NAME PERIOD DATE

ENERGY TRANSFORMATIONS

Driving Question | Objective

How are energy transformations observed?

Energy is constantly moving and changing all around you. Consider a few of the energy changes that happen when you ride a bicycle.

Your legs would not be able to push bicycle pedals without energy from food. Plants use photosynthesis to convert electromagnetic (light) energy into chemical energy. Plants store chemical energy in molecules like carbohydrates, fats, and proteins found in foods you eat such as fruits, vegetables, grains, and nuts.

Muscles in your body convert chemical energy from food molecules into mechanical energy needed to push bicycle pedals. Your body becomes warmer while pedaling because thermal (heat) energy is released during energy conversions. Chemical energy also helps your body produce electricity. Your nervous system uses electrical energy to communicate with your entire body and remind your muscles how to ride a bicycle.

Materials

- Data collection system
- Temperature sensor
- Voltage sensor with red and black banana plug leads
- Alligator clip adapters (2), red and black
- Light sensor
- Solar panel
- 250-mL Erlenmeyer flask
- One-hole rubber stopper
- Cloth towel or potholder glove
- 175 mL sand
- Two or more kinds of fruits or vegetables
- Three or more kinds of metal pieces (coins, nails, screws, paper clips, wires or strips)
- Sheet of white paper

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles.

Consider

1. What type of energy is required to turn on a light bulb?

   a) Mechanical

   b) Thermal

   c) Chemical

   d) Electrical

   e) Electromagnetic

3. Provide your own example where energy is converted from one form to another.

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4. Describe at least two types of energy conversions that occurred in your example.

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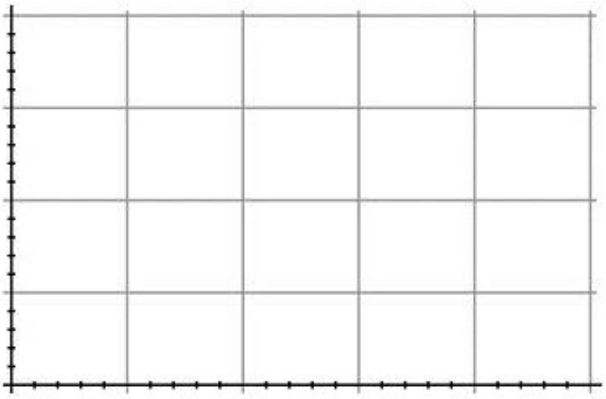
Investigate Sand Energy

1. Connect the temperature sensor. Use **Help (?)** if necessary.

2. Fill the flask with 175 mL of sand.

3. Seal the flask with the stopper. Insert the temperature sensor through the stopper hole so the bottom of the probe is below sand level.

4. Will temperature change if you shake the flask vigorously for one minute? How much? Draw your prediction on the graph. Add Time to the x-axis and Temperature to the y-axis.



5. Build a page with a graph display. Place Temperature on the y-axis. Use **Help (?)** if necessary.

6. Grasp the flask with the glove or cloth. Start collecting data. Shake the flask vigorously for one minute.

7. Stop collecting data after one minute. **Scale** the graph.

Analyze Sand Energy

1. Was your prediction supported by the results? Why or why not?

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2. Did the sand gain energy, or did it lose energy? Use data to support your answer.

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3. What kind of energy did you provide to the flask?

a) Mechanical

b) Thermal

c) Chemical

d) Electrical

e) Electromagnetic

4. The energy you originally provided was converted into which new energy type?

a) Mechanical

b) Thermal

c) Chemical

d) Electrical

e) Electromagnetic

Investigate Food Energy

1. Connect the voltage sensor. Insert banana plug leads if necessary. Use red for (+) and black for (-).

2. Attach alligator clip adapters to the voltage sensor leads. Match colors.

3. Select any two metals and a fruit or vegetable.

4. Insert the metals halfway into the fruit at some distance from each other. Do not allow metals to touch.

5. Build a page with a digits display for Voltage. Start collecting data.

6. Attach an alligator clip to each metal and observe the voltage (electrical energy) produced.

7. Reverse the alligator clips and observe voltage produced.

8. Notice the voltage is the same except one arrangement produces a negative result and the opposite arrangement produces a positive result. You can ignore negative signs in this activity.

9. Build a page with a table display. Set up the table like the one below. Create at least four different food-metal combinations. Write your choices in the appropriate cells in the table. Leave the Voltage column blank for now.

Table 1: Voltage produced from food

Fruit/Vegetable	Metal 1	Metal 2	Voltage (V)

10. Start collecting data. Move the alligator clips to observe voltages for each combination.

11. Record voltages in the table.

12. Stop collecting data.

Analyze Food Energy

1. What kind of energy was converted in order to produce electricity?

    a) Mechanical

    b) Thermal

    c) Chemical

    d) Electrical

    e) Electromagnetic

2. Did energy flow in a specific direction? Why or why not? Support your answer with data.

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3. Which fruit-metal combination produced the greatest voltage? Why might this combination work better than others?

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Investigate Light Energy

1. Connect the light sensor. Make sure the voltage sensor is still connected.

2. Predict which source will produce greater light intensity and voltage: indoor light or outdoor light. Note factors that influenced your predictions.

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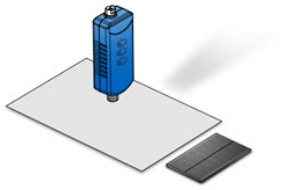
3. Attach alligator clips from the solar panel to the voltage sensor. Match black wires.

4. Move the solar panel, sensors, and piece of paper to a location that best represents average light level inside the classroom. Avoid shadows on the paper.



5. Set the piece of paper on the floor. Position the solar panel next to the paper. Hold the light sensor 10 cm above the center of the paper.

6. Start collecting data. Record the light intensity reading and voltage reading when each becomes stable. If the light sensor indicator is flashing green, select a higher setting.

Light Intensity and Voltage for Indoor Light: _____

7. Take the paper, solar panel, and sensors outdoors. Arrange the paper, panel, and sensors on a part of the ground that represents average light level. Avoid shadows. If you must stay indoors, find a location where sunlight is available.

8. Change the light sensor setting if the green light is flashing. Record the light intensity and voltage levels for outdoor light.

Light Intensity and Voltage for Outdoor Light: _____

9. Stop collecting data.

Analyze Light Energy

1. Were your predictions correct? Why or why not?

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2. What kind of energy was converted to produce electricity in the light energy activity?

a) Mechanical

b) Thermal

c) Chemical

d) Electrical

e) Electromagnetic

3. Does sunlight move or does it stay still? Explain your answer.

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4. Out of the three activities you performed today, which appears to have the greatest ability to produce voltage? Use data to support your answer.

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Extend

Choose any one of the three activities that most interests you. Write a testable question to investigate factors that affect the voltage produced in that system. Design an experiment to answer your testable question.