

Grade 8

STEM Learning Garden Unit: Energy

Grade 8 MS-PS3 Energy

MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer.

MS-PS3-4. Determine the relationships among the energy transferred, how well the type of matter retains or radiates heat, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-5. Present evidence to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

MS-PS3- 6(MA). Explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection, conduction and radiation.

MS-PS3- 7(MA). Describe the relationship between kinetic and potential energy and describe conversions from one form to another.

Essential Questions:

How is energy transferred between objects and converted into different forms?

What does energy do?

Where does energy come from and where does it go?

The Performance Expectation: *(What will the students know and be able to do after this unit? Matching the student task or question directly with the practices.)* Students will determine the different types of transfer Students will make a model of a solar cooker which demonstrates energy transfer using appropriate materials and tools. Students will evaluate, by collecting data, the effectiveness of their design, and the materials they chose, during experimental investigations. Students will write users guide for the solar cooker using scientific evidence and explanations to support their claim that they have a useful design. Students will demonstrate the use of this model to peers.

Science and Engineering Practices

Planning and Carrying Out Investigations

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.

Developing and Using Models

- Develop and use a model to describe phenomena.
- Develop a model to show the relationships among variables, including those that are not observable but predict observable phenomena.

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings.
- Analyze and interpret data to provide evidence for phenomena.

Obtaining, Evaluating, and Communicating Information

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings

Constructing Explanations and Designing Solutions

- Use evidence (e.g., measurements, observations, patterns) to support an explanation.

Engaging in Argument from Evidence

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Standards for Mathematical Practices

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for an express regularity in repeated reasoning.

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

PS3.B: Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- Energy is transferred out of hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

Resources:

Teacher:

Photosynthesis Basics using Energy

<http://www.pbslearningmedia.org/resource/tdc02.sci.life.stru.photosynth/photosynthesis/>

http://www.pbslearningmedia.org/resource/tdc02.sci.life.oate.lp_plantfood/how-do-plants-get-energy/

<http://concord.org/stem-resources/leaf-photosynthesis>

Interactive Website

Energy Flow

<http://www.pbslearningmedia.org/resource/tdc02.sci.life.oate.energyflow/energy-flow/>

Types of Energy

<http://www.scholastic.com/teachers/activity/energy-light-and-sound-10-study-jams-interactive-science-activities>

Heat Transfer Lessons

- Catch the Sun (PDF)
- A Shoebox of Sunshine (PDF)

Review and Extend: Food Chain and Energy Transfer

<http://www.pbslearningmedia.org/resource/tdc02.sci.life.oate.energyflow/energy-flow/>

Sun as the source of energy

http://www.nea.org/assets/docs/Solar_Energy_Intro_and_Overview.pdf

Online Energy Education Website: Powersleuth.org

Solar powered oven lessons

<http://edibleschoolyardpgh.org/wp-content/uploads/2012/11/2.11.05-Baking-in-a-Solar-Oven.pdf>

Solar Cooker Simulation Online

<http://www.pspb.org/e21/media/SolarCooker.html>

Build a Solar Oven, NASA, (PDF)

Discussion Questions

- Where do plants get the energy they need to grow?
- What do plants use most of their energy for?
- How would changing to a plant-based diet help reduce world hunger?

Assessment:

Science Notebook

Science Notebook Rubric

Solar Cooker Virtual Student Sheet Follow up

Group Performance Rubric

Math Standards

8.F Functions

- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.

8.G Geometry

- Understand congruence and similarity using physical models, transparencies, or geometry software.

ELA Standards

WHST. 1 Write arguments focused on discipline-specific content.

WHST. 2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

RST. 1 Cite specific textual evidence to support analysis of science and technical texts.

RST. 3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

SL. 1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 7 topics, texts, and issues*, building on others' ideas and expressing their own clearly.

Career Connection:

- **UMASS:**
<https://www.uml.edu/Catalog/Graduate/Engineering/Energy-Engineering/Masters-Program.aspx>
- <http://www.seia.org/solar-jobs>

Related Standards

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MS-ETS1 Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.*

MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.

MS-ETS2 Materials, Tools and Manufacturing

MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution.

MS-ETS2-1(MA). Analyze and compare properties of metals, plastics, wood and ceramics, including stiffness, strength, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.

MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution. MS-ETS2-3(MA). Choose and safely use appropriate measuring tools, hand tools, fasteners and common power tools used to construct a prototype. MS-ETS2-4(MA). Analyze the shape, form, size and materials of a designed object to infer the function for which it was designed.

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Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
- These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

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