

Ohio Academic Content Standards

GRADE 3 ES:

Earth's resources can be used for energy.

Many of Earth's resources can be used for the energy they contain. Renewable energy is an energy resource, such as wind, water or solar energy, that is replenished within a short amount of time by natural processes. Nonrenewable energy is an energy resource, such as coal or oil, that is a finite energy source that cannot be replenished in a short amount of time.

Some of Earth's resources are limited.

Some of Earth's resources become limited due to overuse and/or contamination. Reducing resource use, decreasing waste and/or pollution, recycling and reusing can help conserve these resources.

GRADE 4 LS:

Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.

Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

GRADE 6 PS:

Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.

Thermal energy is a measure of the motion of the atoms and molecules in a substance.

GRADE 7 PS:

The properties of matter are determined by the arrangement of atoms.

When substances interact to form new substances, the properties of the new substances may be very different from those of the old, but the amount of mass does not change.

Energy can be transferred through a variety of ways.

Thermal energy can be transferred through radiation, convection and conduction.

INQUIRY PRE K-3

Observe and ask questions about the natural environment;

- *Plan and conduct simple investigations;*
- *Employ simple equipment and tools to gather data and extend the senses;*
- *Use appropriate mathematics with data to construct reasonable explanations;*
- *Communicate about observations, investigations and explanations; and*
- *Review and ask questions about the observations and explanations of others.*

INQUIRY 5-8

Identify questions that can be answered through scientific investigations;

- *Design and conduct a scientific investigation;*
- *Use appropriate mathematics, tools and techniques to gather data and information;*
- *Analyze and interpret data;*
- *Develop descriptions, models, explanations and predictions;*
- *Think critically and logically to connect evidence and explanations;*
- *Recognize and analyze alternative explanations and predictions; and*
- *Communicate scientific procedures and explanations.*

Polymer Plastic Recycling

There are over 6,000 products that come from petroleum!

Materials:

- Samples of six types of polymers (reference the recycling code chart for different types) cut into squares small enough to submerge in the liquid
- One Styrofoam egg carton per group (small containers could also be used, but egg cartons are easier)
- Craft sticks or other stir sticks
- Set of four liquids per group- water, vegetable oil, glycerin and a solution that is 3 parts 70% isopropyl alcohol to 2 parts water
- Recycling code chart for each group

Procedure:

1. Drop a piece of plastic into one of the liquids. If it does not sink immediately, gently submerge the plastic using a craft stick. Observe the plastic until it stops moving.
2. Record whether the piece sinks or floats.
3. Repeat with another type of plastic in the same liquid.
4. Repeat this process with all types of plastic available.

Density Table				
	Vegetable Oil	Alcohol/Water	Water	Glycerin
PETE				
HDPE				
V				
PP				
PS				
LDPE				

Questions

1. What is the benefit of producing different types of plastics?
2. Different types of plastics have different uses. Based on your observations, why do you think polyethylene terephthalate (PETE) is used for soft drink containers while tile and drainage pipes are produced from vinyl plastic?
3. What are some of the petroleum products that you use?
4. Sorting products is an important part of recycling. Could the experiment you conducted today be used to sort plastics on a large scale? Why or why not?

Discovering Densities

Materials:

- Glass or transparent plastic container with a tight lid (mayo jars are good)
- Gravel (aquarium gravel will work also)
- Vegetable oil
- Permanent marker
- Water

Procedure:

1. Divide the container into fourths and label with the permanent marker from the bottom, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$.
2. Add gravel to fill the bottle to the $\frac{1}{4}$ mark.
3. Add water to fill the container to the $\frac{1}{2}$ mark.
4. Add oil to fill the container to the top and close the lid.
5. Shake the bottle vigorously for 15 seconds.
6. Put the container down and observe what happens over the next four minutes.
7. Record your observations using both drawings and words.
8. Repeat steps 5 and 6 and note any changes.

Questions:

1. Where do the different materials settle?
2. Why do you think they settle there?
3. What application could this experiment have for the oil and gas industry?

DID YOU KNOW?

Rocks that are porous, such as sandstone and limestone, contain small spaces that can hold natural gas, oil and water. Non-porous rocks cannot hold these materials because they do not have these natural spaces. Granite is a good example of a non-porous rock. Once oil and natural gas are formed (a process that takes millions of years), these materials tend to move through the rock strata towards the earth's surface. This is because these products are lighter than water. The property of gases and liquids to move through porous rock is called permeability. Typically, these gases and liquids will reach a non-permeable layer of rock, like shale, and become trapped. The job of a petroleum geologist is to study how the earth's layers of rock were formed and learn how to locate the places where oil and natural gas are trapped.

