Main Criteria: Ohio Learning Standards
Secondary Criteria: JoVE
Subject: Science
Grade: 9-12
Correlation Options: Show Correlated
Adopted: 2011

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.B.**	**BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.**
STANDARD / BENCHMARK	**B.SI.**	**Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:**
BENCHMARK / GRADE LEVEL INDICATOR	**B.SI.2.**	**Design and conduct scientific investigations.** **JoVE** **• Ethics in Psychology Research** **• Experimentation using a Confederate** **• From Theory to Design: The Role of Creativity in Designing Experiments** **• Manipulating an Independent Variable through Embodiment** **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**
BENCHMARK / GRADE LEVEL INDICATOR	**B.SI.3.**	**Use technology and mathematics to improve investigations and communications.** **JoVE** **• An Introduction to Aging and Regeneration**

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

		• Development and Reproduction of the Laboratory Mouse • Dichotic Listening • Drosophila Development and Reproduction • Electro-encephalography (EEG) • Ethics in Psychology Research • Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • From Theory to Design: The Role of Creativity in Designing Experiments • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Screens • Habituation: Studying Infants Before They Can Talk • Histological Sample Preparation for Light Microscopy • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Learning and Memory: The Remember-Know Task • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate

		Their Memory **• Modeling Social Stress** **• Motion-induced Blindness** **• Motor Learning in Mirror Drawing** **• Motor Maps** **• Multiple Object Tracking** **• Mutual Exclusivity: How Children Learn the Meanings of Words** **• Numerical Cognition: More or Less** **• Object Substitution Masking** **• Observational Research** **• PCR: The Polymerase Chain Reaction** **• Patch Clamp Electrophysiology** **• Pericardiocentesis** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• Perspectives on Cognitive Psychology** **• Perspectives on Neuropsychology** **• Physiological Correlates of Emotion Recognition** **• Piaget's Conservation Task and the Influence of Task Demands** **• Pilot Testing** **• Placebos in Research** **• Plasmid Purification** **• Positive Reinforcement Studies** **• Prospect Theory** **• Purification of a Total Lipid Extract with Column Chromatography** **• RNA Analysis of Environmental Samples Using RT-PCR** **• RNA-Seq** **• RNAi in C. elegans** **• Realism in Experimentation** **• Regulating Temperature in the Lab: Applying Heat** **• Regulating Temperature in the Lab: Preserving Samples Using Cold** **• Reliability in Psychology Experiments** **• SNP Genotyping** **• Self-administration Studies** **• Self-report vs. Behavioral Measures of Recycling** **• Spatial Cueing** **• Spatial Memory Testing Using Mazes** **• The ATP Bioluminescence Assay** **• The Attentional Blink** **• The Costs and Benefits of Natural Pedagogy** **• The ELISA Method** **• The Factorial Experiment** **• The Inverted-face Effect** **• The Morris Water Maze** **• The Multi-group Experiment** **• The Precision of Visual Working Memory with Delayed Estimation**

		• The Rouge Test: Searching for a Sense of Self • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Within-subjects Repeated-measures Design • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
BENCHMARK / GRADE LEVEL INDICATOR	**B.SI.5.**	**Recognize and analyze explanations and models.** **JoVE** • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Endocytosis and Exocytosis • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Cell Cycle Analysis • Cell-surface Biotinylation Assay • DNA Gel Electrophoresis • DNA Ligation Reactions • FM Dyes in Vesicle Recycling • Gel Purification • Invasion Assay Using 3D Matrices • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Passaging Cells • Plasmid Purification • Restriction Enzyme Digests • Separating Protein with SDS-PAGE • The ATP Bioluminescence Assay

		• The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.B.**	**BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.**
STANDARD / BENCHMARK	**B.1.**	**Heredity**
BENCHMARK / GRADE LEVEL INDICATOR	**B.1.1.**	**Cellular genetics** **JoVE** • An Introduction to Developmental Genetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering
BENCHMARK / GRADE LEVEL INDICATOR	**B.1.2.**	**Structure and function of DNA in cells** **JoVE** • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Molecular Developmental Biology • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Cell Cycle Analysis • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse

		• Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Molecular Cloning • Mouse Genotyping • PCR: The Polymerase Chain Reaction • Photometric Protein Determination • Plasmid Purification • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • Recombineering and Gene Targeting • Restriction Enzyme Digests • SNP Genotyping • Testing For Genetically Modified Foods • The TUNEL Assay • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling
BENCHMARK / GRADE LEVEL INDICATOR	B.1.3.	Genetic mechanisms and inheritance <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology

		• An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Cell Cycle Analysis • Chick ex ovo Culture • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Gel Electrophoresis • DNA Ligation Reactions • DNA Methylation Analysis • Density Gradient Ultracentrifugation • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture for Developmental Studies • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Förster Resonance Energy Transfer (FRET) • Gel Purification • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing

		• In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Method of Standard Addition • Molecular Cloning • Mouse Genotyping • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Passaging Cells • Photometric Protein Determination • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • SNP Genotyping • Testing For Genetically Modified Foods • The ELISA Method • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Two-Dimensional Gel Electrophoresis • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
BENCHMARK / GRADE LEVEL INDICATOR	**B.1.4.**	**Mutations** **JoVE** • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio

		• An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The TUNEL Assay
BENCHMARK / GRADE LEVEL INDICATOR	B.1.5.	Modern genetics <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetic Engineering • An Overview of Genetics and Disease • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • C. elegans Development and Reproduction • C. elegans Maintenance • Capillary Electrophoresis (CE) • Chick ex ovo Culture • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Cytogenetics • DNA Ligation Reactions • DNA Methylation Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance

		• Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies • Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Fundamentals of Breeding and Weaning • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • Genetic Screens • Genome Editing • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Molecular Cloning • Mouse Genotyping • Murine In Utero Electroporation • Neuronal Transfection Methods • PCR: The Polymerase Chain Reaction • Passaging Cells • Plasmid Purification • Primary Neuronal Cultures • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Recombineering and Gene Targeting • Restriction Enzyme Digests • Rodent Stereotaxic Surgery • SNP Genotyping • Solid-Liquid Extraction • Testing For Genetically Modified Foods • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.B.**	**BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction**

		to explore the living world, the physical environment and the interactions within and between them.
STANDARD / BENCHMARK	B.2.	Evolution
BENCHMARK / GRADE LEVEL INDICATOR	B.2.1.	Mechanisms
PROFICIENCY LEVEL	B.2.1.1.	Natural selection JoVE • An Overview of Genetic Analysis
PROFICIENCY LEVEL	B.2.1.2.	Mutation JoVE • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Developmental Genetics • An Introduction to Drosophila melanogaster • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • An Overview of Genetic Analysis • An Overview of Genetics and Disease • Genetic Engineering of Model Organisms • Genetic Screens • Isolating Nucleic Acids from Yeast • Passaging Cells • The TUNEL Assay
PROFICIENCY LEVEL	B.2.1.3.	Genetic drift JoVE • An Overview of Genetic Analysis
PROFICIENCY LEVEL	B.2.1.5.	Sexual selection JoVE • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Genetic Analysis
PROFICIENCY LEVEL	B.2.1.6.	History of life on Earth JoVE • An Introduction to the Chick: Gallus gallus domesticus • An Overview of Genetic Analysis
DOMAIN / ACADEMIC CONTENT STANDARD	OH.B.	BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on

		Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.
STANDARD / BENCHMARK	**B.2.**	**Evolution**
BENCHMARK / GRADE LEVEL INDICATOR	**B.2.2.**	**Diversity of Life**
PROFICIENCY LEVEL	**B.2.2.1.**	**Speciation and biological classification based on molecular evidence** **JoVE** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Drosophila melanogaster** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Genetic Analysis** **• Basic Chick Care and Maintenance** **• Basic Mouse Care and Maintenance** **• C. elegans Chemotaxis Assay** **• C. elegans Development and Reproduction** **• C. elegans Maintenance** **• Chick ex ovo Culture** **• Culturing and Enumerating Bacteria from Soil Samples** **• Detection of Bacteriophages in Environmental Samples** **• Development and Reproduction of the Laboratory Mouse** **• Development of the Chick** **• Drosophila Development and Reproduction** **• Drosophila Larval IHC** **• Drosophila Maintenance** **• Drosophila melanogaster Embryo and Larva Harvesting and Preparation** **• Filamentous Fungi** **• In ovo Electroporation of Chicken Embryos** **• Introducing Experimental Agents into the Mouse** **• Isolating Nucleic Acids from Yeast** **• Mouse Genotyping** **• RNAi in C. elegans** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry** **• Yeast Maintenance** **• Yeast Reproduction** **• Yeast Transformation and Cloning** **• Zebrafish Breeding and Embryo Handling** **• Zebrafish Maintenance and Husbandry**

		• Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
PROFICIENCY LEVEL	B.2.2.2.	Variation of organisms within a species due to population genetics and gene frequency JoVE • An Overview of Genetic Analysis • C. elegans Development and Reproduction • SNP Genotyping • Yeast Reproduction • Zebrafish Maintenance and Husbandry
DOMAIN / ACADEMIC CONTENT STANDARD	OH.B.	BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.
STANDARD / BENCHMARK	B.3.	Diversity and Interdependence of Life
BENCHMARK / GRADE LEVEL INDICATOR	B.3.1.	Classification systems are frameworks created by scientists for describing the vast diversity of organisms indicating the degree of relatedness between organisms. JoVE • An Introduction to Caenorhabditis elegans • An Introduction to Drosophila melanogaster • An Introduction to Saccharomyces cerevisiae • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Analysis of Earthworm Populations in Soil • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • C. elegans Development and Reproduction • C. elegans Maintenance • Chick ex ovo Culture • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Filamentous Fungi • In ovo Electroporation of Chicken Embryos

		• Introducing Experimental Agents into the Mouse • Isolating Nucleic Acids from Yeast • Mouse Genotyping • RNAi in C. elegans • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Using GIS to Investigate Urban Forestry • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.B.**	**BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.**
STANDARD / BENCHMARK	**B.3.**	**Diversity and Interdependence of Life**
BENCHMARK / GRADE LEVEL INDICATOR	**B.3.2.**	**Ecosystems**
PROFICIENCY LEVEL	**B.3.2.1.**	**Homeostasis**
INDICATOR	**B.3.2.1.b.**	**Equilibrium and disequilibrium** **JoVE** • Analysis of Earthworm Populations in Soil • Determination of Moisture Content in Soil • Dissolved Oxygen in Surface Water • Nutrients in Aquatic Ecosystems • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.B.**	**BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.**
STANDARD / BENCHMARK	**B.4.**	**Cells**
BENCHMARK / GRADE LEVEL INDICATOR	**B.4.1.**	**Cell structure and function**
PROFICIENCY LEVEL	**B.4.1.1.**	**Structure, function and interrelatedness of cell organelles** **JoVE** • An Introduction to Aging and Regeneration • An Introduction to Cell Death

