction to Titration<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Ion-Exchange Chromatography<br>• Isolating Nucleic Acids from Yeast<br>• Just-noticeable Differences<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle |

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| | | • Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Making a Geologic Cross Section<br>• Manipulating an Independent Variable through Embodiment<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Motion-induced Blindness<br>• Motor Learning in Mirror Drawing<br>• Motor Maps<br>• Multiple Object Tracking<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• Observational Research<br>• PCR: The Polymerase Chain Reaction<br>• Patch Clamp Electrophysiology<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Perspectives on Cognitive Psychology<br>• Perspectives on Neuropsychology<br>• Photometric Protein Determination<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Pilot Testing<br>• Placebos in Research |

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| | | • Plasmid Purification<br>• Positive Reinforcement Studies<br>• Preparing Anhydrous Reagents and Equipment<br>• Prospect Theory<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells<br>• Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Reconstitution of Membrane Proteins<br>• Reliability in Psychology Experiments<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Rotary Evaporation to Remove Solvent<br>• SNP Genotyping<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Self-administration Studies<br>• Self-report vs. Behavioral Measures of Recycling<br>• Separation of Mixtures via Precipitation<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Surface Plasmon Resonance (SPR)<br>• Tandem Mass Spectrometry<br>• Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Factorial Experiment<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The Morris Water Maze<br>• The Multi-group Experiment<br>• The Precision of Visual Working Memory with Delayed |

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| | | Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Simple Experiment: Two-group Design<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• fMRI: Functional Magnetic Resonance Imaging |
| **STRAND/TOPIC** | **GA.CC.W9-10HST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **STANDARD / DESCRIPTION** | | **Text Types and Purposes** |
| **ELEMENT** | **W9-10HST1.** | **Write arguments focused on discipline-specific content.** |
| **ELEMENT/GLE** | **W9-10HST1.a.** | **Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.**<br><br>**JoVE** |

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| | | • The Multi-group Experiment<br>• The Simple Experiment: Two-group Design |
| **STRAND/TOPIC** | **GA.CC.W9-10HST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **STANDARD / DESCRIPTION** | | **Text Types and Purposes** |
| **ELEMENT** | **W9-10HST2.** | **Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.** |
| **ELEMENT/GLE** | **W9-10HST2.a.** | **Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.**<br><br>**JoVE**<br>**• The Multi-group Experiment**<br>**• The Simple Experiment: Two-group Design** |
| **ELEMENT/GLE** | **W9-10HST2.d.** | **Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.**<br><br>**JoVE**<br>**• Abdominal Exam I: Inspection and Auscultation**<br>**• Abdominal Exam II: Percussion**<br>**• Abdominal Exam III: Palpation**<br>**• Abdominal Exam IV: Acute Abdominal Pain Assessment**<br>**• Algae Enumeration via Culturable Methodology**<br>**• An Introduction to Aging and Regeneration**<br>**• An Introduction to Behavioral Neuroscience**<br>**• An Introduction to Caenorhabditis elegans**<br>**• An Introduction to Cell Death**<br>**• An Introduction to Cell Division**<br>**• An Introduction to Cell Metabolism**<br>**• An Introduction to Cell Motility and Migration**<br>**• An Introduction to Cellular and Molecular Neuroscience**<br>**• An Introduction to Cognition**<br>**• An Introduction to Developmental Genetics**<br>**• An Introduction to Developmental Neurobiology**<br>**• An Introduction to Drosophila melanogaster**<br>**• An Introduction to Endocytosis and Exocytosis**<br>**• An Introduction to Learning and Memory**<br>**• An Introduction to Modeling Behavioral Disorders and Stress**<br>**• An Introduction to Molecular Developmental Biology**<br>**• An Introduction to Motor Control**<br>**• An Introduction to Neuroanatomy**<br>**• An Introduction to Neurophysiology** |