Insulation Investigation

Materials (per group):

- Two 12 ounce soda cans
- Two glass lab thermometers
- Timer
- Hot water (50°- 80° C)
- Graduated cylinder or measuring cup with milliliters
- Measuring cup with handle
- Insulating materials (enough to wrap a can once) - cotton, cloth, steel wool, Styrofoam, bubble wrap, newspaper, etc.
- Rubber bands or tape
- Scissors
- Funnel
- Hot plate or coffee maker to heat water

Procedure:

1. Have each group completely wrap one of their soda cans with an insulating material of their choosing. Make sure different groups are testing different materials. Students should wrap the roof and the bottom, but should leave space near the can opening for the thermometer.
2. Students should secure the insulation with tape or rubber bands.
3. Identify the second can in each group as the control. No insulation will be added to this can.
4. Suspend a thermometer in each of the cans. This can be difficult. Students should use rubber bands, tape or even clay to secure the thermometer. Make sure the thermometer is not touching the sides or the bottom of the can.
5. Fill the cans with 200 mL of hot water. For younger students, make sure you pour the water. Use the funnel to make pouring easier.
6. Instruct students to measure and record the starting temperature of the water in each can.
7. Continue to measure the temperature in the can every minute for 20 minutes.
8. Have students calculate the loss of temperature in each of the cans.
For older students, calculate the change in temperature of the water in each can.
 $\text{Heat Loss (calories)} = \text{Mass of water (g)} \times \text{Temp (C)}$. This formula indicates the actual loss of heat from the water in each can.
9. Students can create a graph to plot their data for their insulated homes (Temp/Time).

The Heat is On!

Materials:

- 6 -10 different colors of flat, enamel spray paints (select both light and dark colors)
- Glass lab thermometers
- Soda cans that have been emptied and cleaned
- Stop watch

Procedure:

1. Have students work in groups. Give each group 2 soda cans of differing colors (these represent your students' homes). You can choose to paint the soda cans before the lesson or have students paint the cans the day prior to experimentation.
2. Have students make a hypothesis about which of their soda cans will gain the greatest temperature and why. Have students record their thoughts.
3. Place all the cans in the same location with direct sunlight. You can choose to place the cans outside provided that it is not too cold or windy.
4. Place the thermometers through the can openings. It is important that the thermometer does not touch any part of the can. Use tape, clay or rubber bands to secure the thermometers.
5. Each group should take temperature readings every minute for 10 minutes.
6. Have students determine the temperature change that occurred in each can over the 10 minutes. Share results as a class.
7. Have students compare their actual results to their initial predictions.
8. Have students graph the temperature change of their cans and that of another group with different colored cans.
9. What conclusions can students draw?

DID YOU KNOW?

Various colors absorb heat differently. The darker the color, the more heat energy that is absorbed. The lighter the color, the greater the amount of light that is reflected. For example, white has a reflectivity of 82%. This means that white reflects away 82% of light and absorbs only 18%. Black, on the other hand, reflects 5% of light and absorbs 95%.

This activity demonstrates that the color of homes and roofs have an impact on energy consumption. For example, on a 90° F sunny day, a white roof has a temp of 110° F, an aluminum-coated roof has a temperature of 140° F and a black roof has a temperature of 190° F. Research indicates that buildings with lighter colored roofs use up to 40% less energy in cooling than buildings with darker roofs.

This tends to be greater in urban areas where there is a lot of dark pavement, little vegetation and less reflective roofs. This leads to an effect known as the 'urban heat island' where densely populated areas are warmer than the suburbs.

The Heat is On!

The two colors I am experimenting with are _____ and _____.

I predict that the _____ soda can will have the greater temperature difference over the 10 minutes of observation because _____.

Write four can colors in the columns and record the different temperatures.

	Temperature			
Time				
1 min.				
2 min.				
3 min.				
4 min.				
5 min.				
6 min.				
7 min.				
8 min.				
9 min.				
10 min.				
Total Change				

What did you observe? _____

Is this different from what you predicted? _____

Why do you think this is? _____

If you lived in a hot climate like Texas, what color building materials would you use? _____

Polymer Plastic Recycling

Recycling Codes		
Recycling Symbol	Name of Polymer	Sample Uses
PETE 	polyethylene terephthalate	soft drink bottle, carpets, fiberfill rope, scouring pads, fabrics Mylar tape (cassette and computer)
HDPE 	high density polyethylene	milk jugs, detergent bottles, bags plastic lumber, garden furniture flower pots, trash cans, signs
V 	vinyl	cooking oil bottles, drainage and sewer pipes, tile, bird feeders institutional furniture, credit cards
LDPE 	low density polyethylene	bags, Elmer's® glue bottles and other squeeze bottles, wrapping films, container lids
PP 	polypropylene	yogurt containers, automobile batteries, bottles, lab equipment carpets, rope, wrapping films
PS 	polystyrene	disposable cups and utensils, toys lighting and signs, construction, foam containers and insulation
Other 	all other polymers	catsup, snack and other food containers, hand cream, toothpaste, and cosmetic containers

Extension Activity