

Module	Module Description	Instructional Time	NGSS Science Concepts	Science Concepts
Making a Magnet Mining Machine	Students study environmental problems caused by careless mining in the Iron Range of Minnesota, and discover ways that the properties of magnets can be used to solve problems caused by iron ore tailings.	15 hours	3-PS2-3: Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.	<ul style="list-style-type: none"> • Measure, test, and record physical properties of matter, including magnetism. • Explore and recognize that a mixture is created when two materials are combined such as gravel and sand and metal and plastic paper clips. • Observe forces such as magnetism and gravity acting on objects.
Building Beaver Dam Models	Students find solutions to minimize the environmental impact of the changes caused by a beaver dam on plants and animals that live downstream of the dam while respecting the needs of the beavers.	14 hours	3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, less well, and some cannot survive at all. 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	<ul style="list-style-type: none"> • Observe the physical characteristics of environments and interdependent relationships between populations within an ecosystem. • Describe environmental changes such as floods and droughts where some organisms thrive and others perish or move to new locations. • Explore how structures and functions of plants and animals allow them to survive in a particular environment.
Constructing Earthquake Resistant Structures	Students find solutions for building structures that are designed to withstand rapid changes on the Earth's surface, such as earthquakes.	15 hours	4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features. 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<ul style="list-style-type: none"> • Investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides; • Demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done such as swings, balls, pulleys, and wagons.
Making Morse Code Messages	Students use knowledge of mechanical, electrical, and sound energy to make a Morse code message system.	13 hours	4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. 4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. 4-PS4-3: Generate and compare multiple solutions that use patterns to transfer information.	<ul style="list-style-type: none"> • Differentiate among forms of energy, including mechanical, sound, electrical, light, and heat. • Demonstrate that electricity travels in a closed path to create an electrical circuit. • Use patterns to transfer information.
Connecting an Irrigation System	Students design a geometric irrigation system model out of straws and connectors to provide water to plants.	14 hours	4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS2-2: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	<ul style="list-style-type: none"> • Investigate the water cycle, including evaporation, condensation, and precipitation. • Identify the Sun as a star that provides light and heat energy for the water cycle. • Develop a model to illustrate the continuous movement of water through the water cycle using the Sun as a major source of energy. • Develop a model to illustrate the distribution of fresh and salt water on Earth.
Welding Weather Resistant Roofs	Students design, print, "weld", and test roof models that resist damage from wind, water, and ice.	15 hours	3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	<ul style="list-style-type: none"> • Predict changes caused by heating and cooling. • Observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice. • Measure and record changes in weather and make predictions using weather maps, weather symbols, and a map key. • Differentiate between weather and climate.
Building a Better Rubber Band Racer	Students design, print, and build a rubber band racer that is powered by the elastic potential energy of a rubber band.	16 hours	3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. 4-PS3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide. 4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. 5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.	<ul style="list-style-type: none"> • Explore different forms of energy, including mechanical, light, sound, and heat. • Demonstrate and observe how position and motion can be changed by pushing and pulling objects to show work being done. • Observe forces such as magnetism and gravity acting on objects. • Design an experiment to test the effect of force on an object such as a push or a pull, gravity, friction, or magnetism. • Design an experiment that tests the effect of force on an object.
Creating Crab Coverings	Students design and create a shell-like cover that could be used by a hermit crab to protect its soft abdomen rather than purchasing a new shell for each growth period from the pet store.	14 hours	5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	<ul style="list-style-type: none"> • Identify fossils as evidence of past living organisms using models. • Observe the way organisms live and survive in their ecosystem by interacting with the living and non-living elements. • Compare the structures and functions of different species that help them live and survive such as webbed feet in aquatic animals.
Tinkering With Turbines	Students design, print, and test a wind turbine model that transforms wind energy into electrical energy after researching types of energy and energy transformations.	14 hours	3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	<ul style="list-style-type: none"> • Explore the uses of mechanical, light, thermal, electrical, and sound energy. • Demonstrate that the flow of electricity in circuits requires a complete path through which an electric current can pass and can produce light, heat, and sound. • Identify alternative energy resources such as wind, solar, hydroelectric, and geothermal.

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Creating a Construction Crane	Students design a construction crane that uses hydraulic force and electromagnetism to lift a load.	16 hours	MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	<ul style="list-style-type: none"> Investigate how inclined planes and pulleys can be used to change the amount of force to move an object. Compare and contrast situations where work is done with different amounts of force to situations where no work is done such as moving a box with a ramp and without a ramp, or standing still.
Designing an Efficient Compost Bin	Students design and build an efficient compost bin model with features to aerate the compost and decomposers.	13 hours	MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.	<ul style="list-style-type: none"> Recognize that radiant energy from the Sun is transformed into chemical energy through the process of photosynthesis. Demonstrate and explain the cycling of matter within living systems such as in the decay of biomass in a compost bin.
Producing Plate Tectonic Models	Students use a model of Pangaea to design, print, and label the plates of the Earth's crust	14 hours	MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	<ul style="list-style-type: none"> Identify the major tectonic plates, including Eurasian, African, Indo-Australian, Pacific, North American, and South American. Earth and Space. The student knows that natural events can impact Earth systems. Relate plate tectonics to the formation of crustal features. Interpret topographical maps and satellite views to identify land features and predict how these features may be reshaped by weathering.
Building an Organ Transport Compartment	Students design and print a container that provides a constant, appropriate temperature for the transport of a model organ.	16 hours	MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	<ul style="list-style-type: none"> Investigate methods of thermal energy transfer, including conduction, convection, and radiation; Verify through investigations that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperatures such as an ice cube melting;
Synthesize a Solar Leaf Model	Students design and print a leaf model containing a solar cell, and other forms of biomimicry	15 hours	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.	<ul style="list-style-type: none"> Recognize that radiant energy from the Sun is transformed into chemical energy through the process of photosynthesis.
Creating Coastal Barriers	Students design and build a coastal barrier resembling a seawall to protect a city from the storm surge of a tsunami or hurricane.	15 hours	MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	<ul style="list-style-type: none"> Build a model to illustrate the structural layers of Earth, including the inner core, outer core, mantle, crust, asthenosphere, and lithosphere. Identify the major tectonic plates, including Eurasian, African, Indo-Australian, Pacific, North American, and South American. Relate plate tectonics to the formation of crustal features and major geological events such as ocean basins, earthquakes, volcanic eruptions, and mountain building. Describe the historical development of evidence that supports plate tectonic theory.
Fabricating Football Helmets	Students research, design, print and test a helmet-like covering for soft-boiled eggs that undergo simulated collisions resembling the collisions of football players during a game.	16 hours	MS-PS2-1: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. MSPS2.A: For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	<ul style="list-style-type: none"> Demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion; Investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.
Making a Survival Heat Pack	Students design and test a self-contained hand warming pouch that generates heat from a controlled chemical reaction.	15 hours	MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	<ul style="list-style-type: none"> Investigate how evidence of chemical reactions indicate that new substances with different properties are formed.
Making a 3D Topographic Landform Model	Students design and print a 3D model of a topographic map	13 hours	MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	<ul style="list-style-type: none"> Relate plate tectonics to the formation of crustal features. Interpret topographical maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering.