CEREAL CITY SCIENCE by BCAMSC

ENERGY AND WAVES (4.PS.NGSS)

UNIT AT A GLANCE

ACTIVITY 1 - What is Energy

QUESTIONS: How do we define energy?

Time to Complete

Preparation: 20 min.
Activity: 2 classes
Lesson 1A: 50–55 min.
Lesson 1B: 60–65 min.

Phenomena

Observe video of a Rube Goldberg device.
Energy Stations:
1: First domino falls and remaining dominos fall in order.
2: Ball released from top of ramp travels farther than ball released halfway down ramp.
3: A stretched rubber band can travel a distance when released and returns to original shape.
4: Turning the switch to the on position causes light to shine. The light beam illuminates objects in its path.
5: Marble magnets attract other magnets and cause motion from a distance.

Summary: Students Will...

- Introduce performance task: Rube Goldberg device.
- Brainstorm ideas about energy.
- Explore Energy Stations.
- Compare initial ideas about energy as related to energy moving from place to place.

Students Figure Out How To:

- Construct explanations of the concept of energy through definitions, characteristics, and examples.
- Determine when energy is present and how it transfers from place to place.

Practices

Asking Questions

Constructing Explanations

Patterns

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level
Recognize evidence of change due to weathering and erosion.
Deve **PE at Lesson Level**
Develop an initial understanding of the possible definitions of energy.
Formative Assessment
Freyer Model
Energy Station probes
Journal Entries lop an understanding of the terms *weathering* and *erosion*.
Formative Assessment
Activity Pages
Science Talk

ACTIVITY 2 - The Energy of Motion

QUESTIONS: What can we learn about energy when we measure and collect data related to motion, bouncing, and collisions?

Time to Complete

Preparation: 15 min.
Activity: 8 classes
Lesson 2A: 45–50 min.
Lesson 2B: 45–50 min.
2B: 45–50 min.
Lesson 2C: 45–50 min.
Lesson 2D: 30–35 min.
30–35 min.
Lesson 2E: 30–35 min.
30–35 min.

Phenomena

When objects move at different speeds down a ramp, the distance traveled changes.
When a ball is dropped from different heights, the height of the bounce changes.
When there is a collision, there is a change in motion of the objects.

Summary: Students Will...

- Investigate energy related to motion.
- Make measurements and collect data to determine the relationship between speed and amount of energy.
- Investigate energy transfer as it is related to bounce.
- Investigate energy and energy transfer as related to collisions of objects.

Students Figure Out How To:

- Gather evidence to demonstrate that energy is present in moving objects.
- Make observations to determine that energy can be transferred from place to place by moving objects and collisions.
- Recognize the cause-and-effect relationships between motion and energy transfer from place to place.

Practices

Asking Questions and Defining Problems

Planning and Carrying Out Investigations

Constructing Explanations

Cause and Effect

Patterns

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level

Use evidence to communicate understanding of the change in energy when there is a change in speed.
Use evidence to communicate understanding of how colliding objects transfer energy from one object to another.

Formative Assessment

What We Think About Energy chart
Scientific Explanation: Claim, Evidence, Reasoning (CER)

Summative Assessment

Journal Entries (CER)

ACTIVITY 3 - Energy of Sound

QUESTIONS: How can I model how sounds are produced?

Time to Complete

Preparation: 20 min.
Activity: 7 classes
Lesson 3A: 45–50 min
Lesson 3B: 45–50 min.
Lesson 3C: 45–50 min.
Lesson 3D: 45–50 min.
20–25 min.
Lesson 3E: 45–50 min.
20–25 min.

Phenomena

Vibrations from a tuning fork can be heard and felt.
Sound vibrations can cause water to move.
Vibrations of different materials cause different pitches.

Summary: Students Will...

- Investigate vibrations and how sounds are made.
- Build a model instrument to demonstrate vibrations and sound waves.
- Demonstrate how energy can move from one place to another by sound.
- Compare different instruments to determine how vibrations of different materials create different pitches.