		• An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Balance and Coordination Testing • C. elegans Development and Reproduction • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Cytogenetics • DNA Ligation Reactions • Density Gradient Ultracentrifugation • Detecting Reactive Oxygen Species • Electro-encephalography (EEG) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gene Silencing with Morpholinos • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Protein Crystallization • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Surface Plasmon Resonance (SPR) • The ATP Bioluminescence Assay • The TUNEL Assay

		• The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
PROFICIENCY LEVEL	B.4.1.2.	Eukaryotic cells and prokaryotic cells JoVE • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Saccharomyces cerevisiae • An Introduction to Transfection • An Overview of Genetic Engineering • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Culturing and Enumerating Bacteria from Soil Samples • Density Gradient Ultracentrifugation • Electrophoretic Mobility Shift Assay (EMSA) • Genetic Engineering of Model Organisms • Invasion Assay Using 3D Matrices • Molecular Cloning • Plasmid Purification • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • The Transwell Migration Assay • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
DOMAIN / ACADEMIC CONTENT STANDARD	OH.B.	BIOLOGY: This course investigates the composition, diversity, complexity and interconnectedness of life on Earth. Fundamental concepts of heredity and evolution provide a framework through inquiry-based instruction to explore the living world, the physical environment and the interactions within and between them.
STANDARD / BENCHMARK	B.4.	Cells
BENCHMARK / GRADE LEVEL INDICATOR	B.4.2.	Cellular processes
PROFICIENCY LEVEL	B.4.2.1.	Characteristics of life regulated by cellular processes JoVE • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience

		• An Introduction to Developmental Neurobiology • An Introduction to Endocytosis and Exocytosis • An Introduction to Molecular Developmental Biology • An Introduction to Neurophysiology • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Biofuels: Producing Ethanol from Cellulosic Material • C. elegans Development and Reproduction • Calcium Imaging in Neurons • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Cytogenetics • DNA Ligation Reactions • Detecting Reactive Oxygen Species • Electrophoretic Mobility Shift Assay (EMSA) • Embryonic Stem Cell Culture and Differentiation • Enzyme Assays and Kinetics • Explant Culture of Neural Tissue • FM Dyes in Vesicle Recycling • Förster Resonance Energy Transfer (FRET) • Gene Silencing with Morpholinos • Genetic Crosses • Histological Staining of Neural Tissue • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invasion Assay Using 3D Matrices • Isolating Nucleic Acids from Yeast • Live Cell Imaging of Mitosis • Metabolic Labeling • Molecular Cloning • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Patch Clamp Electrophysiology • Plasmid Purification • Primary Neuronal Cultures • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Restriction Enzyme Digests • Surface Plasmon Resonance (SPR) • The ATP Bioluminescence Assay • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tissue Regeneration with Somatic Stem Cells • Whole-Mount In Situ Hybridization

		• Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning
PROFICIENCY LEVEL	B.4.2.2.	Photosynthesis, chemosynthesis, cellular respiration <u>JoVE</u> • An Introduction to Cell Metabolism • Biofuels: Producing Ethanol from Cellulosic Material • Detecting Reactive Oxygen Species • The ATP Bioluminescence Assay
PROFICIENCY LEVEL	B.4.2.3.	Cell division and differentiation <u>JoVE</u> • An Introduction to Aging and Regeneration • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Molecular Developmental Biology • An Introduction to Organogenesis • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Epigenetics • An Overview of Gene Expression • Annexin V and Propidium Iodide Labeling • Bacterial Growth Curve Analysis and its Environmental Applications • Basic Chick Care and Maintenance • C. elegans Development and Reproduction • Cell Cycle Analysis • Chick ex ovo Culture • Cytogenetics • DNA Methylation Analysis • Detecting Reactive Oxygen Species • Development and Reproduction of the Laboratory Mouse • Development of the Chick • Drosophila Development and Reproduction • Drosophila Larval IHC • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Embryonic Stem Cell Culture and Differentiation • Explant Culture for Developmental Studies

		• Explant Culture of Neural Tissue • Expression Profiling with Microarrays • Fate Mapping • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Engineering of Model Organisms • In ovo Electroporation of Chicken Embryos • Induced Pluripotency • Invertebrate Lifespan Quantification • Live Cell Imaging of Mitosis • Metabolic Labeling • Murine In Utero Electroporation • Neuronal Transfection Methods • Passaging Cells • Primary Neuronal Cultures • RNA-Seq • Recombineering and Gene Targeting • The TUNEL Assay • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Whole-Mount In Situ Hybridization • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.SI.	Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:
BENCHMARK / GRADE LEVEL INDICATOR	C.SI.3.	Use technology and mathematics to improve investigations and communications. <u>JoVE</u> • An Introduction to the Micropipettor • Common Lab Glassware and Uses • Determining the Density of a Solid and Liquid • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer

		• Making Solutions in the Laboratory • Measuring Mass in the Laboratory • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Understanding Concentration and Measuring Volumes
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.1.	Structure and Properties of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.1.1.	Atomic structure
PROFICIENCY LEVEL	C.1.1.2.	Electrons JoVE • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Scanning Electron Microscopy (SEM) • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
PROFICIENCY LEVEL	C.1.1.3.	Electron configurations JoVE • Coordination Chemistry Complexes • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.1.	Structure and Properties of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.1.2.	Periodic table

PROFICIENCY LEVEL	C.1.2.1.	Properties JoVE • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Determining the Solubility Rules of Ionic Compounds • Introduction to Mass Spectrometry • Surface Plasmon Resonance (SPR) • X-ray Fluorescence (XRF)
PROFICIENCY LEVEL	C.1.2.2.	Trends JoVE • Coordination Chemistry Complexes
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.1.	Structure and Properties of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.1.3.	Intramolecular chemical bonding
PROFICIENCY LEVEL	C.1.3.1.	Ionic JoVE • Determining the Solubility Rules of Ionic Compounds
PROFICIENCY LEVEL	C.1.3.2.	Polar/covalent JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Chromatography-Based Biomolecule Purification Methods • Column Chromatography • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis

		• High-Performance Liquid Chromatography (HPLC) • Ion-Exchange Chromatography • Performing 1D Thin Layer Chromatography • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Reconstitution of Membrane Proteins • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.1.	Structure and Properties of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.1.4.	Representing compounds
PROFICIENCY LEVEL	C.1.4.1.	Formula writing JoVE • Determining the Empirical Formula
PROFICIENCY LEVEL	C.1.4.2.	Nomenclature JoVE • Purification of a Total Lipid Extract with Column Chromatography • Sonication Extraction of Lipid Biomarkers from Sediment
PROFICIENCY LEVEL	C.1.4.3.	Models and shapes (Lewis structures, ball and stick, molecular geometries) JoVE • Determining the Empirical Formula
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter

		and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	**C.1.**	**Structure and Properties of Matter**
BENCHMARK / GRADE LEVEL INDICATOR	**C.1.5.**	**Quantifying matter** **JoVE** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Determining Rate Laws and the Order of Reaction** **• Determining the Empirical Formula** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Freezing-Point Depression to Determine an Unknown Compound** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• High-Performance Liquid Chromatography (HPLC)** **• Ideal Gas Law** **• Internal Standards** **• Introduction to Mass Spectrometry** **• Introduction to Titration** **• Introduction to the Microplate Reader** **• Introduction to the Spectrophotometer** **• Le Châtelier's Principle** **• MALDI-TOF Mass Spectrometry** **• Making Solutions in the Laboratory** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Photometric Protein Determination** **• Sample Preparation for Analytical Preparation** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant** **• Tandem Mass Spectrometry** **• The Ideal Gas Law** **• Understanding Concentration and Measuring Volumes**
BENCHMARK / GRADE LEVEL INDICATOR	**C.1.6.**	**Phases of matter** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Degassing Liquids with Freeze-Pump-Thaw Cycling** **• Fractional Distillation** **• Freezing-Point Depression to Determine an Unknown Compound** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Growing Crystals for X-ray Diffraction Analysis**

		• Ideal Gas Law • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • The Ideal Gas Law • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.1.	Structure and Properties of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.1.7.	Intermolecular chemical bonding
PROFICIENCY LEVEL	C.1.7.1.	Types and strengths JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Förster Resonance Energy Transfer (FRET) • Purification of a Total Lipid Extract with Column Chromatography • Raman Spectroscopy for Chemical Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment

		• Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy • X-ray Fluorescence (XRF)
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.C.**	**CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.**
STANDARD / BENCHMARK	**C.1.**	**Structure and Properties of Matter**
BENCHMARK / GRADE LEVEL INDICATOR	**C.1.7.**	**Intermolecular chemical bonding**
PROFICIENCY LEVEL	**C.1.7.2.**	**Implications for properties of substances**
INDICATOR	**C.1.7.2.a.**	**Melting and boiling point** **JoVE** • Assembly of a Reflux System for Heated Chemical Reactions • Fractional Distillation • Growing Crystals for X-ray Diffraction Analysis • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
INDICATOR	**C.1.7.2.b.**	**Solubility** **JoVE** • An Introduction to the Micropipettor • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Assembly of a Reflux System for Heated Chemical Reactions • Calibration Curves • Capillary Electrophoresis (CE) • Column Chromatography • Conducting Reactions Below Room Temperature • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Cyclic Voltammetry (CV) • Degassing Liquids with Freeze-Pump-Thaw Cycling • Density Gradient Ultracentrifugation • Determining the Mass Percent Composition in an Aqueous Solution • Determining the Solubility Rules of Ionic Compounds

		• Dialysis: Diffusion Based Separation • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Freezing-Point Depression to Determine an Unknown Compound • Growing Crystals for X-ray Diffraction Analysis • Internal Standards • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Ion-Exchange Chromatography • Making Solutions in the Laboratory • Method of Standard Addition • Performing 1D Thin Layer Chromatography • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Understanding Concentration and Measuring Volumes
INDICATOR	C.1.7.2.c.	Vapor pressure JoVE • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Ideal Gas Law • Rotary Evaporation to Remove Solvent • Solutions and Concentrations • The Ideal Gas Law
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.2.	Interactions of Matter

