NGSS OVERVIEW

ENERGY

Performance Expectation MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Performance Expectation MS-PS3-4: Plan an investigation to determine the relationship 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.

Performance Expectation MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Performance Expectation MS-ETS1-4: Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Investigation: Home Energy Use** Students begin exploring concepts about energy transfer by analyzing qualitative data on energy use in two hypothetical homes in different environments. They consider how certain features of a home may cause the homeowner to use more or less energy. This introduces them to the idea of energy-efficiency. They begin tracking their understanding about energy transfer and developing a plan to increase home energy-efficiency. They will finalize and present that plan in the final activity in this unit.	MS-PS3.A MS-PS3.B	Analyzing and Interpreting Data Asking Questions and Defining Problems	Cause and Effect Energy and Matter	ELA/Literacy: WHST.6-8.9
2. **Laboratory: Drive a Nail** Students plan and carry out an investigation to examine the relationship between gravitational potential energy and kinetic energy of motion. They analyze and interpret the data to quantify the transfer of energy from a falling object (metal rod) to a stationary object (nail). They expand on their understanding of energy-efficiency by considering whether all of the gravitational potential energy has been transferred to the nail.	MS-PS3.B MS-PS3.A MS-PS3.C	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Patterns Cause and Effect Energy and Matter	Mathematics: MP.2 6.EE.C.9 ELA/Literacy: RST. 6-8.3
3. **Role Play: Roller Coaster Energy** Students expand on their understanding of energy transfer and transformations by exploring what is happening to energy during a roller coaster ride. Students use a model to help them explain the repeated transformations of gravitational potential and kinetic energy along the ride, and the transfer of kinetic energy from the roller coaster cars to thermal energy and sound in the tracks.	MS-PS3.B MS-PS3.A	Constructing Explanations and Designing Solutions Developing and Using Models	Energy and Matter	Mathematics: MP.2 ELA/Literacy: WHST.6-8.9

ENERGY (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
4. **Investigation: Shake the Shot** Students continue their exploration of energy transformation and transfer by analyzing and interpreting data from an investigation. This investigation involves transferring kinetic energy from a moving arm to moving metal pellets and then transforming that energy into thermal energy in the metal pellets inside the container. Students measure the rise in temperature of the metal pellets as evidence of the amount of thermal energy transferred.	MS-PS3.B MS-PS3.A MS-PS3.C	Analyzing and Interpreting Data Planning and Carrying Out Investigations	Energy and Matter Patterns Cause and Effect Systems and System Models Scale, Proportion, and Quantity	Mathematics: MP.2 6.EE.C.9 ELA/Literacy: RST. 6-8.3
5. **Reading: Conservation of Energy** Students obtain information from a reading on the behavior of energy. In particular, they develop an initial understanding of the conservation of energy during energy transformations. Students develop arguments to explain that energy cannot be "lost" during energy transformations, arguments that are informed by their growing understanding of systems and system models. They apply this understanding to the topic of energy-efficiency, and use the information to inform their home energy-efficiency plans.	MS-PS3.B MS-PS3.A	Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Energy and Matter Systems and System Models	ELA/Literacy: WHST.6-8.1 WHST.6-8.9
6. **Investigation: Follow the Energy** Students explore many types of energy transformations and transfers that people encounter regularly in their everyday lives. The ubiquity of energy transfers and transformations reinforces the crosscutting nature of energy. Students present arguments that a change in the kinetic energy of an object results in an energy transfer either to or from that object. This activity provides an opportunity to assess student work related to Performance Expectation MS-PS3-5.	MS-PS3.B MS-PS3.A	Engaging in Argument from Evidence Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Energy and Matter	ELA/Literacy: WHST.6-8.1 WHST.6-8.9