ACTIVITY 3 - Energy of Sound - *Continued*

Students Figure Out How To:

- Construct explanations of sound energy and how vibrations produce sound.
- Compare different sounds in terms of amplitude and frequency.
- Construct explanations of how energy can move from place to place by sound.
- Make a model of a wave that demonstrates amplitude and wavelength.

Practices

Developing and Using Models

Obtaining, Evaluating, and Communicating Information

Constructing Explanations

Cause and Effect

Patterns

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level

Use models to observe how vibrations produce sound.

Formative Assessment

What We Think About Sound Energy chart

Activity Page

Summative Assessment

Journal Entries

Respond to Text

Instruments and Presentations

ACTIVITY 4 - Rube Goldberg

QUESTIONS: How can a Rube Goldberg device demonstrate how energy moves from place to place?

Time to Complete

Preparation:
Activity 4: Set the time frame for building the Rube Goldberg devices as one of the limitations that is appropriate for your class.

Phenomena

Models can be developed using the Engineering Design Plan to build a Rube Goldberg device that demonstrates energy transfer and how energy moves from place to place.

Summary: Students Will...

- Design and build a device that solves a problem and demonstrates how energy can move from one place to another.
- Complete the task within constraints and limitations.

Students Figure Out How To:

- Design, test, and refine a device that converts energy from one form to another that ends with the production of a sound or signal.

Practices

Developing and Using Models

Constructing Explanations and Designing Solutions

Cause and Effect

Performance Expectations (PE) at Lesson Level and Assessment

PE at the Lesson Level

Develop and build a Rube Goldberg device and communicate understanding of how energy is present in motion, light, heat, sound, and electrical current. Demonstrate how energy moves from place to place.

Summative Assessment

Rube Goldberg device

Rube Goldberg presentation

ACTIVITY 5 - Heat Energy

QUESTIONS: How does heat energy move from one object to another?

Time to Complete

Preparation: 10 min.
Activity: 5 classes
Lesson 5A: 45–50 min.
Lesson 5B: 45–50 min.
30–35 min.
Lesson 5C: 45–50 min.
30–35 min.

Phenomena

Rubbing your hands together makes them warmer.
Holding a hot dog over a campfire heats the hot dog.
Hot water warms the container it is in.
Adding ice to a beverage makes the beverage colder.

Summary: Students Will...

- Investigate temperature change due to rubbing.
- Collect data to determine how heat energy moves from warm objects to cold objects.
- Relate heat energy transfer to how adding ice to a beverage decreases the temperature of the beverage.

ACTIVITY 5 - Heat Energy - *Continued*

Students Figure Out How To:

- Provide evidence that energy can be transferred from place to place by heat.
- Determine how heat transfers from warm objects to cooler objects.

Practices

Constructing Explanations

Planning and Carrying Out Investigations

Developing and Using Models

Cause and Effect

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level

Plan and conduct an investigation to provide evidence that heat moves from warm objects to cooler objects.
Develop a model that demonstrates how heat moves from place to place.

Formative Assessment

What We Think About Heat Energy chart
Investigations and Journal Entries

ACTIVITY 6 - Light Energy

QUESTIONS: What happens to the temperature of objects when placed in the light?

Time to Complete

Preparation: 15 min.
Activity: 4 classes
Lesson 6A: 45–50 min.
45–50 min.
Lesson 6B: 45–50 min.
45–50 min.

Phenomena

Walking across the black asphalt is hotter on the feet than walking on the grass or dirt path.

Summary: Students Will...

- Gather evidence to demonstrate how light energy transforms to heat energy.
- Design and conduct an investigation into the transformation of light energy to heat energy in a variety of materials.

Students Figure Out How To:

- Provide evidence that energy can be transferred from place to place by light.
- Determine how light energy from the sun transfers to heat energy and warms Earth.