BENCHMARK / GRADE LEVEL INDICATOR	**C.2.1.**	**Chemical reactions**
PROFICIENCY LEVEL	**C.2.1.1.**	**Types of reactions** **JoVE** **• Co-Immunoprecipitation and Pull-Down Assays** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Cyclic Voltammetry (CV)** **• Determining Rate Laws and the Order of Reaction** **• Determining the Solubility Rules of Ionic Compounds** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Growing Crystals for X-ray Diffraction Analysis** **• Introduction to Catalysis** **• Introduction to Titration** **• Le Châtelier's Principle** **• Photometric Protein Determination** **• Preparing Anhydrous Reagents and Equipment** **• Proton Exchange Membrane Fuel Cells** **• Purifying Compounds by Recrystallization** **• Rotary Evaporation to Remove Solvent** **• Separation of Mixtures via Precipitation** **• Spectrophotometric Determination of an Equilibrium Constant** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy** **• Using a pH Meter**
PROFICIENCY LEVEL	**C.2.1.2.**	**Kinetics** **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** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Introduction to Catalysis** **• Le Châtelier's Principle** **• Spectrophotometric Determination of an Equilibrium Constant**
PROFICIENCY LEVEL	**C.2.1.3.**	**Energy** **JoVE** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Determining Rate Laws and the Order of Reaction** **• Enzyme Assays and Kinetics**

		• Introduction to Catalysis • Le Châtelier's Principle • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
PROFICIENCY LEVEL	C.2.1.4.	Equilibrium 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 • Using a pH Meter
PROFICIENCY LEVEL	C.2.1.5.	Acids/bases JoVE • Determining the Empirical Formula • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Using a pH Meter
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.2.	Interactions of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.2.2.	Gas laws
PROFICIENCY LEVEL	C.2.2.1.	Pressure, volume and temperature JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
PROFICIENCY LEVEL	C.2.2.2.	Ideal gas law JoVE • Determining Rate Laws and the Order of Reaction • Ideal Gas Law • The Ideal Gas Law
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced

		science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	**C.2.**	**Interactions of Matter**
BENCHMARK / GRADE LEVEL INDICATOR	**C.2.3.**	**Stoichiometry**
PROFICIENCY LEVEL	**C.2.3.1.**	**Molar calculations** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Determining Rate Laws and the Order of Reaction** **• Determining the Empirical Formula** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Determining the Solubility Rules of Ionic Compounds** **• Freezing-Point Depression to Determine an Unknown Compound** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• High-Performance Liquid Chromatography (HPLC)** **• Internal Standards** **• Introduction to Catalysis** **• Introduction to Mass Spectrometry** **• Introduction to Titration** **• Introduction to the Microplate Reader** **• Introduction to the Spectrophotometer** **• Le Châtelier's Principle** **• MALDI-TOF Mass Spectrometry** **• Making Solutions in the Laboratory** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Photometric Protein Determination** **• Preparing Anhydrous Reagents and Equipment** **• Proton Exchange Membrane Fuel Cells** **• Sample Preparation for Analytical Preparation** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant** **• Tandem Mass Spectrometry** **• Understanding Concentration and Measuring Volumes** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy**

PROFICIENCY LEVEL	C.2.3.2.	Solutions JoVE • Calibration Curves • Capillary Electrophoresis (CE) • Determining Rate Laws and the Order of Reaction • Determining the Mass Percent Composition in an Aqueous Solution • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization Detection • High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Le Châtelier's Principle • Making Solutions in the Laboratory • Photometric Protein Determination • Sample Preparation for Analytical Preparation • Solutions and Concentrations • Spectrophotometric Determination of an Equilibrium Constant • Understanding Concentration and Measuring Volumes
PROFICIENCY LEVEL	C.2.3.3.	Limiting reagents JoVE • Cyclic Voltammetry (CV) • Spectrophotometric Determination of an Equilibrium Constant
DOMAIN / ACADEMIC CONTENT STANDARD	OH.C.	CHEMISTRY: This course introduces students to key concepts and theories that provide a foundation for further study in other sciences as well as advanced science disciplines. Chemistry comprises a systematic study of the predictive physical interactions of matter and subsequent events that occur in the natural world. The study of matter through the exploration of classification, its structure and its interactions is how this course is organized.
STANDARD / BENCHMARK	C.2.	Interactions of Matter
BENCHMARK / GRADE LEVEL INDICATOR	C.2.4.	Nuclear Reactions
PROFICIENCY LEVEL	C.2.4.1.	Radioisotopes JoVE • Column Chromatography • Determining Rate Laws and the Order of Reaction

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.ES.**	**ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.**
STANDARD / BENCHMARK	**ES.SI.**	**Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.SI.2.**	**Design and conduct scientific investigations;** **JoVE** **• Ethics in Psychology Research** **• Experimentation using a Confederate** **• From Theory to Design: The Role of Creativity in Designing Experiments** **• Manipulating an Independent Variable through Embodiment** **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.SI.3.**	**Use technology and mathematics to improve investigations and communications;** **JoVE** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Aging and Regeneration** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• An Introduction to the Centrifuge** **• An Introduction to the Micropipettor** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry**

		• An Overview of Genetic Analysis • An Overview of Genetics and Disease • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Analysis of Earthworm Populations in Soil • Annexin V and Propidium Iodide Labeling • Anterograde Amnesia • Anxiety Testing • Approximate Number Sense Test • Are You Smart or Hardworking? How Praise Influences Children's Motivation • Assessing Dexterity with Reaching Tasks • Bacterial Growth Curve Analysis and its Environmental Applications • Balance and Coordination Testing • Basic Mouse Care and Maintenance • Binocular Rivalry • Biofuels: Producing Ethanol from Cellulosic Material • Blood Pressure Measurement • C. elegans Chemotaxis Assay • Calcium Imaging in Neurons • Carbon and Nitrogen Analysis of Environmental Samples • Categories and Inductive Inferences • Cell Cycle Analysis • Cell-surface Biotinylation Assay • Children's Reliance on Artist Intentions When Identifying Pictures • Chromatin Immunoprecipitation • Community DNA Extraction from Bacterial Colonies • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Crowding • Culturing and Enumerating Bacteria from Soil Samples • DNA Methylation Analysis • Decision-making and the Iowa Gambling Task • Decoding Auditory Imagery with Multivoxel Pattern Analysis • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Detecting Reactive Oxygen Species • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Determination of Moisture Content in Soil • Development and Reproduction of the Laboratory Mouse • Dichotic Listening • Dissolved Oxygen in Surface Water • Drosophila Development and Reproduction • Electro-encephalography (EEG) • Ethics in Psychology Research

		• Event-related Potentials and the Oddball Task • Executive Function and the Dimensional Change Card Sort Task • Executive Function in Autism Spectrum Disorder • Experimentation using a Confederate • Expression Profiling with Microarrays • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • From Theory to Design: The Role of Creativity in Designing Experiments • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Screens • Habituation: Studying Infants Before They Can Talk • Histological Sample Preparation for Light Microscopy • How Children Solve Problems Using Causal Reasoning • Inattentional Blindness • Incidental Encoding • Introducing Experimental Agents into the Mouse • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Introduction to Serological Pipettes and Pipettors • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Tropospheric Ozone • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metacognitive Development: How Children Estimate Their Memory • Modeling Social Stress • Motion-induced Blindness

		• Motor Learning in Mirror Drawing • Motor Maps • Multiple Object Tracking • Mutual Exclusivity: How Children Learn the Meanings of Words • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Observational Research • PCR: The Polymerase Chain Reaction • Patch Clamp Electrophysiology • Pericardiocentesis • Peripheral Vascular Exam Using a Continuous Wave Doppler • Perspectives on Cognitive Psychology • Perspectives on Neuropsychology • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Prospect Theory • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Realism in Experimentation • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Reliability in Psychology Experiments • SNP Genotyping • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment

		• The Inverted-face Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Your Head: Measuring Infants' Rational Imitation of Actions • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Within-subjects Repeated-measures Design • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
BENCHMARK / GRADE LEVEL INDICATOR	**ES.SI.5.**	**Recognize and analyze explanations and models; and** **JoVE** • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Endocytosis and Exocytosis • An Introduction to Transfection • Annexin V and Propidium Iodide Labeling • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method • Cell Cycle Analysis • Cell-surface Biotinylation Assay • DNA Gel Electrophoresis • DNA Ligation Reactions • FM Dyes in Vesicle Recycling

		• Gel Purification • Invasion Assay Using 3D Matrices • Live Cell Imaging of Mitosis • Molecular Cloning • PCR: The Polymerase Chain Reaction • Passaging Cells • Plasmid Purification • Restriction Enzyme Digests • Separating Protein with SDS-PAGE • The ATP Bioluminescence Assay • The ELISA Method • The TUNEL Assay • The Transwell Migration Assay • The Western Blot
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.1.	Earth Systems: Interconnected Spheres of Earth
BENCHMARK / GRADE LEVEL INDICATOR	ES.1.1.	Biosphere
PROFICIENCY LEVEL	ES.1.1.1.	Evolution and adaptation in populations <u>JoVE</u> • An Introduction to Caenorhabditis elegans • An Introduction to Cognition • An Introduction to Drosophila melanogaster • An Introduction to Learning and Memory • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of Genetic Analysis • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Basic Chick Care and Maintenance • Basic Mouse Care and Maintenance • C. elegans Chemotaxis Assay • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Development of the Chick • Drosophila Development and Reproduction • Drosophila Maintenance • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Fear Conditioning • Positive Reinforcement Studies

		• 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 • Spatial Memory Testing Using Mazes • Yeast Maintenance
PROFICIENCY LEVEL	ES.1.1.2.	Biodiversity JoVE • Analysis of Earthworm Populations in Soil • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method
PROFICIENCY LEVEL	ES.1.1.3.	Ecosystems (equilibrium, species interactions, stability) JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • C. elegans Development and Reproduction • Culturing and Enumerating Bacteria from Soil Samples • Dissolved Oxygen in Surface Water • Filamentous Fungi • Genetic Crosses • Nutrients in Aquatic Ecosystems • Recombineering and Gene Targeting • 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 • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Zebrafish Maintenance and Husbandry
PROFICIENCY LEVEL	ES.1.1.4.	Population dynamics JoVE • Algae Enumeration via Culturable Methodology • An Introduction to the Chick: Gallus gallus domesticus • An Introduction to the Laboratory Mouse: Mus musculus • An Introduction to the Zebrafish: Danio rerio • Analysis of Earthworm Populations in Soil • Aseptic Technique in Environmental Science • Bacterial Growth Curve Analysis and its Environmental Applications • Bacterial Transformation: Electroporation • Bacterial Transformation: The Heat Shock Method