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| | | • An Introduction to Organogenesis<br>• An Introduction to Reward and Addiction<br>• An Introduction to Saccharomyces cerevisiae<br>• An Introduction to Stem Cell Biology<br>• An Introduction to Transfection<br>• An Introduction to Working in the Hood<br>• An Introduction to the Centrifuge<br>• An Introduction to the Chick: Gallus gallus domesticus<br>• An Introduction to the Laboratory Mouse: Mus musculus<br>• An Introduction to the Micropipettor<br>• An Introduction to the Zebrafish: Danio rerio<br>• An Overview of Alkenone Biomarker Analysis for Paleothermometry<br>• An Overview of Epigenetics<br>• An Overview of Gene Expression<br>• An Overview of Genetic Analysis<br>• An Overview of Genetic Engineering<br>• An Overview of Genetics and Disease<br>• An Overview of bGDGT Biomarker Analysis for Paleoclimatology<br>• Analysis of Earthworm Populations in Soil<br>• Anesthesia Induction and Maintenance<br>• Ankle Exam<br>• Annexin V and Propidium Iodide Labeling<br>• Anterograde Amnesia<br>• Anxiety Testing<br>• Approximate Number Sense Test<br>• Are You Smart or Hardworking? How Praise Influences Children's Motivation<br>• Arterial Line Placement<br>• Aseptic Technique in Environmental Science<br>• Assembly of a Reflux System for Heated Chemical Reactions<br>• Assessing Dexterity with Reaching Tasks<br>• Auscultation<br>• Bacterial Growth Curve Analysis and its Environmental Applications<br>• Bacterial Transformation: Electroporation<br>• Bacterial Transformation: The Heat Shock Method<br>• Balance and Coordination Testing<br>• Basic Care Procedures<br>• Basic Chick Care and Maintenance<br>• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation<br>• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation<br>• Basic Mouse Care and Maintenance<br>• Binocular Rivalry<br>• Biofuels: Producing Ethanol from Cellulosic Material<br>• Blood Pressure Measurement |

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| | | • Blood Withdrawal I<br>• Blood Withdrawal II<br>• C. elegans Chemotaxis Assay<br>• C. elegans Development and Reproduction<br>• C. elegans Maintenance<br>• Calcium Imaging in Neurons<br>• Calibration Curves<br>• Capillary Electrophoresis (CE)<br>• Carbon and Nitrogen Analysis of Environmental Samples<br>• Cardiac Exam I: Inspection and Palpation<br>• Cardiac Exam II: Auscultation<br>• Cardiac Exam III: Abnormal Heart Sounds<br>• Categories and Inductive Inferences<br>• Cell Cycle Analysis<br>• Cell-surface Biotinylation Assay<br>• Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance<br>• Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance<br>• Central Venous Catheter Insertion: Subclavian Vein<br>• Chick ex ovo Culture<br>• Children's Reliance on Artist Intentions When Identifying Pictures<br>• Chromatin Immunoprecipitation<br>• Chromatography-Based Biomolecule Purification Methods<br>• Co-Immunoprecipitation and Pull-Down Assays<br>• Color Afterimages<br>• Column Chromatography<br>• Common Lab Glassware and Uses<br>• Community DNA Extraction from Bacterial Colonies<br>• Compound Administration I<br>• Compound Administration II<br>• Compound Administration III<br>• Compound Administration IV<br>• Comprehensive Breast Exam<br>• Conducting Reactions Below Room Temperature<br>• Considerations for Rodent Surgery<br>• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry<br>• Coordination Chemistry Complexes<br>• Cranial Nerves Exam I (I-VI)<br>• Cranial Nerves Exam II (VII-XII)<br>• Crowding<br>• Culturing and Enumerating Bacteria from Soil Samples<br>• Cyclic Voltammetry (CV)<br>• Cytogenetics<br>• DNA Gel Electrophoresis<br>• DNA Ligation Reactions<br>• DNA Methylation Analysis |

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| | | • Decision-making and the Iowa Gambling Task<br>• Decoding Auditory Imagery with Multivoxel Pattern Analysis<br>• Degassing Liquids with Freeze-Pump-Thaw Cycling<br>• Density Gradient Ultracentrifugation<br>• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis<br>• Detecting Reactive Oxygen Species<br>• Detection of Bacteriophages in Environmental Samples<br>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy<br>• Determination of Moisture Content in Soil<br>• Determining Rate Laws and the Order of Reaction<br>• Determining Spatial Orientation of Rock Layers with the Brunton Compass<br>• Determining the Density of a Solid and Liquid<br>• Determining the Empirical Formula<br>• Determining the Mass Percent Composition in an Aqueous Solution<br>• Determining the Solubility Rules of Ionic Compounds<br>• Development and Reproduction of the Laboratory Mouse<br>• Development of the Chick<br>• Diagnostic Necropsy and Tissue Harvest<br>• Dialysis: Diffusion Based Separation<br>• Dichotic Listening<br>• Dissolved Oxygen in Surface Water<br>• Drosophila Development and Reproduction<br>• Drosophila Larval IHC<br>• Drosophila Maintenance<br>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation<br>• Ear Exam<br>• Elbow Exam<br>• Electro-encephalography (EEG)<br>• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat<br>• Electrophoretic Mobility Shift Assay (EMSA)<br>• Embryonic Stem Cell Culture and Differentiation<br>• Emergency Tube Thoracostomy (Chest Tube Placement)<br>• Emergent Lateral Canthotomy and Inferior Catholysis<br>• Enzyme Assays and Kinetics<br>• Ethics in Psychology Research<br>• Event-related Potentials and the Oddball Task<br>• Executive Function and the Dimensional Change Card Sort Task<br>• Executive Function in Autism Spectrum Disorder<br>• Experimentation using a Confederate<br>• Explant Culture for Developmental Studies<br>• Explant Culture of Neural Tissue |

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| | | • Expression Profiling with Microarrays<br>• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction<br>• Eye Exam<br>• Eye Tracking in Cognitive Experiments<br>• FM Dyes in Vesicle Recycling<br>• Fate Mapping<br>• Fear Conditioning<br>• Filamentous Fungi<br>• Finding Your Blind Spot and Perceptual Filling-in<br>• Foot Exam<br>• Fractional Distillation<br>• Freezing-Point Depression to Determine an Unknown Compound<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Fundamentals of Breeding and Weaning<br>• Förster Resonance Energy Transfer (FRET)<br>• Gas Chromatography (GC) with Flame-Ionization Detection<br>• Gel Purification<br>• Gene Silencing with Morpholinos<br>• General Approach to the Physical Exam<br>• Genetic Crosses<br>• Genetic Engineering of Model Organisms<br>• Genetic Screens<br>• Genome Editing<br>• Gram Staining of Bacteria from Environmental Sources<br>• Growing Crystals for X-ray Diffraction Analysis<br>• Habituation: Studying Infants Before They Can Talk<br>• Hand and Wrist Exam<br>• High-Performance Liquid Chromatography (HPLC)<br>• Hip Exam<br>• Histological Sample Preparation for Light Microscopy<br>• Histological Staining of Neural Tissue<br>• How Children Solve Problems Using Causal Reasoning<br>• Ideal Gas Law<br>• Igneous Intrusive Rock<br>• Igneous Volcanic Rock<br>• In ovo Electroporation of Chicken Embryos<br>• Inattentional Blindness<br>• Incidental Encoding<br>• Induced Pluripotency<br>• Internal Standards<br>• Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation<br>• Intraosseous Needle Placement<br>• Introducing Experimental Agents into the Mouse<br>• Introduction to Catalysis<br>• Introduction to Fluorescence Microscopy<br>• Introduction to Light Microscopy |

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| | | • Introduction to Mass Spectrometry<br>• Introduction to Serological Pipettes and Pipettors<br>• Introduction to Titration<br>• Introduction to the Bunsen Burner<br>• Introduction to the Microplate Reader<br>• Introduction to the Spectrophotometer<br>• Invasion Assay Using 3D Matrices<br>• Invertebrate Lifespan Quantification<br>• Ion-Exchange Chromatography<br>• Isolating Nucleic Acids from Yeast<br>• Isolation of Fecal Bacteria from Water Samples by Filtration<br>• Just-noticeable Differences<br>• Knee Exam<br>• Language: The N400 in Semantic Incongruity<br>• Le Châtelier's Principle<br>• Lead Analysis of Soil Using Atomic Absorption Spectroscopy<br>• Learning and Memory: The Remember-Know Task<br>• Live Cell Imaging of Mitosis<br>• Lower Back Exam<br>• Lymph Node Exam<br>• MALDI-TOF Mass Spectrometry<br>• Making Solutions in the Laboratory<br>• Making a Geologic Cross Section<br>• Male Rectal Exam<br>• Manipulating an Independent Variable through Embodiment<br>• Measuring Children's Trust in Testimony<br>• Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain<br>• Measuring Mass in the Laboratory<br>• Measuring Reaction Time and Donders' Method of Subtraction<br>• Measuring Tropospheric Ozone<br>• Measuring Verbal Working Memory Span<br>• Measuring Vital Signs<br>• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories<br>• Mental Rotation<br>• Metabolic Labeling<br>• Metacognitive Development: How Children Estimate Their Memory<br>• Method of Standard Addition<br>• Modeling Social Stress<br>• Molecular Cloning<br>• Motion-induced Blindness<br>• Motor Exam I<br>• Motor Exam II<br>• Motor Learning in Mirror Drawing<br>• Motor Maps |

