**Main Criteria:** Oregon Academic Content Standards  
**Secondary Criteria:** JoVE  
**Subject:** Science  
**Grade:** 9-12  
**Correlation Options:** Show Correlated  
**Adopted:** 2014

<table>
<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-LS1.</th>
<th>From Molecules to Organisms: Structures and Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
<td>HS-LS1-1.</td>
<td>Students who demonstrate understanding can:</td>
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<tr>
<td>BENCHMARK / STRAND</td>
<td></td>
<td>Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</td>
</tr>
</tbody>
</table>

**JoVE**  
- An Introduction to Caenorhabditis elegans  
- An Introduction to Cell Death  
- An Introduction to Cell Division  
- An Introduction to Cellular and Molecular Neuroscience  
- An Introduction to Developmental Genetics  
- An Introduction to Molecular Developmental Biology  
- An Introduction to Saccharomyces cerevisiae  
- An Introduction to Transfection  
- An Overview of Epigenetics  
- An Overview of Gene Expression  
- An Overview of Genetic Analysis  
- An Overview of Genetic Engineering  
- An Overview of Genetics and Disease  
- Annexin V and Propidium Iodide Labeling  
- Bacterial Transformation: Electroporation  
- Bacterial Transformation: The Heat Shock Method  
- Cell Cycle Analysis  
- Chromatin Immunoprecipitation  
- Community DNA Extraction from Bacterial Colonies  
- Cytogenetics  
- DNA Gel Electrophoresis  
- DNA Ligation Reactions  
- DNA Methylation Analysis  
- Density Gradient Ultracentrifugation  
- Detecting Environmental Microorganisms with the
<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS1-2.</th>
<th>Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</th>
<th>JoVE</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>• An Introduction to Aging and Regeneration</td>
<td>• An Introduction to Behavioral Neuroscience</td>
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<tr>
<td></td>
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<td>• An Introduction to Caenorhabditis elegans</td>
<td>• An Introduction to Cell Motility and Migration</td>
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<td>• An Introduction to Cell Motility and Migration</td>
<td>• An Introduction to Cell Motility and Migration</td>
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</tbody>
</table>
• An Introduction to Cellular and Molecular Neuroscience
• An Introduction to Developmental Genetics
• An Introduction to Developmental Neurobiology
• An Introduction to Learning and Memory
• An Introduction to Modeling Behavioral Disorders and Stress
• An Introduction to Molecular Developmental Biology
• An Introduction to Motor Control
• An Introduction to Organogenesis
• An Introduction to Reward and Addiction
• An Introduction to the Chick: Gallus gallus domesticus
• An Introduction to the Zebrafish: Danio rerio
• Anesthesia Induction and Maintenance
• Anxiety Testing
• Approximate Number Sense Test
• Assessing Dexterity with Reaching Tasks
• Balance and Coordination Testing
• Basic Care Procedures
• Binocular Rivalry
• Blood Withdrawal I
• Blood Withdrawal II
• C. elegans Chemotaxis Assay
• C. elegans Development and Reproduction
• C. elegans Maintenance
• Calcium Imaging in Neurons
• Chick ex ovo Culture
• Co-Immunoprecipitation and Pull-Down Assays
• Color Afterimages
• Compound Administration I
• Compound Administration II
• Compound Administration III
• Compound Administration IV
• Considerations for Rodent Surgery
• Crowding
• Detecting Reactive Oxygen Species
• Development and Reproduction of the Laboratory Mouse
• Development of the Chick
• Diagnostic Necropsy and Tissue Harvest
• Dichotic Listening
• Drosophila Development and Reproduction
• Drosophila Larval IHC
• Embryonic Stem Cell Culture and Differentiation
• Explant Culture for Developmental Studies
• Explant Culture of Neural Tissue
• Expression Profiling with Microarrays
• Fate Mapping
• Finding Your Blind Spot and Perceptual Filling-in
• Fundamentals of Breeding and Weaning
• Genetic Engineering of Model Organisms
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<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS1-3.</th>
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<tbody>
<tr>
<td>Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td>
<td></td>
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**JoVE**
- Abdominal Exam I: Inspection and Auscultation
- Abdominal Exam II: Percussion
- Abdominal Exam III: Palpation
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<th>Course Topic</th>
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<td>Abdominal Exam IV: Acute Abdominal Pain Assessment</td>
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<td>An Introduction to Cell Death</td>
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<td>An Introduction to Cell Division</td>
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<tr>
<td>An Introduction to Cell Metabolism</td>
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<tr>
<td>An Introduction to Cellular and Molecular Neuroscience</td>
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<tr>
<td>An Introduction to Cognition</td>
</tr>
<tr>
<td>An Introduction to Developmental Neurobiology</td>
</tr>
<tr>
<td>An Introduction to Endocytosis and Exocytosis</td>
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<tr>
<td>An Introduction to Learning and Memory</td>
</tr>
<tr>
<td>An Introduction to Molecular Developmental Biology</td>
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<tr>
<td>An Introduction to Reward and Addiction</td>
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<tr>
<td>An Introduction to Stem Cell Biology</td>
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<tr>
<td>Anesthesia Induction and Maintenance</td>
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<tr>
<td>Ankle Exam</td>
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<tr>
<td>Annexin V and Propidium Iodide Labeling</td>
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<tr>
<td>Arterial Line Placement</td>
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<tr>
<td>Assessing Dexterity with Reaching Tasks</td>