		• Basic Mouse Care and Maintenance • C. elegans Maintenance • Culturing and Enumerating Bacteria from Soil Samples • Detection of Bacteriophages in Environmental Samples • Dissolved Oxygen in Surface Water • Drosophila Maintenance • Drosophila melanogaster Embryo and Larva Harvesting and Preparation • Filamentous Fungi • Isolation of Fecal Bacteria from Water Samples by Filtration • Passaging Cells • Plasmid Purification • Quantifying Environmental Microorganisms and Viruses Using qPCR • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Yeast Maintenance • Yeast Reproduction
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.ES.**	**ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.**
STANDARD / BENCHMARK	**ES.1.**	**Earth Systems: Interconnected Spheres of Earth**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.1.2.**	**Atmosphere**
PROFICIENCY LEVEL	**ES.1.2.1.**	**Atmospheric properties and currents** **JoVE** • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.ES.**	**ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.**
STANDARD / BENCHMARK	**ES.1.**	**Earth Systems: Interconnected Spheres of Earth**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.1.3.**	**Lithosphere**
PROFICIENCY LEVEL	**ES.1.3.1.**	**Geologic events and processes** **JoVE** • Determining Spatial Orientation of Rock Layers with the Brunton Compass • 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
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.1.	Earth Systems: Interconnected Spheres of Earth
BENCHMARK / GRADE LEVEL INDICATOR	ES.1.4.	Hydrosphere
PROFICIENCY LEVEL	ES.1.4.2.	Surface and ground water flow patterns and movement JoVE • Dissolved Oxygen in Surface Water • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.1.	Earth Systems: Interconnected Spheres of Earth
BENCHMARK / GRADE LEVEL INDICATOR	ES.1.5.	Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere
PROFICIENCY LEVEL	ES.1.5.2.	Biogeochemical cycles 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 • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Filamentous Fungi • Fundamentals of Breeding and Weaning

		• Metabolic Labeling • Nutrients in Aquatic Ecosystems • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Using GIS to Investigate Urban Forestry
PROFICIENCY LEVEL	ES.1.5.3.	Ecosystems JoVE • Turbidity and Total Solids in Surface Water
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.2.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	ES.2.1.	Energy resources
PROFICIENCY LEVEL	ES.2.1.1.	Renewable and nonrenewable energy sources and efficiency JoVE • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Dissolved Oxygen in Surface Water • Fractional Distillation • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
PROFICIENCY LEVEL	ES.2.1.2.	Alternate energy sources and efficiency JoVE • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis

PROFICIENCY LEVEL	ES.2.1.3.	Resource availability JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Nutrients in Aquatic Ecosystems • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.2.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	ES.2.2.	Air and air pollution
PROFICIENCY LEVEL	ES.2.2.1.	Primary and secondary contaminants JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
PROFICIENCY LEVEL	ES.2.2.2.	Greenhouse gases JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
PROFICIENCY LEVEL	ES.2.2.3.	Clean Air Act JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Lead Analysis of Soil Using Atomic Absorption Spectroscopy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.2.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	ES.2.3.	Water and water pollution

PROFICIENCY LEVEL	ES.2.3.1.	Potable water and water quality JoVE • Algae Enumeration via Culturable Methodology • Detection of Bacteriophages in Environmental Samples • Determining the Solubility Rules of Ionic Compounds • Dissolved Oxygen in Surface Water • Gram Staining of Bacteria from Environmental Sources • Introduction to Mass Spectrometry • Isolation of Fecal Bacteria from Water Samples by Filtration • Le Châtelier's Principle • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms • Zebrafish Maintenance and Husbandry
PROFICIENCY LEVEL	ES.2.3.2.	Hypoxia, eutrophication JoVE • Algae Enumeration via Culturable Methodology • Determining the Solubility Rules of Ionic Compounds • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Le Châtelier's Principle • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
PROFICIENCY LEVEL	ES.2.3.3.	Clean Water Act JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Lead Analysis of Soil Using Atomic Absorption Spectroscopy
PROFICIENCY LEVEL	ES.2.3.4.	Point source and non-point source contamination JoVE • Dissolved Oxygen in Surface Water • Introduction to Mass Spectrometry • Making a Geologic Cross Section • Nutrients in Aquatic Ecosystems • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
DOMAIN / ACADEMIC CONTENT STANDARD	OH.ES.	ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical

		geology and introduces students to key concepts, principles and theories within environmental science.
STANDARD / BENCHMARK	ES.2.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	ES.2.4.	Soil and land
PROFICIENCY LEVEL	ES.2.4.2.	Mass wasting and erosion JoVE • Turbidity and Total Solids in Surface Water
PROFICIENCY LEVEL	ES.2.4.3.	Sediment contamination JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Gram Staining of Bacteria from Environmental Sources • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
PROFICIENCY LEVEL	ES.2.4.4.	Land use and land management (including food production, agriculture and zoning) JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Carbon and Nitrogen Analysis of Environmental Samples • Determination of Moisture Content in Soil • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Testing For Genetically Modified Foods
PROFICIENCY LEVEL	ES.2.4.5.	Solid and hazardous waste JoVE • Self-report vs. Behavioral Measures of Recycling

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.ES.**	**ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.**
STANDARD / BENCHMARK	**ES.2.**	**Earth's Resources**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.2.5.**	**Wildlife and wilderness**
PROFICIENCY LEVEL	**ES.2.5.1.**	**Wildlife and wilderness management** **JoVE** **• Self-report vs. Behavioral Measures of Recycling** **• Tree Identification: How To Use a Dichotomous Key** **• Tree Survey: Point-Centered Quarter Sampling Method** **• Using GIS to Investigate Urban Forestry**
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.ES.**	**ENVIRONMENTAL SCIENCE: Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.**
STANDARD / BENCHMARK	**ES.3.**	**Global Environmental Problems and Issues**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.3.1.**	**Human population** **JoVE** **• Nutrients in Aquatic Ecosystems**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.3.2.**	**Potable water quality, use and availability** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Detection of Bacteriophages in Environmental Samples** **• Dissolved Oxygen in Surface Water** **• Gram Staining of Bacteria from Environmental Sources** **• Introduction to Mass Spectrometry** **• Isolation of Fecal Bacteria from Water Samples by Filtration** **• Nutrients in Aquatic Ecosystems** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• Turbidity and Total Solids in Surface Water** **• Water Quality Analysis via Indicator Organisms** **• Zebrafish Maintenance and Husbandry**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.3.3.**	**Climate change** **JoVE** **• Biofuels: Producing Ethanol from Cellulosic Material**
BENCHMARK / GRADE LEVEL INDICATOR	**ES.3.4.**	**Sustainability** **JoVE**

		• Electrophoretic Mobility Shift Assay (EMSA) • Self-report vs. Behavioral Measures of Recycling
BENCHMARK / GRADE LEVEL INDICATOR	ES.3.6.	Air quality JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Gas Chromatography (GC) with Flame-Ionization Detection • Measuring Tropospheric Ozone • Using GIS to Investigate Urban Forestry
BENCHMARK / GRADE LEVEL INDICATOR	ES.3.7.	Food production and availability JoVE • An Overview of Genetic Engineering
BENCHMARK / GRADE LEVEL INDICATOR	ES.3.9.	Waste management (solid and hazardous) JoVE • Dissolved Oxygen in Surface Water • Isolation of Fecal Bacteria from Water Samples by Filtration • Nutrients in Aquatic Ecosystems • Self-report vs. Behavioral Measures of Recycling • Turbidity and Total Solids in Surface Water
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.SI.	Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:
BENCHMARK / GRADE LEVEL INDICATOR	PG.SI.3.	Use technology and mathematics to improve investigations and communications. JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Making a Geologic Cross Section • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment

DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.1.	Minerals
BENCHMARK / GRADE LEVEL INDICATOR	PG.1.1.	Atoms and elements JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography
BENCHMARK / GRADE LEVEL INDICATOR	PG.1.2.	Chemical bonding (ionic, covalent, metallic) JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography
BENCHMARK / GRADE LEVEL INDICATOR	PG.1.3.	Crystallinity (crystal structure) JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography
BENCHMARK / GRADE LEVEL INDICATOR	PG.1.4.	Criteria of a mineral (crystalline solid, occurs in nature, inorganic, defined chemical composition) JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography
BENCHMARK / GRADE LEVEL INDICATOR	PG.1.5.	Properties of minerals (hardness, luster, cleavage, streak, crystal shape. fluorescence, flammability, density/specific gravity, malleability) JoVE • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Purification of a Total Lipid Extract with Column Chromatography

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PG.**	**PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.**
STANDARD / BENCHMARK	**PG.2.**	**Igneous Rocks**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.1.**	**Mafic and felsic rocks and minerals** **JoVE** **• Igneous Intrusive Rock** **• Igneous Volcanic Rock**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.2.**	**Intrusive (igneous structures: dikes, sills, batholiths, pegmatites)** **JoVE** **• Igneous Intrusive Rock** **• Igneous Volcanic Rock**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.3.**	**Earth's interior (inner core, outer core, lower mantle, upper mantle, Mohorovicic discontinuity, crust)** **JoVE** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass** **• Igneous Intrusive Rock** **• Igneous Volcanic Rock** **• Using Topographic Maps to Generate Topographic Profiles**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.4.**	**Magnetic reversals and Earth's magnetic field** **JoVE** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.6.**	**Extrusive (volcanic activity, volcanoes: cinder cones, composite, shield)** **JoVE** **• Igneous Intrusive Rock** **• Igneous Volcanic Rock**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.2.7.**	**Bowen's Reaction Series (continuous and discontinuous branches)** **JoVE** **• Igneous Intrusive Rock** **• Igneous Volcanic Rock**
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PG.**	**PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.**

STANDARD / BENCHMARK	PG.4.	Sedimentary Rocks
BENCHMARK / GRADE LEVEL INDICATOR	PG.4.1.	The ocean
PROFICIENCY LEVEL	PG.4.1.6.	Passive and active continental margins JoVE • Igneous Intrusive Rock
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.5.	Earth's History
BENCHMARK / GRADE LEVEL INDICATOR	PG.5.1.	The geologic rock record
PROFICIENCY LEVEL	PG.5.1.1.	Relative and absolute age JoVE • Making a Geologic Cross Section
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.5.	Earth's History
BENCHMARK / GRADE LEVEL INDICATOR	PG.5.1.	The geologic rock record
PROFICIENCY LEVEL	PG.5.1.2.	Principles to determine relative age
INDICATOR	PG.5.1.2.a.	Original horizontality JoVE • Making a Geologic Cross Section
INDICATOR	PG.5.1.2.b.	Superposition JoVE • Making a Geologic Cross Section
INDICATOR	PG.5.1.2.c.	Cross-cutting relationships JoVE • Making a Geologic Cross Section
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.5.	Earth's History