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| | | • Mouse Genotyping<br>• Multiple Object Tracking<br>• Murine In Utero Electroporation<br>• Mutual Exclusivity: How Children Learn the Meanings of Words<br>• Neck Exam<br>• Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment<br>• Neuronal Transfection Methods<br>• Nose, Sinuses, Oral Cavity and Pharynx Exam<br>• Nuclear Magnetic Resonance (NMR) Spectroscopy<br>• Numerical Cognition: More or Less<br>• Nutrients in Aquatic Ecosystems<br>• Object Substitution Masking<br>• Observation and Inspection<br>• Observational Research<br>• Ophthalmoscopic Examination<br>• PCR: The Polymerase Chain Reaction<br>• Palpation<br>• Passaging Cells<br>• Patch Clamp Electrophysiology<br>• Pelvic Exam I: Assessment of the External Genitalia<br>• Pelvic Exam II: Speculum Exam<br>• Pelvic Exam III: Bimanual and Rectovaginal Exam<br>• Percussion<br>• Percutaneous Cricothyrotomy (Seldinger Technique)<br>• Performing 1D Thin Layer Chromatography<br>• Pericardiocentesis<br>• Peripheral Vascular Exam<br>• Peripheral Vascular Exam Using a Continuous Wave Doppler<br>• Peripheral Venous Cannulation<br>• Perspectives on Sensation and Perception<br>• Photometric Protein Determination<br>• Physical Properties Of Minerals I: Crystals and Cleavage<br>• Physical Properties Of Minerals II: Polymineralic Analysis<br>• Physiological Correlates of Emotion Recognition<br>• Piaget's Conservation Task and the Influence of Task Demands<br>• Pilot Testing<br>• Placebos in Research<br>• Plasmid Purification<br>• Positive Reinforcement Studies<br>• Preparing Anhydrous Reagents and Equipment<br>• Primary Neuronal Cultures<br>• Proper Adjustment of Patient Attire during the Physical Exam<br>• Prospect Theory<br>• Protein Crystallization<br>• Proton Exchange Membrane Fuel Cells |

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| | | • Purification of a Total Lipid Extract with Column Chromatography<br>• Purifying Compounds by Recrystallization<br>• Quantifying Environmental Microorganisms and Viruses Using qPCR<br>• RNA Analysis of Environmental Samples Using RT-PCR<br>• RNA-Seq<br>• RNAi in C. elegans<br>• Raman Spectroscopy for Chemical Analysis<br>• Realism in Experimentation<br>• Recombineering and Gene Targeting<br>• Reconstitution of Membrane Proteins<br>• Regulating Temperature in the Lab: Applying Heat<br>• Regulating Temperature in the Lab: Preserving Samples Using Cold<br>• Reliability in Psychology Experiments<br>• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry<br>• Respiratory Exam I: Inspection and Palpation<br>• Respiratory Exam II: Percussion and Auscultation<br>• Restriction Enzyme Digests<br>• Rodent Handling and Restraint Techniques<br>• Rodent Identification I<br>• Rodent Identification II<br>• Rodent Stereotaxic Surgery<br>• Rotary Evaporation to Remove Solvent<br>• SNP Genotyping<br>• Sample Preparation for Analytical Preparation<br>• Scanning Electron Microscopy (SEM)<br>• Schlenk Lines Transfer of Solvents<br>• Self-administration Studies<br>• Self-report vs. Behavioral Measures of Recycling<br>• Sensory Exam<br>• Separating Protein with SDS-PAGE<br>• Separation of Mixtures via Precipitation<br>• Shoulder Exam I<br>• Shoulder Exam II<br>• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium<br>• Solid-Liquid Extraction<br>• Solutions and Concentrations<br>• Sonication Extraction of Lipid Biomarkers from Sediment<br>• Soxhlet Extraction of Lipid Biomarkers from Sediment<br>• Spatial Cueing<br>• Spatial Memory Testing Using Mazes<br>• Spectrophotometric Determination of an Equilibrium Constant<br>• Sterile Tissue Harvest<br>• Surface Plasmon Resonance (SPR)<br>• Surgical Cricothyrotomy |