ENERGY (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
7. **Laboratory: Mixing Hot and Cold Water** Students conduct an investigation on thermal energy transfer in water, documenting this transfer by measuring temperature changes. They observe the effects of thermal energy being spontaneously transferred from a hot region into a cold one until thermal equilibrium is reached. Students analyze and interpret the data that they collect as they explain the relationship between changes in temperature and thermal energy transfer.	MS-PS3.A MS-PS3.B	Constructing Explanations and Designing Solutions Analyzing and Interpreting Data Planning and Carrying Out Investigations Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Energy and Matter Scale, Proportion, and Quantity	Mathematics: MP.2 6.EE.C.9 ELA/Literacy: RST.6-8.3
8. **Laboratory: Thermal Energy Storage** Students apply their understanding of energy transfer to plan and carry out an investigation to determine the factors that influence the change in temperature of cold water when a hot object is immersed in it. This activity provides an opportunity to assess Performance Expectation MS-PS3-4.	MS-PS3.A MS-PS3.B	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Energy and Matter Scale, Proportion, and Quantity Connections to Nature of Science: Science Is a Human Endeavor	Mathematics: MP.2
9. **Reading: Energy Across the Sciences** Students obtain information from text about how scientists in several different disciplines use their understanding of energy to explain scientific phenomena. They read about energy transfers and transformations in examples from the life sciences, earth sciences, and physical sciences. In doing so, students develop an understanding of the crosscutting nature of energy. Students communicate their understanding about the universal nature of energy to others.	MS-PS3.B MS-PS3.A	Obtaining, Evaluating, and Communicating Information	Energy and Matter Systems and System Models	ELA/Literacy: RST.6-8.1 WHST.6-8.9
10. **Design: Energy Transfer Challenge** Students are introduced to the idea that thermal energy transfer can be maximized and minimized by engineering systems that are either good thermal conductors or insulators. They use an engineering design process to design, construct, and test their systems.	MS-PS3.A MS-PS3.B MS-ETS1.A MS-ETS1.B	Constructing Explanations and Designing Solutions Analyzing and Interpreting Data	Energy and Matter Structure and Function	ELA/Literacy: RST.6-8.3

ENERGY (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
11. **Laboratory: Energy in Light** Students investigate the behavior of electromagnetic energy when it hits a surface. They see that the energy can be transmitted, reflected, and absorbed. By conducting an investigation they find that shiny surfaces reflect much of the energy while dark surfaces absorb, transforming some of the light energy into thermal energy.	MS-PS3.B MS-PS3.A	Analyzing and Interpreting Data Constructing Explanations and Designing Solutions	Energy and Matter Patterns	Mathematics: MP.2 6.EE.A.2 ELA/Literacy: RST.6-8.3
12. **Reading: Conduction, Convection, and Radiation** Students are formally introduced to the three types of thermal energy transfer: conduction, convection, and radiation. This knowledge enables students to be able to look at a system and understand how thermal energy enters or exits that system through these different methods of energy transfer, thus reinforcing the idea that when energy is transferred, it can be transferred out of the observed system into a larger system.	MS-PS3.A MS-PS3.B	Constructing Explanations and Designing Solutions	Energy and Matter	ELA/Literacy: WHST.6-8.9
13. **Design: Maximizing Solar Energy Transfer** From the previous two activities, students should now have a better understanding of how solar energy is transferred from the sun to Earth and that different materials absorb, reflect, or transmit this energy in different proportions. In this activity, students design, build, test, and optimize a device to maximize thermal energy transfer: a solar heater. The success of their devices is determined by how well students apply what they have learned about thermal energy transfer and how well students are able to redesign the devices based on performance evaluations in early tests. Students present their final designs to the class and use their results to explain their design process. This activity provides an opportunity to assess Performance Expectations MS-PS3-3 and MS-ETS1-4.	MS-PS3.A MS-PS3.B MS-ETS1.A MS-ETS1.B MS-ETS1.C	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence Developing and Using Models	Energy and Matter	ELA/Literacy: SL.8.4

ENERGY (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
14. **Laboratory: Hot Bulbs** Students apply their understanding of the concepts of energy transfer and transformation to compare the efficiencies of two different types of light bulbs. They do so by measuring the amount of thermal energy produced by the two bulbs, applying the law of conservation of energy, and calculating how much of the electrical energy supplied was converted into light energy.	MS-PS3.A MS-PS3.B	Analyzing and Interpreting Data Planning and Carrying Out Investigations	Energy and Matter Connections to Nature of Science: Science Addresses Questions About the Natural and Material World	Mathematics: MP.2 6.EE.A.2 ELA/Literacy: RST.6-8.3
15. **Problem Solving: Improving Home Energy-Efficiency** Students obtain more information about factors that can affect energy use in the home. They apply their understanding of energy transfer and energy transformation to develop a home energy-efficiency plan to use less energy. Students communicate their plan be preparing a report to present to the hypothetical homeowners.	MS-PS3.B	Obtaining, Evaluating and Communicating Information	Energy and Matter Connections to Nature of Science: Science Addresses Questions About the Natural and Material World	Mathematics: MP.2 ELA/Literacy: WHST.6-8.9