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<tr>
<td>Auscultation</td>
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<tr>
<td>Balance and Coordination Testing</td>
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<tr>
<td>Basic Care Procedures</td>
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<tr>
<td>Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation</td>
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<tr>
<td>Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation</td>
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<tr>
<td>Basic Mouse Care and Maintenance</td>
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<td>Blood Pressure Measurement</td>
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<td>Blood Withdrawal I</td>
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<td>C. elegans Development and Reproduction</td>
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<td>Calcium Imaging in Neurons</td>
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<td>Cardiac Exam I: Inspection and Palpation</td>
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<tr>
<td>Cardiac Exam II: Auscultation</td>
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<td>Cardiac Exam III: Abnormal Heart Sounds</td>
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<tr>
<td>Cell-surface Biotinylation Assay</td>
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<tr>
<td>Central Venous Catheter Insertion: Femoral Vein with Ultrasound Guidance</td>
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<tr>
<td>Central Venous Catheter Insertion: Internal Jugular with Ultrasound Guidance</td>
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<tr>
<td>Central Venous Catheter Insertion: Subclavian Vein</td>
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<tr>
<td>Compound Administration I</td>
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<td>Compound Administration II</td>
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<td>Compound Administration III</td>
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<td>Compound Administration IV</td>
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<tr>
<td>Comprehensive Breast Exam</td>
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<td>Considerations for Rodent Surgery</td>
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<td>Cranial Nerves Exam I (I-VI)</td>
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<td>Cranial Nerves Exam II (VII-XII)</td>
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<td>Detecting Reactive Oxygen Species</td>
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<td>Diagnostic Necropsy and Tissue Harvest</td>
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<td>Ear Exam</td>
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</table>
- Elbow Exam
- Electro-encephalography (EEG)
- Embryonic Stem Cell Culture and Differentiation
- Emergency Tube Thoracostomy (Chest Tube Placement)
- Emergent Lateral Canthotomy and Inferior Catholysis
- Explant Culture of Neural Tissue
- Eye Exam
- FM Dyes in Vesicle Recycling
- Fear Conditioning
- Foot Exam
- General Approach to the Physical Exam
- Hand and Wrist Exam
- Hip Exam
- Histological Staining of Neural Tissue
- In ovo Electroporation of Chicken Embryos
- Induced Pluripotency
- Intra-articular Shoulder Injection for Reduction Following Anterior Shoulder Dislocation
- Intraosseous Needle Placement
- Isolating Nucleic Acids from Yeast
- Knee Exam
- Lower Back Exam
- Lymph Node Exam
- Male Rectal Exam
- Measuring Vital Signs
- Motor Exam I
- Motor Exam II
- Murine In Utero Electroporation
- Neck Exam
- Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment
- Nose, Sinuses, Oral Cavity and Pharynx Exam
- Observation and Inspection
- Ophthalmoscopic Examination
- Palpation
- Patch Clamp Electrophysiology
- Pelvic Exam I: Assessment of the External Genitalia
- Pelvic Exam II: Speculum Exam
- Pelvic Exam III: Bimanual and Rectovaginal Exam
- Percussion
- Percutaneous Cricothyrotomy (Seldinger Technique)
- Pericardiocentesis
- Peripheral Vascular Exam
- Peripheral Vascular Exam Using a Continuous Wave Doppler
- Peripheral Venous Cannulation
- Physiological Correlates of Emotion Recognition
- Proper Adjustment of Patient Attire during the Physical Exam
- Reconstitution of Membrane Proteins
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<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS1-4.</th>
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<tr>
<td>• Respiratory Exam II: Percussion and Auscultation</td>
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<td>• Self-administration Studies</td>
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<td>• Sensory Exam</td>
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<td>• Shoulder Exam I</td>
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<tr>
<td>• Shoulder Exam II</td>
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<td>• Spatial Memory Testing Using Mazes</td>
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<td>• Sterile Tissue Harvest</td>
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<tr>
<td>• Surgical Cricothyrotomy</td>
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<tr>
<td>• The ATP Bioluminescence Assay</td>
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<td>• The TUNEL Assay</td>
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<td>• Thyroid Exam</td>
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<td>• Tissue Regeneration with Somatic Stem Cells</td>
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<td>• Tree Identification: How To Use a Dichotomous Key</td>
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<td>• Using a pH Meter</td>
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<td>• Yeast Maintenance</td>
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<td>• Yeast Reproduction</td>
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<td>• Yeast Transformation and Cloning</td>
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<tr>
<td>• Zebrafish Maintenance and Husbandry</td>
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</tbody>
</table>

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

**JoVE**

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- An Introduction to Molecular Developmental Biology
- An Introduction to Organogenesis
- An Introduction to Saccharomyces cerevisiae
- An Introduction to Stem Cell Biology
- An Overview of Epigenetics
- An Overview of Gene Expression
- C. elegans Development and Reproduction
- Cell Cycle Analysis
- DNA Methylation Analysis
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- Embryonic Stem Cell Culture and Differentiation
- Explant Culture for Developmental Studies
- Explant Culture of Neural Tissue
- Expression Profiling with Microarrays
- Fate Mapping
- Gene Silencing with Morpholinos
- Genetic Engineering of Model Organisms
- Induced Pluripotency
<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS1-5.</th>
<th>Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.</th>
</tr>
</thead>
</table>
| JoVE              |          | • An Introduction to Cell Metabolism  
|                   |          | • Reconstitution of Membrane Proteins                                                    |

<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS1-6.</th>
<th>Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.</th>
</tr>
</thead>
</table>
| JoVE              |          | • An Introduction to Caenorhabditis elegans  
|                   |          | • An Introduction to Cell Death  
|                   |          | • An Introduction to Cell Division  
|                   |          | • An Introduction to Cell Metabolism  
|                   |          | • An Introduction to Cell Motility and Migration  
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|                   |          | • An Overview of Alkenone Biomarker Analysis for Paleothermometry  
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|                   |          | • An Overview of Gene Expression  
|                   |          | • An Overview of Genetic Analysis  
|                   |          | • An Overview of Genetic Engineering  
|                   |          | • An Overview of Genetics and Disease  
|                   |          | • An Overview of bGDGT Biomarker Analysis for Paleoclimatology  
|                   |          | • Annexin V and Propidium Iodide Labeling  
|                   |          | • Bacterial Transformation: Electroporation  
|                   |          | • Bacterial Transformation: The Heat Shock Method  
|                   |          | • Biofuels: Producing Ethanol from Cellulosic Material  
|                   |          | • C. elegans Maintenance  
|                   |          | • Carbon and Nitrogen Analysis of Environmental Samples  
|                   |          | • Cell Cycle Analysis  
|                   |          | • Cell-surface Biotinylation Assay  
<p>|                   |          | • Chromatin Immunoprecipitation  |</p>
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<tr>
<th>Topics</th>
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<td>Chromatography-Based Biomolecule Purification Methods</td>
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<td>Co-Immunoprecipitation and Pull-Down Assays</td>
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<td>Column Chromatography</td>
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<tr>
<td>Community DNA Extraction from Bacterial Colonies</td>
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<tr>
<td>Conversion of Fatty Acid Methyl Esters by Saponification for Uk’37 Paleothermometry</td>
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<tr>
<td>Cytogenetics</td>
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<td>DNA Gel Electrophoresis</td>
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<tr>
<td>DNA Ligation Reactions</td>
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<tr>
<td>DNA Methylation Analysis</td>
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<tr>
<td>Density Gradient Ultracentrifugation</td>
</tr>
<tr>
<td>Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis</td>
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<tr>
<td>Detecting Reactive Oxygen Species</td>
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<tr>
<td>Development and Reproduction of the Laboratory Mouse</td>
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<td>Development of the Chick</td>
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<td>Dialysis: Diffusion Based Separation</td>
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<td>Drosophila Development and Reproduction</td>
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<td>Drosophila Larval IHC</td>
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<tr>
<td>Drosophila melanogaster Embryo and Larva Harvesting and Preparation</td>
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<td>Electrophoretic Mobility Shift Assay (EMSA)</td>
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<td>Embryonic Stem Cell Culture and Differentiation</td>
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<td>Enzyme Assays and Kinetics</td>
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<tr>
<td>Explant Culture for Developmental Studies</td>
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<td>Expression Profiling with Microarrays</td>
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<tr>
<td>Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction</td>
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<td>FM Dyes in Vesicle Recycling</td>
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<td>Förster Resonance Energy Transfer (FRET)</td>
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<td>Gel Purification</td>
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<td>Gene Silencing with Morpholinos</td>
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<td>Genetic Crosses</td>
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<td>Genetic Engineering of Model Organisms</td>
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<td>Genetic Screens</td>
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<tr>
<td>Genome Editing</td>
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<td>In ovo Electroporation of Chicken Embryos</td>
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<td>Induced Pluripotency</td>
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<td>Introduction to Catalysis</td>
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<td>Introduction to Mass Spectrometry</td>
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<td>Invasion Assay Using 3D Matrices</td>
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<td>Invertebrate Lifespan Quantification</td>
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<td>Ion-Exchange Chromatography</td>
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<td>Isolating Nucleic Acids from Yeast</td>
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<td>Live Cell Imaging of Mitosis</td>
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<tr>
<td>MALDI-TOF Mass Spectrometry</td>
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<td>Metabolic Labeling</td>
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<td>Method of Standard Addition</td>
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<tr>
<td>Molecular Cloning</td>
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</tbody>
</table>
Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
<table>
<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-LS2.</th>
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<tbody>
<tr>
<td>Ecosystems: Interactions, Energy, and Dynamics</td>
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<td><strong>CONTENT STANDARD / PROFICIENCY</strong></td>
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<tr>
<td>Students who demonstrate understanding can:</td>
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</tr>
<tr>
<td><strong>BENCHMARK / STRAND</strong></td>
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<tr>
<td>HS-LS2-2.</td>
<td></td>
</tr>
<tr>
<td>Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</td>
<td></td>
</tr>
</tbody>
</table>