BENCHMARK / GRADE LEVEL INDICATOR	PG.5.1.	The geologic rock record
PROFICIENCY LEVEL	PG.5.1.4.	Combining relative and absolute age data JoVE • Making a Geologic Cross Section
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.5.	Earth's History
BENCHMARK / GRADE LEVEL INDICATOR	PG.5.1.	The geologic rock record
PROFICIENCY LEVEL	PG.5.1.5.	The geologic time scale
INDICATOR	PG.5.1.5.a.	Comprehending geologic time JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.6.	Plate Tectonics
BENCHMARK / GRADE LEVEL INDICATOR	PG.6.1.	Internal Earth
PROFICIENCY LEVEL	PG.6.1.2.	Structure of Earth (Note: specific layers were part of grade 8)
INDICATOR	PG.6.1.2.a.	Asthenosphere JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
INDICATOR	PG.6.1.2.b.	Lithosphere JoVE • Determining Spatial Orientation of Rock Layers with

		the Brunton Compass • Igneous Volcanic Rock • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	PG.6.1.2.c.	Mohorovicic boundary (Moho) JoVE • Igneous Intrusive Rock • Igneous Volcanic Rock • Using Topographic Maps to Generate Topographic Profiles
INDICATOR	PG.6.1.2.d.	Composition of each of the layers of Earth JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass • Igneous Intrusive Rock • Igneous Volcanic Rock • Using Topographic Maps to Generate Topographic Profiles
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.6.	Plate Tectonics
BENCHMARK / GRADE LEVEL INDICATOR	PG.6.2.	Historical review (Note: this would include a review of continental drift and sea-floor spreading found in grade 8)
PROFICIENCY LEVEL	PG.6.2.1.	Paleomagnetism and magnetic anomalies JoVE • Determining Spatial Orientation of Rock Layers with the Brunton Compass
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.6.	Plate Tectonics
BENCHMARK / GRADE LEVEL INDICATOR	PG.6.3.	Plate motion (Note: introduced in grade 8)
PROFICIENCY LEVEL	PG.6.3.1.	Causes and evidence of plate motion 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
PROFICIENCY LEVEL	PG.6.3.2.	Measuring plate motion 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
PROFICIENCY LEVEL	PG.6.3.3.	Characteristics of oceanic and continental plates 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
PROFICIENCY LEVEL	PG.6.3.4.	Relationship of plate movement and geologic events and features JoVE • Igneous Volcanic Rock
PROFICIENCY LEVEL	PG.6.3.5.	Mantle plumes JoVE • Igneous Volcanic Rock
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.7.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	PG.7.1.	Energy resources
PROFICIENCY LEVEL	PG.7.1.1.	Renewable and nonrenewable energy sources and efficiency JoVE • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy

		• Dissolved Oxygen in Surface Water • Fractional Distillation • Nutrients in Aquatic Ecosystems • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis • Turbidity and Total Solids in Surface Water • Water Quality Analysis via Indicator Organisms
PROFICIENCY LEVEL	PG.7.1.2.	Alternate energy sources and efficiency JoVE • Bacterial Growth Curve Analysis and its Environmental Applications • Biofuels: Producing Ethanol from Cellulosic Material • Proton Exchange Membrane Fuel Cells • Raman Spectroscopy for Chemical Analysis
PROFICIENCY LEVEL	PG.7.1.3.	Resource availability JoVE • Biofuels: Producing Ethanol from Cellulosic Material • Dissolved Oxygen in Surface Water • Igneous Intrusive Rock • Nutrients in Aquatic Ecosystems • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Using GIS to Investigate Urban Forestry • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PG.	PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.
STANDARD / BENCHMARK	PG.7.	Earth's Resources
BENCHMARK / GRADE LEVEL INDICATOR	PG.7.2.	Air
PROFICIENCY LEVEL	PG.7.2.1.	Primary and secondary contaminants JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone
PROFICIENCY LEVEL	PG.7.2.2.	Greenhouse gases JoVE • Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy • Measuring Tropospheric Ozone

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PG.**	**PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.**
STANDARD / BENCHMARK	**PG.7.**	**Earth's Resources**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.7.3.**	**Water**
PROFICIENCY LEVEL	**PG.7.3.1.**	**Potable water and water quality** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Detection of Bacteriophages in Environmental Samples** **• Determining the Solubility Rules of Ionic Compounds** **• Dissolved Oxygen in Surface Water** **• Gram Staining of Bacteria from Environmental Sources** **• Introduction to Mass Spectrometry** **• Isolation of Fecal Bacteria from Water Samples by Filtration** **• Le Châtelier's Principle** **• Making a Geologic Cross Section** **• Nutrients in Aquatic Ecosystems** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR** **• Turbidity and Total Solids in Surface Water** **• Water Quality Analysis via Indicator Organisms** **• Zebrafish Maintenance and Husbandry**
PROFICIENCY LEVEL	**PG.7.3.2.**	**Hypoxia, eutrophication** **JoVE** **• Algae Enumeration via Culturable Methodology** **• Determining the Solubility Rules of Ionic Compounds** **• Dissolved Oxygen in Surface Water** **• Introduction to Mass Spectrometry** **• Le Châtelier's Principle** **• Making a Geologic Cross Section** **• Nutrients in Aquatic Ecosystems** **• Turbidity and Total Solids in Surface Water** **• Water Quality Analysis via Indicator Organisms**
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PG.**	**PHYSICAL GEOLOGY: Physical geology incorporates chemistry, physics and environmental science and introduces students to key concepts, principles and theories within geology.**
STANDARD / BENCHMARK	**PG.7.**	**Earth's Resources**
BENCHMARK / GRADE LEVEL INDICATOR	**PG.7.4.**	**Soil and sediment**

PROFICIENCY LEVEL	PG.7.4.2.	Mass wasting and erosion JoVE • Turbidity and Total Solids in Surface Water
PROFICIENCY LEVEL	PG.7.4.3.	Sediment contamination JoVE • Analysis of Earthworm Populations in Soil • Bacterial Growth Curve Analysis and its Environmental Applications • Carbon and Nitrogen Analysis of Environmental Samples • Community DNA Extraction from Bacterial Colonies • Culturing and Enumerating Bacteria from Soil Samples • Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis • Determination of Moisture Content in Soil • Gram Staining of Bacteria from Environmental Sources • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.SI.	Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:
BENCHMARK / GRADE LEVEL INDICATOR	PS.SI.3.	Use technology and mathematics to improve investigations and communications; JoVE • Common Lab Glassware and Uses

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PS.**	**PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.**
STANDARD / BENCHMARK	**PS.1.**	**Study of Matter**
BENCHMARK / GRADE LEVEL INDICATOR	**PS.1.1.**	**Classification of matter**
PROFICIENCY LEVEL	**PS.1.1.1.**	**Heterogeneous vs. homogeneous** **JoVE** **• An Introduction to the Micropipettor** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Chromatography-Based Biomolecule Purification Methods** **• Column Chromatography** **• Conducting Reactions Below Room Temperature** **• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry** **• Cyclic Voltammetry (CV)** **• Degassing Liquids with Freeze-Pump-Thaw Cycling** **• Density Gradient Ultracentrifugation** **• Determining the Density of a Solid and Liquid** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Determining the Solubility Rules of Ionic Compounds** **• Dialysis: Diffusion Based Separation** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction** **• Fractional Distillation** **• Freezing-Point Depression to Determine an Unknown Compound** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Growing Crystals for X-ray Diffraction Analysis**

		• High-Performance Liquid Chromatography (HPLC) • Internal Standards • Introduction to Serological Pipettes and Pipettors • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Ion-Exchange Chromatography • Le Châtelier's Principle • Making Solutions in the Laboratory • Method of Standard Addition • Performing 1D Thin Layer Chromatography • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Preparing Anhydrous Reagents and Equipment • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • Sample Preparation for Analytical Preparation • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spectrophotometric Determination of an Equilibrium Constant • Two-Dimensional Gel Electrophoresis • Understanding Concentration and Measuring Volumes • Using a pH Meter
PROFICIENCY LEVEL	PS.1.1.2.	Properties of matter JoVE • An Introduction to Cell Metabolism • Common Lab Glassware and Uses • Cyclic Voltammetry (CV) • Detecting Reactive Oxygen Species • Determining the Density of a Solid and Liquid • Determining the Mass Percent Composition in an Aqueous Solution • Enzyme Assays and Kinetics • Freezing-Point Depression to Determine an Unknown Compound • Introduction to Titration • Proton Exchange Membrane Fuel Cells • The ATP Bioluminescence Assay

		• The ELISA Method • Using a pH Meter
PROFICIENCY LEVEL	PS.1.1.3.	States of matter and its changes <u>JoVE</u> • Assembly of a Reflux System for Heated Chemical Reactions • Degassing Liquids with Freeze-Pump-Thaw Cycling • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • Gas Chromatography (GC) with Flame-Ionization Detection • Growing Crystals for X-ray Diffraction Analysis • Ideal Gas Law • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Preparing Anhydrous Reagents and Equipment • Protein Crystallization • Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent • Schlenk Lines Transfer of Solvents • Separation of Mixtures via Precipitation • Solid-Liquid Extraction • Solutions and Concentrations • The Ideal Gas Law • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.1.	Study of Matter
BENCHMARK / GRADE LEVEL INDICATOR	PS.1.2.	Atoms
PROFICIENCY LEVEL	PS.1.2.1.	Models of the atom (components) <u>JoVE</u> • Coordination Chemistry Complexes • Determining the Empirical Formula

		• Scanning Electron Microscopy (SEM) • X-ray Fluorescence (XRF)
PROFICIENCY LEVEL	PS.1.2.2.	Ions (cations and anions) <u>JoVE</u> • Capillary Electrophoresis (CE) • Chromatography-Based Biomolecule Purification Methods • Determining the Solubility Rules of Ionic Compounds • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat • Electrophoretic Mobility Shift Assay (EMSA) • Introduction to Mass Spectrometry • Ion-Exchange Chromatography • MALDI-TOF Mass Spectrometry • Tandem Mass Spectrometry • Two-Dimensional Gel Electrophoresis
PROFICIENCY LEVEL	PS.1.2.3.	Isotopes <u>JoVE</u> • Metabolic Labeling
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.1.	Study of Matter
BENCHMARK / GRADE LEVEL INDICATOR	PS.1.3.	Periodic trends of the elements
PROFICIENCY LEVEL	PS.1.3.2.	Representative groups <u>JoVE</u> • Chromatography-Based Biomolecule Purification Methods • Coordination Chemistry Complexes • Determining the Solubility Rules of Ionic Compounds • Introduction to Mass Spectrometry • Surface Plasmon Resonance (SPR) • X-ray Fluorescence (XRF)
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science

		disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.1.	Study of Matter
BENCHMARK / GRADE LEVEL INDICATOR	PS.1.4.	Bonding and compounds
PROFICIENCY LEVEL	PS.1.4.1.	Bonding (ionic and covalent) JoVE • An Overview of Alkenone Biomarker Analysis for Paleothermometry • An Overview of bGDGT Biomarker Analysis for Paleoclimatology • Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry • Determining the Solubility Rules of Ionic Compounds • Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Purification of a Total Lipid Extract with Column Chromatography • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Ultraviolet-Visible (UV-Vis) Spectroscopy
PROFICIENCY LEVEL	PS.1.4.2.	Nomenclature JoVE • Purification of a Total Lipid Extract with Column Chromatography • Sonication Extraction of Lipid Biomarkers from Sediment
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.