Practices

Planning and Carrying Out Investigations

Constructing Explanations

Asking Questions and Defining Problems

Cause and Effect

Patterns

Performance Expectations (PE) at Lesson Level and Assessment

PE at the Lesson Level

Use evidence to communicate understanding of the temperature change of objects placed in the light.

Formative Assessment

What We Think About Light Energy chart
Scientific Explanation (CER)

Summative Assessment

Student-led investigations and conclusions
Journal Entries

ACTIVITY 7 - Electricity

QUESTIONS: How can I build an electrical circuit?

Time to Complete

Preparation: 15 minutes
Activity: 7 classes
Lesson 7A: 45–50 min.
20–25 min.
Lesson 7B: 45–50 min.
20–25 min.
Lesson 7C: 45–50 min.
45–50 min.
Lesson 7D: 45–50 min.

Phenomena

When an electrical circuit is complete (or closed), the lightbulb will light.

Summary: Students Will...

- Experiment with a battery, bulb, and wire to make a complete circuit.
- Gather evidence to demonstrate how electrical energy can transform to different types of energy.
- Use their knowledge about a complete circuit to design a switch.

Students Figure Out How To:

- Design and build an electrical circuit to demonstrate how energy is transferred from place to place by electricity.
- Determine that electrical energy transforms to heat, light, and sound.

Practices

Developing and Using Models

Constructing Explanations

Obtaining, Evaluating, and Communicating Information

Patterns

Matter and Energy

Science as a Human Endeavor

Performance Expectations (PE) at Lesson Level and Assessment

PE at the Lesson Level
Develop a model to demonstrate how an electrical current can produce light,sound, motion, and heat.

Formative Assessment
What We Think About Light Energy chart
Electrical circuit trials
Switch model
Lightbulb circuit explanation

Summative Assessment
Journal Entries
Respond to Text

ACTIVITY 8 - Energy All Around

QUESTIONS: What further information about energy can I gather through text and videos?

Time to Complete

Preparation: 10 minutes
Activity: 3 classes
Lesson 8A: 45–50 min.
Lesson 8B: 45–50 min.
Lesson 8C: 45–50 min.

Phenomena

Energy exists whenever there is change or motion.

Summary: Students Will...

- Use and compare resources to gather information about energy.
- Analyze and compare their previous ideas about energy with their new knowledge.
- Look for patterns and common characteristics that can be applied to all forms of energy.

ACTIVITY 8 - Energy All Around - *Continued*

Students Figure Out How To:

- Recognize patterns and commonalities among the different forms of energy.
- Make connections among information gained through their investigations and information in written text and video.

Practices

Obtaining, Evaluating, and Communicating Information

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level

Obtain and evaluate information from text and video and compare information with observations from investigations and activities.

Formative Assessment

Freyer Model
Summary Discussion
Energy Stations Data Chart discussion

Summative Assessment

Respond to Text
Journal Entries

ACTIVITY 9 - Energy We Use

QUESTIONS: How can energy be used to communicate?

Time to Complete

Preparation: 20 minutes
Activity 9: 4 classes
Lesson 9A: 45–50 min.
45–50 min.
Lesson 9B: 45–50 min.
20–25 min.

Phenomena

Energy is used to communicate over a distance.

Summary: Students Will...

- Gather information about early communication systems.
- Design a communication system using sound waves, light, and/or electricity.
- Present and compare communication systems.

Students Figure Out How To:

- Explore how patterns can communicate using sound, light, and electricity to carry messages over a distance.
- Design and construct a system that will communicate over a distance using sound, light, and/or electricity.

Practices

Obtaining, Evaluating, and Communicating Information

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, And Technology

Performance Expectations (PE) at Lesson Level and Assessment

PE at Lesson Level

Obtain information from text and video and use information to make a model of a device that will communicate over a distance.

Formative Assessment

Communication device
Engineering plan
Activity Page

Summative Assessment

Communication device and presentation
Journal Entries