**JoVE**
- An Introduction to Cell Metabolism
- Biofuels: Producing Ethanol from Cellulosic Material
- Detecting Reactive Oxygen Species
- The ATP Bioluminescence Assay
- Algae Enumeration via Culturable Methodology
- An Introduction to the Chick: Gallus gallus domesticus
- An Introduction to the Laboratory Mouse: Mus musculus
- An Introduction to the Zebrafish: Danio rerio
- Analysis of Earthworm Populations in Soil
- Aseptic Technique in Environmental Science
- Bacterial Growth Curve Analysis and its Environmental Applications
- Bacterial Transformation: Electroporation
- Bacterial Transformation: The Heat Shock Method
- Basic Mouse Care and Maintenance
- C. elegans Maintenance
- Culturing and Enumerating Bacteria from Soil Samples
- Detection of Bacteriophages in Environmental Samples
- Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy
- Dissolved Oxygen in Surface Water
- Drosophila Maintenance
- Drosophila melanogaster Embryo and Larva Harvesting and Preparation
- Filamentous Fungi
- Introduction to Mass Spectrometry
- Isolation of Fecal Bacteria from Water Samples by Filtration
- Lead Analysis of Soil Using Atomic Absorption Spectroscopy
- Measuring Tropospheric Ozone
- Nutrients in Aquatic Ecosystems
- Passaging Cells
- Plasmid Purification
- Quantifying Environmental Microorganisms and Viruses Using qPCR
- Tree Identification: How To Use a Dichotomous Key
- Tree Survey: Point-Centered Quarter Sampling Method
- Turbidity and Total Solids in Surface Water
<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS2-3.</th>
</tr>
</thead>
</table>
| Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.  
**JoVE**  
- Algae Enumeration via Culturable Methodology  
- Analysis of Earthworm Populations in Soil  
- Bacterial Growth Curve Analysis and its Environmental Applications  
- Carbon and Nitrogen Analysis of Environmental Samples  
- Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy  
- Dissolved Oxygen in Surface Water  
- Filamentous Fungi  
- Fundamentals of Breeding and Weaning  
- Nutrients in Aquatic Ecosystems  
- Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium  
- Using GIS to Investigate Urban Forestry |

| BENCHMARK / STRAND | HS-LS2-4. | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.  
**JoVE**  
- Algae Enumeration via Culturable Methodology  
- An Overview of Alkenone Biomarker Analysis for Paleothermometry  
- An Overview of bGDGT Biomarker Analysis for Paleoclimatology  
- Analysis of Earthworm Populations in Soil  
- Bacterial Growth Curve Analysis and its Environmental Applications  
- Carbon and Nitrogen Analysis of Environmental Samples  
- Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry  
- Culturing and Enumerating Bacteria from Soil Samples  
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- Dissolved Oxygen in Surface Water  
- Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction  
- Filamentous Fungi  
- Fundamentals of Breeding and Weaning  
- Metabolic Labeling  
- Nutrients in Aquatic Ecosystems  
- Purification of a Total Lipid Extract with Column |
| BENCHMARK / STRAND | HS-LS2.5 | Chromatography  
• Removal of Branched and Cyclic Compounds by Urea Adduction for Uk’37 Paleothermometry  
• Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium  
• Sonication Extraction of Lipid Biomarkers from Sediment  
• Soxhlet Extraction of Lipid Biomarkers from Sediment  
• Using GIS to Investigate Urban Forestry |
|---|---|---|
| BENCHMARK / STRAND | HS-LS2-7 | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.  
**JoVE**  
• An Introduction to Cell Metabolism  
• Biofuels: Producing Ethanol from Cellulosic Material  
• Detecting Reactive Oxygen Species  
• The ATP Bioluminescence Assay |
| STANDARD / CONTENT AREA | OR.HS-LS3. | Heredity: Inheritance and Variation of Traits  
**CONTENT STANDARD / PROFICIENCY**  
Students who demonstrate understanding can:  
**BENCHMARK / STRAND**  
HS-LS3-1 | Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.  
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• An Introduction to Cell Death  
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• An Introduction to Drosophila melanogaster  
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• An Introduction to Saccharomyces cerevisiae  
• An Introduction to Transfection  
• An Introduction to the Zebrafish: Danio rerio  
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• Genetic Engineering of Model Organisms
• Genetic Screens
• Genome Editing
• In ovo Electroporation of Chicken Embryos
• Induced Pluripotency
• Isolating Nucleic Acids from Yeast
• Live Cell Imaging of Mitosis
• Molecular Cloning
• Mouse Genotyping
• PCR: The Polymerase Chain Reaction
• Photometric Protein Determination
• Plasmid Purification
• Protein Crystallization
• Quantifying Environmental Microorganisms and Viruses Using qPCR
• RNA Analysis of Environmental Samples Using RT-PCR
• RNA-Seq
• Recombineering and Gene Targeting
• Restriction Enzyme Digests
• SNP Genotyping
• Testing For Genetically Modified Foods
<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS3-2.</th>
<th>Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</th>
</tr>
</thead>
</table>
| JoVE              |          | • An Introduction to Aging and Regeneration  
• An Introduction to Caenorhabditis elegans  
• An Introduction to Cell Death  
• An Introduction to Cell Division  
• An Introduction to Developmental Genetics  
• An Introduction to Drosophila melanogaster  
• An Introduction to Modeling Behavioral Disorders and Stress  
• An Introduction to Saccharomyces cerevisiae  
• An Introduction to Transfection  
• An Introduction to the Zebrafish: Danio rerio  
• An Overview of Epigenetics  
• An Overview of Gene Expression  
• An Overview of Genetic Analysis  
• An Overview of Genetics and Disease  
• C. elegans Development and Reproduction  
• Drosophila Development and Reproduction  
• Genetic Crosses  
• Genetic Engineering of Model Organisms  
• Genetic Screens  
• Isolating Nucleic Acids from Yeast  
• Passaging Cells  
• Recombineering and Gene Targeting  
• SNP Genotyping  
• The ELISA Method  
• The TUNEL Assay  
• Yeast Reproduction  
• Zebrafish Maintenance and Husbandry |
| BENCHMARK / STRAND | HS-LS3-3. | Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. |
| JoVE              |          | • An Introduction to Developmental Genetics  
• An Overview of Epigenetics  
• An Overview of Genetic Analysis  
• An Overview of Genetics and Disease  
• DNA Methylation Analysis |
<table>
<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-LS4.</th>
<th>Biological Evolution: Unity and Diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
<td></td>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-LS4-1.</td>
<td>Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>JoVE</strong></td>
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<tr>
<td></td>
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<td>• An Introduction to Caenorhabditis elegans</td>
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<td>• An Introduction to Drosophila melanogaster</td>
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<td>• An Introduction to the Chick: Gallus gallus domesticus</td>
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<td>• An Introduction to the Laboratory Mouse: Mus musculus</td>
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<td>• An Introduction to the Zebrafish: Danio rerio</td>
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<td>• An Overview of Genetic Analysis</td>
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<tr>
<td></td>
<td></td>
<td>• Drosophila Development and Reproduction</td>
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<tr>
<td></td>
<td></td>
<td>• Drosophila melanogaster Embryo and Larva Harvesting and Preparation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High-Performance Liquid Chromatography (HPLC)</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-LS4-2.</td>
<td>Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</td>
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<tr>
<td></td>
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<td><strong>JoVE</strong></td>
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<tr>
<td></td>
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<td>• An Introduction to the Chick: Gallus gallus domesticus</td>
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<td>• An Overview of Genetic Analysis</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-LS4-3.</td>
<td>Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.</td>
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<td><strong>JoVE</strong></td>
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<td>• An Overview of Genetic Analysis</td>
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<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-LS4-4.</td>
<td>Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</td>
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<td><strong>JoVE</strong></td>
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<tr>
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<td>• An Overview of Genetic Analysis</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-LS4-5.</td>
<td>Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in</td>
</tr>
</tbody>
</table>
the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

JoVE
- Algae Enumeration via Culturable Methodology
- An Introduction to the Chick: Gallus gallus domesticus
- An Introduction to the Laboratory Mouse: Mus musculus
- An Introduction to the Zebrafish: Danio rerio
- Analysis of Earthworm Populations in Soil
- Aseptic Technique in Environmental Science
- Bacterial Growth Curve Analysis and its Environmental Applications
- Bacterial Transformation: Electroporation
- Bacterial Transformation: The Heat Shock Method
- Basic Mouse Care and Maintenance
- C. elegans Maintenance
- Culturing and Enumerating Bacteria from Soil Samples
- Detection of Bacteriophages in Environmental Samples
- Dissolved Oxygen in Surface Water
- Drosophila Maintenance
- Drosophila melanogaster Embryo and Larva Harvesting and Preparation
- Filamentous Fungi
- Isolation of Fecal Bacteria from Water Samples by Filtration
- Passaging Cells
- Plasmid Purification
- Quantifying Environmental Microorganisms and Viruses Using qPCR
- Yeast Maintenance
- Yeast Reproduction

<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-LS4-6.</th>
<th>Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JoVE</td>
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<tr>
<td></td>
<td></td>
<td>- Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy</td>
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<tr>
<td></td>
<td></td>
<td>- Lead Analysis of Soil Using Atomic Absorption Spectroscopy</td>
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<tr>
<td></td>
<td></td>
<td>- Self-report vs. Behavioral Measures of Recycling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-ESS1.</th>
<th>Earth’s Place in the Universe</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
<td></td>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS1-1.</td>
<td>Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS1-5.</td>
<td>Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</td>
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</tbody>
</table>
| JoVE                | • Determining Spatial Orientation of Rock Layers with the Brunton Compass  
|                     | • Igneous Intrusive Rock  
|                     | • Igneous Volcanic Rock  
|                     | • Making a Geologic Cross Section  
|                     | • Using Topographic Maps to Generate Topographic Profiles |

<table>
<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-ESS2.</th>
<th>Earth’s Systems</th>
</tr>
</thead>
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<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
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<td>Students who demonstrate understanding can:</td>
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<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS2-1.</td>
<td>Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</td>
</tr>
</tbody>
</table>
| JoVE | • Igneous Intrusive Rock  
| | • Igneous Volcanic Rock  
| | • Making a Geologic Cross Section  
| | • Turbidity and Total Solids in Surface Water  
| | • Using Topographic Maps to Generate Topographic Profiles |

<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-ESS2-2.</th>
<th>Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth’s systems.</th>
</tr>
</thead>
</table>
| JoVE                | • Algae Enumeration via Culturable Methodology  
|                     | • Determining the Solubility Rules of Ionic Compounds  
|                     | • Dissolved Oxygen in Surface Water  
|                     | • Le Châtelier’s Principle  
|                     | • Nutrients in Aquatic Ecosystems  
|                     | • Turbidity and Total Solids in Surface Water  
|                     | • Water Quality Analysis via Indicator Organisms |

<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-ESS2-5.</th>
<th>Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>JoVE</td>
<td>• Determination of Moisture Content in Soil</td>
<td></td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS2-6.</td>
<td>Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</td>
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**JoVE**
- An Overview of Alkenone Biomarker Analysis for Paleothermometry
- An Overview of bGDGT Biomarker Analysis for Paleoclimatology
- Conversion of Fatty Acid Methyl Esters by Saponification for Uk’37 Paleothermometry
- Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy
- Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction
- Purification of a Total Lipid Extract with Column Chromatography
- Removal of Branched and Cyclic Compounds by Urea Adduction for Uk’37 Paleothermometry
- Sonication Extraction of Lipid Biomarkers from Sediment
- Soxhlet Extraction of Lipid Biomarkers from Sediment
- Using GIS to Investigate Urban Forestry

<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-ESS2-7.</th>
<th>Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.</th>
</tr>
</thead>
</table>