STANDARD / BENCHMARK	**PS.1.**	**Study of Matter**
BENCHMARK / GRADE LEVEL INDICATOR	**PS.1.5.**	**Reactions of matter**
PROFICIENCY LEVEL	**PS.1.5.1.**	**Chemical reactions** **JoVE** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Calibration Curves** **• Conducting Reactions Below Room Temperature** **• Coordination Chemistry Complexes** **• Cyclic Voltammetry (CV)** **• Determining Rate Laws and the Order of Reaction** **• Determining the Empirical Formula** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Determining the Solubility Rules of Ionic Compounds** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Enzyme Assays and Kinetics** **• Freezing-Point Depression to Determine an Unknown Compound** **• Growing Crystals for X-ray Diffraction Analysis** **• Introduction to Catalysis** **• Introduction to Titration** **• Le Châtelier's Principle** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Photometric Protein Determination** **• Preparing Anhydrous Reagents and Equipment** **• Proton Exchange Membrane Fuel Cells** **• Purifying Compounds by Recrystallization** **• Rotary Evaporation to Remove Solvent** **• Separation of Mixtures via Precipitation** **• Solutions and Concentrations** **• Spectrophotometric Determination of an Equilibrium Constant** **• The ELISA Method** **• Using Differential Scanning Calorimetry to Measure Changes in Enthalpy** **• Using a pH Meter**
PROFICIENCY LEVEL	**PS.1.5.2.**	**Nuclear reactions** **JoVE** **• Determining Rate Laws and the Order of Reaction** **• Nuclear Magnetic Resonance (NMR) Spectroscopy**
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.PS.**	**PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science**

		disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.2.	Energy and Waves
BENCHMARK / GRADE LEVEL INDICATOR	PS.2.1.	Conservation of energy
PROFICIENCY LEVEL	PS.2.1.3.	Energy is relative JoVE • Raman Spectroscopy for Chemical Analysis
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.2.	Energy and Waves
BENCHMARK / GRADE LEVEL INDICATOR	PS.2.2.	Transfer and transformation of energy (including work) JoVE • fMRI: Functional Magnetic Resonance Imaging
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.2.	Energy and Waves
BENCHMARK / GRADE LEVEL INDICATOR	PS.2.3.	Waves

PROFICIENCY LEVEL	**PS.2.3.1.**	**Refraction, reflection, diffraction, absorption, superposition** **JoVE** **• Abdominal Exam II: Percussion** **• Auscultation** **• Color Afterimages** **• Crowding** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Finding Your Blind Spot and Perceptual Filling-in** **• Histological Sample Preparation for Light Microscopy** **• Inattentional Blindness** **• Introduction to Fluorescence Microscopy** **• Introduction to Light Microscopy** **• Introduction to the Spectrophotometer** **• Just-noticeable Differences** **• Motion-induced Blindness** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• Percussion** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• Photometric Protein Determination** **• Raman Spectroscopy for Chemical Analysis** **• Spatial Cueing** **• Spectrophotometric Determination of an Equilibrium Constant** **• Surface Plasmon Resonance (SPR)** **• The Ames Room** **• The Attentional Blink** **• The Inverted-face Effect** **• Turbidity and Total Solids in Surface Water** **• Ultraviolet-Visible (UV-Vis) Spectroscopy**
PROFICIENCY LEVEL	**PS.2.3.2.**	**Radiant energy and the electromagnetic spectrum** **JoVE** **• Abdominal Exam II: Percussion** **• Auscultation** **• Color Afterimages** **• Crowding** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Finding Your Blind Spot and Perceptual Filling-in** **• Histological Sample Preparation for Light Microscopy** **• Inattentional Blindness** **• Introduction to Fluorescence Microscopy** **• Introduction to Light Microscopy** **• Introduction to the Spectrophotometer** **• Just-noticeable Differences** **• Lead Analysis of Soil Using Atomic Absorption**

		Spectroscopy • Motion-induced Blindness • Nuclear Magnetic Resonance (NMR) Spectroscopy • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Percussion • Photometric Protein Determination • Raman Spectroscopy for Chemical Analysis • Spatial Cueing • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • The Ames Room • The Attentional Blink • The Inverted-face Effect • The Staircase Procedure for Finding a Perceptual Threshold • Turbidity and Total Solids in Surface Water • Ultraviolet-Visible (UV-Vis) Spectroscopy
PROFICIENCY LEVEL	PS.2.3.3.	Doppler shift JoVE • Peripheral Vascular Exam Using a Continuous Wave Doppler
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.2.	Energy and Waves
BENCHMARK / GRADE LEVEL INDICATOR	PS.2.4.	Thermal energy JoVE • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously

		learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.2.	Energy and Waves
BENCHMARK / GRADE LEVEL INDICATOR	PS.2.5.	Electricity
PROFICIENCY LEVEL	PS.2.5.1.	Movement of electrons JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Electro-encephalography (EEG) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
PROFICIENCY LEVEL	PS.2.5.2.	Current JoVE • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
PROFICIENCY LEVEL	PS.2.5.3.	Electric potential (voltage) JoVE • Cyclic Voltammetry (CV) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
DOMAIN / ACADEMIC CONTENT STANDARD	OH.PS.	PHYSICAL SCIENCE: Physical science introduces students to key concepts and theories that provide a foundation for further study in other sciences and advanced science disciplines. Physical science comprises the systematic study of the physical world as it relates to fundamental concepts about matter, energy and motion. A unified understanding of phenomena in physical, living, Earth and space systems is the culmination of all previously learned concepts related to chemistry, physics, and Earth and space science, along with historical perspective and mathematical reasoning.
STANDARD / BENCHMARK	PS.3.	Forces and Motion
BENCHMARK / GRADE LEVEL INDICATOR	PS.3.2.	Forces
PROFICIENCY LEVEL	PS.3.2.2.	Types of forces (gravity, friction, normal, tension) JoVE • Assembly of a Reflux System for Heated Chemical Reactions • Fractional Distillation • Growing Crystals for X-ray Diffraction Analysis

		• Purifying Compounds by Recrystallization • Rotary Evaporation to Remove Solvent
PROFICIENCY LEVEL	PS.3.2.3.	Field model for forces at a distance JoVE • Introduction to Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.SI.	Science Inquiry and Application - During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:
BENCHMARK / GRADE LEVEL INDICATOR	P.SI.3.	Use technology and mathematics to improve investigations and communications. JoVE • Common Lab Glassware and Uses
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.2.	Forces, momentum and motion
BENCHMARK / GRADE LEVEL INDICATOR	P.2.6.	Forces in two dimensions
PROFICIENCY LEVEL	P.2.6.3.	Centripetal forces and circular motion JoVE • An Introduction to the Centrifuge
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.4.	Waves
BENCHMARK / GRADE LEVEL INDICATOR	P.4.1.	Wave properties
PROFICIENCY LEVEL	P.4.1.2.	Reflection JoVE • Abdominal Exam II: Percussion

		• Auscultation • Color Afterimages • Crowding • Finding Your Blind Spot and Perceptual Filling-in • Histological Sample Preparation for Light Microscopy • Inattentional Blindness • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Just-noticeable Differences • Motion-induced Blindness • Object Substitution Masking • Percussion • Peripheral Vascular Exam Using a Continuous Wave Doppler • Spatial Cueing • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • The Ames Room • The Attentional Blink • The Inverted-face Effect
PROFICIENCY LEVEL	P.4.1.3.	Refraction JoVE • Color Afterimages • Crowding • Finding Your Blind Spot and Perceptual Filling-in • Histological Sample Preparation for Light Microscopy • Inattentional Blindness • Introduction to Fluorescence Microscopy • Introduction to Light Microscopy • Just-noticeable Differences • Motion-induced Blindness • Object Substitution Masking • Spatial Cueing • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • The Ames Room • The Attentional Blink • The Inverted-face Effect
PROFICIENCY LEVEL	P.4.1.4.	Interference JoVE • Raman Spectroscopy for Chemical Analysis
PROFICIENCY LEVEL	P.4.1.5.	Diffraction JoVE • Raman Spectroscopy for Chemical Analysis

DOMAIN / ACADEMIC CONTENT STANDARD	**OH.P.**	**PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.**
STANDARD / BENCHMARK	**P.4.**	**Waves**
BENCHMARK / GRADE LEVEL INDICATOR	**P.4.2.**	**Light phenomena**
PROFICIENCY LEVEL	**P.4.2.4.**	**Diffraction patterns** **JoVE** **• Coordination Chemistry Complexes** **• Förster Resonance Energy Transfer (FRET)** **• Gas Chromatography (GC) with Flame-Ionization Detection** **• Introduction to Fluorescence Microscopy** **• Introduction to the Microplate Reader** **• Lead Analysis of Soil Using Atomic Absorption Spectroscopy** **• MALDI-TOF Mass Spectrometry** **• Method of Standard Addition** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Protein Crystallization** **• Raman Spectroscopy for Chemical Analysis** **• Tandem Mass Spectrometry** **• Ultraviolet-Visible (UV-Vis) Spectroscopy** **• X-ray Fluorescence (XRF)**
PROFICIENCY LEVEL	**P.4.2.6.**	**Visible spectrum and color** **JoVE** **• Color Afterimages** **• Crowding** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Finding Your Blind Spot and Perceptual Filling-in** **• Histological Sample Preparation for Light Microscopy** **• Inattentional Blindness** **• Introduction to Fluorescence Microscopy** **• Introduction to Light Microscopy** **• Introduction to the Spectrophotometer** **• Just-noticeable Differences** **• Lead Analysis of Soil Using Atomic Absorption Spectroscopy** **• Motion-induced Blindness** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• Photometric Protein Determination** **• Raman Spectroscopy for Chemical Analysis** **• Spatial Cueing**

		• Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • The Ames Room • The Attentional Blink • The Inverted-face Effect • Turbidity and Total Solids in Surface Water • Ultraviolet-Visible (UV-Vis) Spectroscopy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.5.	Electricity and magnetism
BENCHMARK / GRADE LEVEL INDICATOR	P.5.3.	Electric fields and electric potential energy JoVE • Cyclic Voltammetry (CV) • Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.5.	Electricity and magnetism
BENCHMARK / GRADE LEVEL INDICATOR	P.5.4.	DC circuits
PROFICIENCY LEVEL	P.5.4.4.	Mixed circuits JoVE • Nuclear Magnetic Resonance (NMR) Spectroscopy
PROFICIENCY LEVEL	P.5.4.5.	Applying conservation of charge and energy (junction and loop rules) JoVE • Nuclear Magnetic Resonance (NMR) Spectroscopy
DOMAIN / ACADEMIC CONTENT STANDARD	OH.P.	PHYSICS: Physics elaborates on the study of the key concepts of motion, forces and energy as they relate to increasingly complex systems and applications that will provide a foundation for further study in science and scientific literacy.
STANDARD / BENCHMARK	P.5.	Electricity and magnetism
BENCHMARK / GRADE LEVEL INDICATOR	P.5.5.	Magnetic fields and energy

		JoVE • Introduction to Mass Spectrometry • Nuclear Magnetic Resonance (NMR) Spectroscopy
BENCHMARK / GRADE LEVEL INDICATOR	P.5.6.	Electromagnetic interactions JoVE • Nuclear Magnetic Resonance (NMR) Spectroscopy • Raman Spectroscopy for Chemical Analysis • fMRI: Functional Magnetic Resonance Imaging
DOMAIN / ACADEMIC CONTENT STANDARD	OH.RST.9-10.	Reading Standards for Literacy in Science and Technical Subjects
STANDARD / BENCHMARK		Craft and Structure
BENCHMARK / GRADE LEVEL INDICATOR	RST.9-10.4.	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. JoVE • Abdominal Exam I: Inspection and Auscultation • Abdominal Exam II: Percussion • Abdominal Exam III: Palpation • Abdominal Exam IV: Acute Abdominal Pain Assessment • Algae Enumeration via Culturable Methodology • An Introduction to Aging and Regeneration • An Introduction to Behavioral Neuroscience • An Introduction to Caenorhabditis elegans • An Introduction to Cell Death • An Introduction to Cell Division • An Introduction to Cell Metabolism • An Introduction to Cell Motility and Migration • An Introduction to Cellular and Molecular Neuroscience • An Introduction to Cognition • An Introduction to Developmental Genetics • An Introduction to Developmental Neurobiology • An Introduction to Drosophila melanogaster • An Introduction to Endocytosis and Exocytosis • An Introduction to Learning and Memory • An Introduction to Modeling Behavioral Disorders and Stress • An Introduction to Molecular Developmental Biology • An Introduction to Motor Control • An Introduction to Neuroanatomy • An Introduction to Neurophysiology • An Introduction to Organogenesis • An Introduction to Reward and Addiction • An Introduction to Saccharomyces cerevisiae • An Introduction to Stem Cell Biology • An Introduction to Transfection

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

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

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

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

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

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

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

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

BENCHMARK / GRADE LEVEL INDICATOR	**RST.9-10.5.**	**Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).** **<u>JoVE</u>** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Aging and Regeneration** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cell Motility and Migration** **• An Introduction to Cellular and Molecular Neuroscience** **• An Introduction to Cognition** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Motor Control** **• An Introduction to Neuroanatomy** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Reward and Addiction** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to Working in the Hood** **• An Introduction to the Centrifuge** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus** **• An Introduction to the Micropipettor** **• An Introduction to the Zebrafish: Danio rerio** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Epigenetics** **• An Overview of Gene Expression** **• An Overview of Genetic Analysis** **• An Overview of Genetic Engineering** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for**

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

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

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

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

		• Lower Back Exam • Lymph Node Exam • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Male Rectal Exam • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Mass in the Laboratory • Measuring Reaction Time and Donders' Method of Subtraction • Measuring Tropospheric Ozone • Measuring Verbal Working Memory Span • Measuring Vital Signs • Memory Development: Demonstrating How Repeated Questioning Leads to False Memories • Mental Rotation • Metabolic Labeling • Metacognitive Development: How Children Estimate Their Memory • Method of Standard Addition • Modeling Social Stress • Molecular Cloning • Motion-induced Blindness • Motor Exam I • Motor Exam II • Motor Learning in Mirror Drawing • Motor Maps • Mouse Genotyping • Multiple Object Tracking • Murine In Utero Electroporation • Mutual Exclusivity: How Children Learn the Meanings of Words • Neck Exam • Needle Thoracostomy (needle Decompression) for Temporizing Tension Pneumothorax Treatment • Neuronal Transfection Methods • Nose, Sinuses, Oral Cavity and Pharynx Exam • Nuclear Magnetic Resonance (NMR) Spectroscopy • Numerical Cognition: More or Less • Nutrients in Aquatic Ecosystems • Object Substitution Masking • Observation and Inspection • Observational Research • Ophthalmoscopic Examination • PCR: The Polymerase Chain Reaction • Palpation • Passaging Cells

		• Patch Clamp Electrophysiology • Pelvic Exam I: Assessment of the External Genitalia • Pelvic Exam II: Speculum Exam • Pelvic Exam III: Bimanual and Rectovaginal Exam • Percussion • Percutaneous Cricothyrotomy (Seldinger Technique) • Performing 1D Thin Layer Chromatography • Pericardiocentesis • Peripheral Vascular Exam • Peripheral Vascular Exam Using a Continuous Wave Doppler • Peripheral Venous Cannulation • Perspectives on Sensation and Perception • Photometric Protein Determination • Physical Properties Of Minerals I: Crystals and Cleavage • Physical Properties Of Minerals II: Polymineralic Analysis • Physiological Correlates of Emotion Recognition • Piaget's Conservation Task and the Influence of Task Demands • Pilot Testing • Placebos in Research • Plasmid Purification • Positive Reinforcement Studies • Preparing Anhydrous Reagents and Equipment • Primary Neuronal Cultures • Proper Adjustment of Patient Attire during the Physical Exam • Prospect Theory • Protein Crystallization • Proton Exchange Membrane Fuel Cells • Purification of a Total Lipid Extract with Column Chromatography • Purifying Compounds by Recrystallization • Quantifying Environmental Microorganisms and Viruses Using qPCR • RNA Analysis of Environmental Samples Using RT-PCR • RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Recombineering and Gene Targeting • Reconstitution of Membrane Proteins • Regulating Temperature in the Lab: Applying Heat • Regulating Temperature in the Lab: Preserving Samples Using Cold • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Respiratory Exam I: Inspection and Palpation • Respiratory Exam II: Percussion and Auscultation

		• Restriction Enzyme Digests • Rodent Handling and Restraint Techniques • Rodent Identification I • Rodent Identification II • Rodent Stereotaxic Surgery • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Sensory Exam • Separating Protein with SDS-PAGE • Separation of Mixtures via Precipitation • Shoulder Exam I • Shoulder Exam II • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Sterile Tissue Harvest • Surface Plasmon Resonance (SPR) • Surgical Cricothyrotomy • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Ames Room • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The McGurk Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Rubber Hand Illusion • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual

		Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Thyroid Exam • Tissue Regeneration with Somatic Stem Cells • Transplantation Studies • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water • Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Whole-Mount In Situ Hybridization • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • Yeast Reproduction • Yeast Transformation and Cloning • Zebrafish Breeding and Embryo Handling • Zebrafish Maintenance and Husbandry • Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.RST.9-10.**	**Reading Standards for Literacy in Science and Technical Subjects**
STANDARD / BENCHMARK		**Integration of Knowledge and Ideas**
BENCHMARK / GRADE LEVEL INDICATOR	**RST.9-10.7.**	**Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or**

		mathematically (e.g., in an equation) into words. **JoVE** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Aging and Regeneration** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cognition** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Motor Control** **• An Introduction to Neurophysiology** **• An Introduction to Reward and Addiction** **• An Overview of Alkenone Biomarker Analysis for Paleothermometry** **• An Overview of Genetic Analysis** **• An Overview of Genetics and Disease** **• An Overview of bGDGT Biomarker Analysis for Paleoclimatology** **• Analysis of Earthworm Populations in Soil** **• Annexin V and Propidium Iodide Labeling** **• Anterograde Amnesia** **• Anxiety Testing** **• Approximate Number Sense Test** **• Are You Smart or Hardworking? How Praise Influences Children's Motivation** **• Assembly of a Reflux System for Heated Chemical Reactions** **• Assessing Dexterity with Reaching Tasks** **• Bacterial Growth Curve Analysis and its Environmental Applications** **• Balance and Coordination Testing** **• Basic Mouse Care and Maintenance** **• Binocular Rivalry** **• Biofuels: Producing Ethanol from Cellulosic Material** **• Blood Pressure Measurement** **• C. elegans Chemotaxis Assay** **• Calcium Imaging in Neurons** **• Calibration Curves** **• Capillary Electrophoresis (CE)** **• Carbon and Nitrogen Analysis of Environmental Samples** **• Categories and Inductive Inferences** **• Cell Cycle Analysis** **• Cell-surface Biotinylation Assay** **• Children's Reliance on Artist Intentions When**

		Identifying Pictures **• Chromatin Immunoprecipitation** **• Chromatography-Based Biomolecule Purification Methods** **• Co-Immunoprecipitation and Pull-Down Assays** **• Column Chromatography** **• Community DNA Extraction from Bacterial Colonies** **• Conducting Reactions Below Room Temperature** **• Conversion of Fatty Acid Methyl Esters by Saponification for Uk'37 Paleothermometry** **• Coordination Chemistry Complexes** **• Crowding** **• Culturing and Enumerating Bacteria from Soil Samples** **• Cyclic Voltammetry (CV)** **• DNA Methylation Analysis** **• Decision-making and the Iowa Gambling Task** **• Decoding Auditory Imagery with Multivoxel Pattern Analysis** **• Degassing Liquids with Freeze-Pump-Thaw Cycling** **• Density Gradient Ultracentrifugation** **• Detecting Environmental Microorganisms with the Polymerase Chain Reaction and Gel Electrophoresis** **• Detecting Reactive Oxygen Species** **• Determination Of Nox in Automobile Exhaust Using UV-VIS Spectroscopy** **• Determination of Moisture Content in Soil** **• Determining Rate Laws and the Order of Reaction** **• Determining Spatial Orientation of Rock Layers with the Brunton Compass** **• Determining the Density of a Solid and Liquid** **• Determining the Empirical Formula** **• Determining the Mass Percent Composition in an Aqueous Solution** **• Determining the Solubility Rules of Ionic Compounds** **• Development and Reproduction of the Laboratory Mouse** **• Dialysis: Diffusion Based Separation** **• Dichotic Listening** **• Dissolved Oxygen in Surface Water** **• Drosophila Development and Reproduction** **• Electro-encephalography (EEG)** **• Electrochemical Measurements of Supported Catalysts Using a Potentiostat/Galvanostat** **• Electrophoretic Mobility Shift Assay (EMSA)** **• Enzyme Assays and Kinetics** **• Ethics in Psychology Research** **• Event-related Potentials and the Oddball Task** **• Executive Function and the Dimensional Change Card Sort Task** **• Executive Function in Autism Spectrum Disorder** **• Experimentation using a Confederate** **• Expression Profiling with Microarrays**

