WEI Education Materials: Activities Organized by NGSS Performace Expectations

Browse the list of bioenergy-related performance expectations from the Next Generation Science Standards and see which WEI classroom materials can help students meet those standards. Click on the activity title to go to the landing page where you can download complete instructional materials.

PS1: Matter and Its Interactions

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	• Biofuels vs Fossil Fuels Unit
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	• Biofuels vs Fossil Fuels Unit
HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	• CB2E: Converting Biomass to Ethanol • Quantitative Modeling of Life Cycles

PS3: Energy: Conservation, Forces, and Chemical Processes

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	• Modeling Power Grids with Snap Circuits

LS1: From Molecules to Organisms: Structure and Processes

K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.	• Fermentation in a Bag
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	• Root Depth Model

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	• Exploring Energy Transformations in Plants • Boosting Yeast's Appetite for Sugars
MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.	• Exploring Energy Transformations in Plants • Biofuels vs Fossil Fuels Unit
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	• Exploring Energy Transformations in Plants • Biofuels vs Fossil Fuels Unit
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	• Biofuels vs Fossil Fuels Unit
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	• Measuring Soil Microbial Activity • Biofuels vs Fossil Fuels Unit

LS2: Ecosystems: Interactions, Energy, and Dynamics

2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.	• Exploring Energy Transformations in Plants
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	• Biofuels vs Fossil Fuels Unit
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	• Bioprospecting: Filter Paper Assay Method • Bioprospecting: Individual Isolate Method • Bug Biodiversity & Ecosystem Benefits • Biomass Yield and Root Growth in Crops • Measuring Soil Microbial Activity • Fields of Fuel Computer Game • Biofuels vs Fossil Fuels Unit

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	• Bug Biodiversity & Ecosystem Benefits • Biodiversity and Sustainable Bioenergy Exploration Station
MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	• Bioprospecting: Filter Paper Assay Method • Bioprospecting: Individual Isolate Method • Life Cycle Assessment of Biofuels 101 • Biomass Yield and Root Growth in Crops • Root Depth Model • Measuring Soil Microbial Activity • Poker Chip Model: Carbon Pools & Fluxes • Biofuels vs Fossil Fuels Unit
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	• Biomass Yield and Root Growth in Crops • Measuring Soil Microbial Activity • Fields of Fuel Computer Game • Biofuels vs Fossil Fuels Unit
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	• The Bioenergy Farm Game • Bug Biodiversity & Ecosystem Benefits • Biodiversity and Sustainable Bioenergy Exploration Station • Fields of Fuel Computer Game • Research Story: Entomology Detectives • Farming for Beetles, Bees, and Biomass
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	• Bug Biodiversity & Ecosystem Benefits • Biomass Yield and Root Growth in Crops • Fields of Fuel Computer Game • Research Story: The Science of Farming • Growing Energy: Comparing Crop Yields • Farming for Beetles, Bees, and Biomass
HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	• Fermentation in a Bag • Fermentation Challenge: Making Ethanol • Mini Fermenter • CB2E: Converting Biomass to Ethanol • Measuring Soil Microbial Activity • Biofuels vs Fossil Fuels Unit

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	• Biomass Yield and Root Growth in Crops • Measuring Soil Microbial Activity • Poker Chip Model: Carbon Pools & Fluxes • Biofuels vs Fossil Fuels Unit
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	• Fermentation Challenge: Making Ethanol • Mini Fermenter • CB2E: Converting Biomass to Ethanol • Bioprospecting: Filter Paper Assay Method • Bioprospecting: Individual Isolate Method • The Bioenergy Farm Game • Quantitative Modeling of Life Cycles • Poker Chip Model: Carbon Pools & Fluxes • Global Energy Flows • Fields of Fuel Computer Game • Research Story: Entomology Detectives • Biofuels vs Fossil Fuels Unit • Investigating Fuel Sustainability • Farming for Beetles, Bees, and Biomass

LS3: Heredity: Inheritance and Variation of Traits

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	• Bug Biodiversity & Ecosystem Benefits • Biodiversity and Sustainable Bioenergy Exploration Station

LS4: Biological Evolution: Unity and Diversity

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	• Bug Biodiversity & Ecosystem Benefits • Biodiversity and Sustainable Bioenergy Exploration Station
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	• Boosting Yeast's Appetite for Sugars
MS-LS4-4. Construct an explanation based on evidenec that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	• Boosting Yeast's Appetite for Sugars

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	• The Bioenergy Farm Game • Fields of Fuel Computer Game • Farming for Beetles, Bees, and Biomass

ESS2: Earth's Systems

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	• Poker Chip Model: Carbon Pools & Fluxes

ESS3: Earth and Human Activity

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	• The Bioenergy Farm Game • Life Cycle Assessment of Biofuels 101 • Investigating Fuel Sustainability • Analyzing Fuel Carbon Footprints • Energy and Health Exploration Station
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	• The Bioenergy Farm Game • Life Cycle Assessment of Biofuels 101
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	• Biofuels vs Fossil Fuels Unit
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	• Global Energy Flows
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	• The Bioenergy Farm Game • Life Cycle Assessment of Biofuels 101 • Quantitative Modeling of Life Cycles • Fields of Fuel Computer Game • Analyzing Fuel Carbon Footprints
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	• Quantitative Modeling of Life Cycles • Fields of Fuel Computer Game • Farming for Beetles, Bees, and Biomass

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	• CB2E: Converting Biomass to Ethanol • The Bioenergy Farm Game • Life Cycle Assessment of Biofuels 101 • Quantitative Modeling of Life Cycles • Poker Chip Model: Carbon Pools & Fluxes • Fields of Fuel Computer Game • Research Story: The Science of Farming • Growing Energy: Comparing Crop Yields • Investigating Fuel Sustainability • Microgrid Energy Exploration Station • Modeling Power Grids with Snap Circuits
HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.	• Poker Chip Model: Carbon Pools & Fluxes
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity	• Poker Chip Model: Carbon Pools & Fluxes • Global Energy Flows

ETS1: Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	• Life Cycle Assessment of Biofuels 101 • Quantitative Modeling of Life Cycles • Fields of Fuel Computer Game • Microgrid Energy Exploration Station
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	• The Bioenergy Farm Game • Fields of Fuel Computer Game • Modeling Power Grids with Snap Circuits

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	• Fermentation Challenge: Making Ethanol • CB2E: Converting Biomass to Ethanol • Bioprospecting: Filter Paper Assay Method • Bioprospecting: Individual Isolate Method • Research Story: The World of Fermentation
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of contraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	• Modeling Power Grids with Snap Circuits

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