**JoVE**
- An Overview of Alkenone Biomarker Analysis for Paleothermometry
- An Overview of bGDGT Biomarker Analysis for Paleoclimatology
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<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</td>
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<tr>
<td></td>
<td>JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Igneous Volcanic Rock • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.</td>
</tr>
<tr>
<td></td>
<td>JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Fractional Distillation • Igneous Intrusive Rock • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</td>
</tr>
<tr>
<td></td>
<td>JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Electrophoretic Mobility Shift Assay (EMSA) • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Measuring Tropospheric Ozone • Proton Exchange Membrane Fuel Cells • Self-report vs. Behavioral Measures of Recycling • Tree Identification: How To Use a Dichotomous Key</td>
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<td>BENCHMARK / STRAND</td>
<td>HS-ESS3-4.</td>
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<td>JoVE</td>
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<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-ESS3-5.</th>
<th>Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>JoVE</td>
<td></td>
<td>• Biofuels: Producing Ethanol from Cellulosic Material</td>
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</table>

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<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-ESS3-6.</th>
<th>Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>JoVE</td>
<td></td>
<td>• Biofuels: Producing Ethanol from Cellulosic Material</td>
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</tbody>
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<thead>
<tr>
<th>STANDARD / CONTENT AREA</th>
<th>OR.HS-PS1.</th>
<th>Matter and Its Interactions</th>
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<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
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<td>Students who demonstrate understanding can:</td>
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<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-PS1-1.</td>
<td>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</td>
</tr>
<tr>
<td>BENCHMARK STRAND</td>
<td>HS-PS1-2</td>
<td>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</td>
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<tr>
<td>BENCHMARK STRAND</td>
<td>HS-PS1-4</td>
<td>Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</td>
</tr>
<tr>
<td>BENCHMARK STRAND</td>
<td>HS-PS1-5</td>
<td>Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</td>
</tr>
<tr>
<td>BENCHMARK STRAND</td>
<td>HS-PS1-6</td>
<td>Refine the design of a chemical system by specifying a change in conditions that would produce increased</td>
</tr>
</tbody>
</table>
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

**JoVE**
- Assembly of a Reflux System for Heated Chemical Reactions
- Le Châtelier’s Principle
- Separation of Mixtures via Precipitation
- Spectrophotometric Determination of an Equilibrium Constant

**BENCHMARK / STRAND** | **HS-PS1-7.** | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

**JoVE**
- Assembly of a Reflux System for Heated Chemical Reactions
- Conducting Reactions Below Room Temperature
- Coordination Chemistry Complexes
- Determining Rate Laws and the Order of Reaction
- Determining the Empirical Formula
- Determining the Solubility Rules of Ionic Compounds
- Introduction to Catalysis
- Introduction to Titration
- Preparing Anhydrous Reagents and Equipment
- Proton Exchange Membrane Fuel Cells
- Solutions and Concentrations
- Spectrophotometric Determination of an Equilibrium Constant
- Using Differential Scanning Calorimetry to Measure Changes in Enthalpy

**BENCHMARK / STRAND** | **HS-PS1-8.** | Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

**JoVE**
- Determining Rate Laws and the Order of Reaction

**STANDARD / CONTENT AREA** | **OR.HS-PS2.** | Motion and Stability: Forces and Interactions

**CONTENT STANDARD / PROFICIENCY** | Students who demonstrate understanding can:

**BENCHMARK / STRAND** | **HS-PS2-3.** | Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

**JoVE**
- Raman Spectroscopy for Chemical Analysis

**BENCHMARK / STRAND** | **HS-PS2-5.** | Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric
<table>
<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-PS2-6.</th>
<th>Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD / CONTENT AREA</td>
<td>OR.HS-PS3.</td>
<td>Energy</td>
</tr>
<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
<td>Students who demonstrate understanding can:</td>
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</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-PS3-1.</td>
<td>Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.</td>
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<td>JoVE • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-PS3-2.</td>
<td>Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.</td>
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<td>JoVE • Abdominal Exam II: Percussion • Auscultation • Cyclic Voltammetry (CV) • Ear Exam • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Percussion</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-PS3-3.</td>
<td>Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</td>
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<td>JoVE • fMRI: Functional Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>BENCHMARK / STRAND</td>
<td>HS-PS3-5.</td>
<td>Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</td>
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<td>JoVE • Gas Chromatography (GC) with Flame-Ionization Detection • fMRI: Functional Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>STANDARD / CONTENT AREA</td>
<td>OR.HS-PS4.</td>
<td>Waves and their Applications in Technologies for Information Transfer</td>
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<tr>
<td>CONTENT STANDARD / PROFICIENCY</td>
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<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-PS4-2.</th>
<th>Evaluate questions about the advantages of using a digital transmission and storage of information.</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>JoVE</strong></td>
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<tr>
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<td>• Using GIS to Investigate Urban Forestry</td>
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</tbody>
</table>