		• Extraction of Biomarkers from Sediments - Accelerated Solvent Extraction • Eye Tracking in Cognitive Experiments • FM Dyes in Vesicle Recycling • Fate Mapping • Fear Conditioning • Fractional Distillation • Freezing-Point Depression to Determine an Unknown Compound • From Theory to Design: The Role of Creativity in Designing Experiments • Förster Resonance Energy Transfer (FRET) • Gas Chromatography (GC) with Flame-Ionization Detection • Gene Silencing with Morpholinos • Genetic Crosses • Genetic Screens • Growing Crystals for X-ray Diffraction Analysis • Habituation: Studying Infants Before They Can Talk • High-Performance Liquid Chromatography (HPLC) • How Children Solve Problems Using Causal Reasoning • Ideal Gas Law • Igneous Intrusive Rock • Igneous Volcanic Rock • Inattentional Blindness • Incidental Encoding • Internal Standards • Introducing Experimental Agents into the Mouse • Introduction to Catalysis • Introduction to Mass Spectrometry • Introduction to Titration • Introduction to the Microplate Reader • Introduction to the Spectrophotometer • Invasion Assay Using 3D Matrices • Invertebrate Lifespan Quantification • Ion-Exchange Chromatography • Isolating Nucleic Acids from Yeast • Just-noticeable Differences • Language: The N400 in Semantic Incongruity • Le Châtelier's Principle • Lead Analysis of Soil Using Atomic Absorption Spectroscopy • Learning and Memory: The Remember-Know Task • MALDI-TOF Mass Spectrometry • Making Solutions in the Laboratory • Making a Geologic Cross Section • Manipulating an Independent Variable through Embodiment • Measuring Children's Trust in Testimony • Measuring Grey Matter Differences with Voxel-based Morphometry: The Musical Brain • Measuring Reaction Time and Donders' Method of

		Subtraction **• Measuring Tropospheric Ozone** **• Measuring Verbal Working Memory Span** **• Measuring Vital Signs** **• Memory Development: Demonstrating How Repeated Questioning Leads to False Memories** **• Mental Rotation** **• Metabolic Labeling** **• Metacognitive Development: How Children Estimate Their Memory** **• Method of Standard Addition** **• Modeling Social Stress** **• Motion-induced Blindness** **• Motor Learning in Mirror Drawing** **• Motor Maps** **• Multiple Object Tracking** **• Mutual Exclusivity: How Children Learn the Meanings of Words** **• Nuclear Magnetic Resonance (NMR) Spectroscopy** **• Numerical Cognition: More or Less** **• Nutrients in Aquatic Ecosystems** **• Object Substitution Masking** **• Observational Research** **• PCR: The Polymerase Chain Reaction** **• Patch Clamp Electrophysiology** **• Performing 1D Thin Layer Chromatography** **• Pericardiocentesis** **• Peripheral Vascular Exam Using a Continuous Wave Doppler** **• Perspectives on Cognitive Psychology** **• Perspectives on Neuropsychology** **• Photometric Protein Determination** **• Physical Properties Of Minerals I: Crystals and Cleavage** **• Physical Properties Of Minerals II: Polymineralic Analysis** **• Physiological Correlates of Emotion Recognition** **• Piaget's Conservation Task and the Influence of Task Demands** **• Pilot Testing** **• Placebos in Research** **• Plasmid Purification** **• Positive Reinforcement Studies** **• Preparing Anhydrous Reagents and Equipment** **• Prospect Theory** **• Protein Crystallization** **• Proton Exchange Membrane Fuel Cells** **• Purification of a Total Lipid Extract with Column Chromatography** **• Purifying Compounds by Recrystallization** **• Quantifying Environmental Microorganisms and Viruses Using qPCR** **• RNA Analysis of Environmental Samples Using RT-PCR**

		• RNA-Seq • RNAi in C. elegans • Raman Spectroscopy for Chemical Analysis • Realism in Experimentation • Reconstitution of Membrane Proteins • Reliability in Psychology Experiments • Removal of Branched and Cyclic Compounds by Urea Adduction for Uk'37 Paleothermometry • Rotary Evaporation to Remove Solvent • SNP Genotyping • Sample Preparation for Analytical Preparation • Scanning Electron Microscopy (SEM) • Schlenk Lines Transfer of Solvents • Self-administration Studies • Self-report vs. Behavioral Measures of Recycling • Separation of Mixtures via Precipitation • Soil Nutrient Analysis: Nitrogen, Phosphorus, and Potassium • Solid-Liquid Extraction • Solutions and Concentrations • Sonication Extraction of Lipid Biomarkers from Sediment • Soxhlet Extraction of Lipid Biomarkers from Sediment • Spatial Cueing • Spatial Memory Testing Using Mazes • Spectrophotometric Determination of an Equilibrium Constant • Surface Plasmon Resonance (SPR) • Tandem Mass Spectrometry • Testing For Genetically Modified Foods • The ATP Bioluminescence Assay • The Attentional Blink • The Costs and Benefits of Natural Pedagogy • The ELISA Method • The Factorial Experiment • The Ideal Gas Law • The Inverted-face Effect • The Morris Water Maze • The Multi-group Experiment • The Precision of Visual Working Memory with Delayed Estimation • The Rouge Test: Searching for a Sense of Self • The Simple Experiment: Two-group Design • The Split Brain • The Staircase Procedure for Finding a Perceptual Threshold • The TUNEL Assay • The Transwell Migration Assay • The Western Blot • Tree Identification: How To Use a Dichotomous Key • Tree Survey: Point-Centered Quarter Sampling Method • Turbidity and Total Solids in Surface Water

		• Two-Dimensional Gel Electrophoresis • Ultraviolet-Visible (UV-Vis) Spectroscopy • Understanding Concentration and Measuring Volumes • Using Differential Scanning Calorimetry to Measure Changes in Enthalpy • Using Diffusion Tensor Imaging in Traumatic Brain Injury • Using GIS to Investigate Urban Forestry • Using TMS to Measure Motor Excitability During Action Observation • Using Topographic Maps to Generate Topographic Profiles • Using Your Head: Measuring Infants' Rational Imitation of Actions • Using a pH Meter • Verbal Priming • Visual Attention: fMRI Investigation of Object-based Attentional Control • Visual Search for Features and Conjunctions • Visual Statistical Learning • Visualizing Soil Microorganisms via the Contact Slide Assay and Microscopy • Water Quality Analysis via Indicator Organisms • Within-subjects Repeated-measures Design • X-ray Fluorescence (XRF) • Yeast Maintenance • fMRI: Functional Magnetic Resonance Imaging
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.WHST.9-10.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD / BENCHMARK		**Text Types and Purposes**
BENCHMARK / GRADE LEVEL INDICATOR	**WHST.9-10.1.**	**Write arguments focused on discipline-specific content.**
PROFICIENCY LEVEL	**WHST.9-10.1(a)**	**Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.** **JoVE** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design**
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.WHST.9-10.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD / BENCHMARK		**Text Types and Purposes**
BENCHMARK / GRADE LEVEL INDICATOR	**WHST.9-10.2.**	**Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.**

PROFICIENCY LEVEL	**WHST.9-10.2(a)**	**Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.** **JoVE** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design**
PROFICIENCY LEVEL	**WHST.9-10.2(d)**	**Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.** **JoVE** **• Abdominal Exam I: Inspection and Auscultation** **• Abdominal Exam II: Percussion** **• Abdominal Exam III: Palpation** **• Abdominal Exam IV: Acute Abdominal Pain Assessment** **• Algae Enumeration via Culturable Methodology** **• An Introduction to Aging and Regeneration** **• An Introduction to Behavioral Neuroscience** **• An Introduction to Caenorhabditis elegans** **• An Introduction to Cell Death** **• An Introduction to Cell Division** **• An Introduction to Cell Metabolism** **• An Introduction to Cell Motility and Migration** **• An Introduction to Cellular and Molecular Neuroscience** **• An Introduction to Cognition** **• An Introduction to Developmental Genetics** **• An Introduction to Developmental Neurobiology** **• An Introduction to Drosophila melanogaster** **• An Introduction to Endocytosis and Exocytosis** **• An Introduction to Learning and Memory** **• An Introduction to Modeling Behavioral Disorders and Stress** **• An Introduction to Molecular Developmental Biology** **• An Introduction to Motor Control** **• An Introduction to Neuroanatomy** **• An Introduction to Neurophysiology** **• An Introduction to Organogenesis** **• An Introduction to Reward and Addiction** **• An Introduction to Saccharomyces cerevisiae** **• An Introduction to Stem Cell Biology** **• An Introduction to Transfection** **• An Introduction to Working in the Hood** **• An Introduction to the Centrifuge** **• An Introduction to the Chick: Gallus gallus domesticus** **• An Introduction to the Laboratory Mouse: Mus musculus**

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

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

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

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

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

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

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

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

		• Zebrafish Microinjection Techniques • Zebrafish Reproduction and Development • fMRI: Functional Magnetic Resonance Imaging
DOMAIN / ACADEMIC CONTENT STANDARD	**OH.WHST.9-10.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD / BENCHMARK		**Text Types and Purposes**
BENCHMARK / GRADE LEVEL INDICATOR	**WHST.9-10.3.**	**(See note; not applicable as a separate requirement)**
PROFICIENCY LEVEL	**WHST.9-10.3(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.** **JoVE** **• Ethics in Psychology Research** **• Experimentation using a Confederate** **• From Theory to Design: The Role of Creativity in Designing Experiments** **• Manipulating an Independent Variable through Embodiment** **• Observational Research** **• Pilot Testing** **• Placebos in Research** **• Realism in Experimentation** **• Reliability in Psychology Experiments** **• The Factorial Experiment** **• The Multi-group Experiment** **• The Simple Experiment: Two-group Design** **• Within-subjects Repeated-measures Design**