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| | | • Tandem Mass Spectrometry<br>• Testing For Genetically Modified Foods<br>• The ATP Bioluminescence Assay<br>• The Ames Room<br>• The Attentional Blink<br>• The Costs and Benefits of Natural Pedagogy<br>• The ELISA Method<br>• The Factorial Experiment<br>• The Ideal Gas Law<br>• The Inverted-face Effect<br>• The McGurk Effect<br>• The Morris Water Maze<br>• The Multi-group Experiment<br>• The Precision of Visual Working Memory with Delayed Estimation<br>• The Rouge Test: Searching for a Sense of Self<br>• The Rubber Hand Illusion<br>• The Simple Experiment: Two-group Design<br>• The Split Brain<br>• The Staircase Procedure for Finding a Perceptual Threshold<br>• The TUNEL Assay<br>• The Transwell Migration Assay<br>• The Western Blot<br>• Thyroid Exam<br>• Tissue Regeneration with Somatic Stem Cells<br>• Transplantation Studies<br>• Tree Identification: How To Use a Dichotomous Key<br>• Tree Survey: Point-Centered Quarter Sampling Method<br>• Turbidity and Total Solids in Surface Water<br>• Two-Dimensional Gel Electrophoresis<br>• Ultraviolet-Visible (UV-Vis) Spectroscopy<br>• Understanding Concentration and Measuring Volumes<br>• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy<br>• Using Diffusion Tensor Imaging in Traumatic Brain Injury<br>• Using GIS to Investigate Urban Forestry<br>• Using TMS to Measure Motor Excitability During Action Observation<br>• Using Topographic Maps to Generate Topographic Profiles<br>• Using Your Head: Measuring Infants' Rational Imitation of Actions<br>• Using a pH Meter<br>• Verbal Priming<br>• Visual Attention: fMRI Investigation of Object-based Attentional Control<br>• Visual Search for Features and Conjunctions<br>• Visual Statistical Learning<br>• Visualizing Soil Microorganisms via the Contact Slide |

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| | | Assay and Microscopy<br>• Water Quality Analysis via Indicator Organisms<br>• Whole-Mount In Situ Hybridization<br>• Within-subjects Repeated-measures Design<br>• X-ray Fluorescence (XRF)<br>• Yeast Maintenance<br>• Yeast Reproduction<br>• Yeast Transformation and Cloning<br>• Zebrafish Breeding and Embryo Handling<br>• Zebrafish Maintenance and Husbandry<br>• Zebrafish Microinjection Techniques<br>• Zebrafish Reproduction and Development<br>• fMRI: Functional Magnetic Resonance Imaging |
| **STRAND/TOPIC** | **GA.CC.W9-10HST.** | **Writing Standards for Literacy in Science and Technical Subjects** |
| **STANDARD / DESCRIPTION** | | **Text Types and Purposes** |
| **ELEMENT** | **W9-10HST3.** | **(See note; not applicable as a separate requirement)** |
| **ELEMENT/GLE** | **W9-10HST3.a.** | **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.**<br><br>**JoVE**<br>• Ethics in Psychology Research<br>• Experimentation using a Confederate<br>• From Theory to Design: The Role of Creativity in Designing Experiments<br>• Manipulating an Independent Variable through Embodiment<br>• Observational Research<br>• Pilot Testing<br>• Placebos in Research<br>• Realism in Experimentation<br>• Reliability in Psychology Experiments<br>• The Factorial Experiment<br>• The Multi-group Experiment<br>• The Simple Experiment: Two-group Design<br>• Within-subjects Repeated-measures Design |