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<thead>
<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-PS4-4.</th>
<th>Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.</th>
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<tbody>
<tr>
<td></td>
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<td><strong>JoVE</strong></td>
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<td>• An Introduction to Drosophila melanogaster</td>
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<td>• An Introduction to the Zebrafish: Danio rerio</td>
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<td>• An Overview of Genetics and Disease</td>
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<td>• Color Afterimages</td>
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<td>• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy</td>
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<td>• Histological Sample Preparation for Light Microscopy</td>
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<td>• Introduction to Fluorescence Microscopy</td>
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<td>• Introduction to Light Microscopy</td>
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<td>• Introduction to the Spectrophotometer</td>
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<td>• Mouse Genotyping</td>
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<td>• Nutrients in Aquatic Ecosystems</td>
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<td>• Photometric Protein Determination</td>
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<td>• Spectrophotometric Determination of an Equilibrium Constant</td>
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<td>• Turbidity and Total Solids in Surface Water</td>
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<td>• Ultraviolet-Visible (UV-Vis) Spectroscopy</td>
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<tr>
<th>BENCHMARK / STRAND</th>
<th>HS-PS4-5.</th>
<th>Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</th>
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<tr>
<td></td>
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<td><strong>JoVE</strong></td>
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X-ray Fluorescence (XRF)
Yeast Maintenance
fMRI: Functional Magnetic Resonance Imaging

STANDARD / CONTENT AREA
OR.HS-ETS1. Engineering and Design

CONTENT STANDARD / PROFICIENCY
Students who demonstrate understanding can:

BENCHMARK / STRAND
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

JoVE
Biofuels: Producing Ethanol from Cellulosic Material
Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy
Dissolved Oxygen in Surface Water
Lead Analysis of Soil Using Atomic Absorption
| BENCHMARK / STRAND | HS-ETS1-3. | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |

### JoVE

- Biofuels: Producing Ethanol from Cellulosic Material
- Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy
- Measuring Tropospheric Ozone
- Proton Exchange Membrane Fuel Cells
- Using GIS to Investigate Urban Forestry

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<td>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.</td>
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**JoVE**
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<td>WHST.9-10.1(a)</td>
<td>Write arguments focused on discipline-specific content.</td>
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<td>WHST.9-10.1(a)</td>
<td>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.</td>
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- fMRI: Functional Magnetic Resonance Imaging
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<td>Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.</td>
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<td>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.</td>
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<td>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.</td>
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**JoVE**
- The Multi-group Experiment
- The Simple Experiment: Two-group Design
• An Introduction to Organogenesis
• An Introduction to Reward and Addiction
• An Introduction to Saccharomyces cerevisiae
• An Introduction to Stem Cell Biology
• An Introduction to Transfection
• An Introduction to Working in the Hood
• An Introduction to the Centrifuge
• An Introduction to the Chick: Gallus gallus domesticus
• An Introduction to the Laboratory Mouse: Mus musculus
• An Introduction to the Micropipettor
• An Introduction to the Zebrafish: Danio rerio
• An Overview of Alkenone Biomarker Analysis for Paleothermometry
• An Overview of Epigenetics
• An Overview of Gene Expression
• An Overview of Genetic Analysis
• An Overview of Genetic Engineering
• An Overview of Genetics and Disease
• An Overview of bGDGT Biomarker Analysis for Paleoclimatology
• Analysis of Earthworm Populations in Soil
• Anesthesia Induction and Maintenance
• Ankle Exam
• Annexin V and Propidium Iodide Labeling
• Anterograde Amnesia
• Anxiety Testing
• Approximate Number Sense Test
• Are You Smart or Hardworking? How Praise Influences Children's Motivation
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• Aseptic Technique in Environmental Science
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• Assessing Dexterity with Reaching Tasks
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• Bacterial Growth Curve Analysis and its Environmental Applications
• Bacterial Transformation: Electroporation
• Bacterial Transformation: The Heat Shock Method
• Balance and Coordination Testing
• Basic Care Procedures
• Basic Chick Care and Maintenance
• Basic Life Support Part II: Airway/Breathing and Continued Cardiopulmonary Resuscitation
• Basic Life Support: Cardiopulmonary Resuscitation and Defibrillation
• Basic Mouse Care and Maintenance
• Binocular Rivalry
• Biofuels: Producing Ethanol from Cellulosic Material
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