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Greenhouse S'Mores

The Science of Global Atmospheric Change: Activity 9

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BioEd Online

Greenhouse S'Mores

The objectives of this activity are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. "Greenhouse S'Mores" introduces students to concepts related to the greenhouse effect and provides background content to inform students' thinking about climate change. Students will observe how some transparent materials allow light to pass through, but do not let heat escape. Students will make observations and predictions, model, and draw conclusions based on their investigation.

This activity addresses the following science concepts.

- Different materials absorb and trap heat differently.
- Some materials allow light to pass through but do not let heat escape.

Student Worksheets
Student pages in the teacher's guide are provided in English and in Spanish.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change Teacher's Guide.* Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7.
Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Key Words
lesson, experiment, sun, ozone, energy, heat, temperature, greenhouse gas, greenhouse effect, global warming, global change,

Materials

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Materials

Have students conduct the activity in groups of 4.

Materials per Student Group

- 4 chocolate candies ("kisses" or squares)
- 4 cups, 9-oz clear plastic
- 4 plain round cookies
- 4 toothpicks
- 1/4 cup of marshmallow creme (or frosting)
- Plastic knife or spreader
- Sheet of aluminum foil, approximately 12-in. sq (30-cm sq)
- Sheet of black construction paper, 9 in. x 12 in.
- Sheet of white construction paper, 9 in. x 12 in.
- Tape or stapler
- Tray or paper plate to hold materials

Note: If you are teaching this activity during the winter, you will need to conduct it indoors with a lamp. If the weather is warm, students may conduct the experiment outside in an area that is protected from the wind.

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Image Reference:

Photo by Christopher Burnett © Baylor College of Medicine.

Key Words
materials list, materials needed,

Greenhouse S'Mores © Baylor College of Medicine.

Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

•Always school district and school science laboratory safety guidelines.

•Have a clear understanding of the investigation in advance.

•Practice any investigation with which you are not familiar before conducting it with the class.

•Make sure appropriate safety equipment, such as safety goggles, is available.

•Continually monitor the area where the investigation is being conducted.

Safety note: Have students wash their hands before and after handling the food items.

References

1.Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.

2.Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change Teacher's Guide.* Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7.

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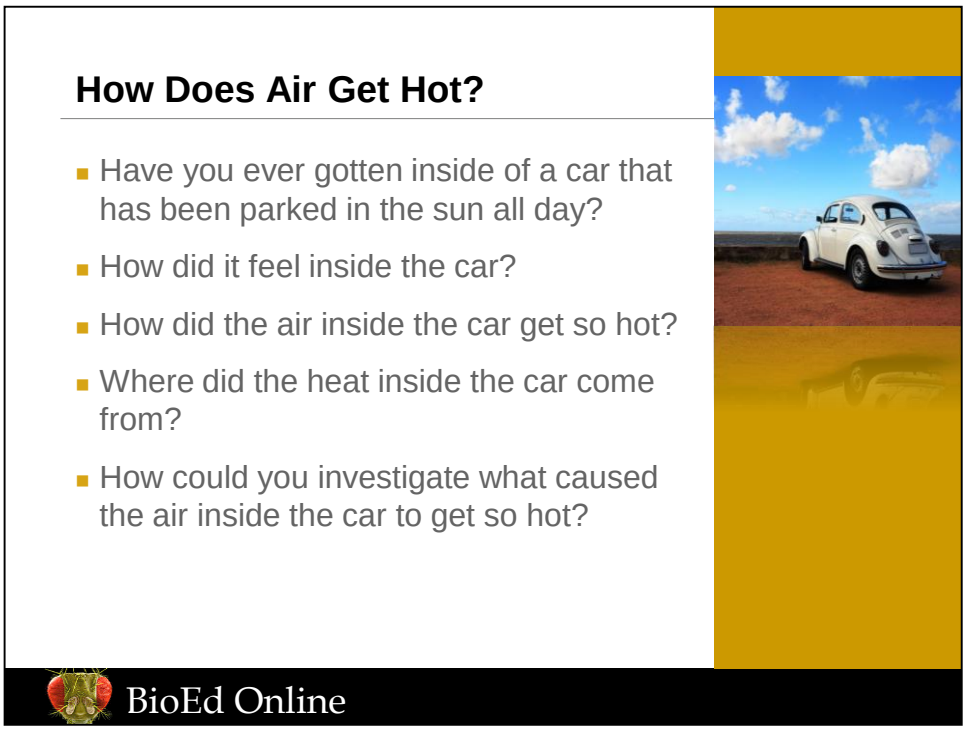
Key Words

science, classroom, safety, lab, laboratory, rules, safety signs,



How Does Air Get Hot?

Begin the activity by asking, *Have you ever gotten into a car that has been parked in the sun all day? Did you notice how warm the car was? Where do you think the heat inside the car came from?* (The windows of the car let sunlight through, but they also do not allow heated air to escape.)

Lead a class discussion about how the sun provides energy and heat to Earth. Remind students that the sun is our ultimate energy source and that Earth has several layers of atmosphere through which the sun's energy must pass.

Follow the discussion by asking, *How do you think we could determine what made the air inside the car get so hot? How could learn more about light and heat?* Tell students that they investigate the heat-trapping qualities of different materials by using the sun to make S'Mores (traditional campfire treats made by sandwiching a warm roasted marshmallow and a square of chocolate between two graham crackers).

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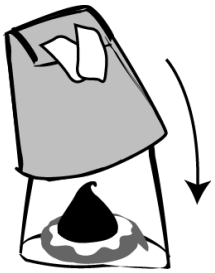
Image Reference:
Microsoft Office Clip Art

Key Words
lesson, experiment, sun, sunlight, energy, heat, temperature, solar, s'mores, solar radiation,

Let's Get Started

1. Make covers for three of your cups out of white construction paper, black construction paper, and aluminum foil. Do not make a cover for one of the cups.
2. Place marshmallow cream and a chocolate candy on three cookies.



3. Predict which cup cover will cause the chocolate to melt the most.
4. Place the cookies on the tray and cover them with each of your cups.

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Let's Get Started

This activity enables students to observe how some transparent materials allow light to pass through, but do not let heat escape. It also helps students to understanding the role of heat-trapping gases in the atmosphere ("greenhouse effect"). Students will make predictions and observations, model, and draw conclusions based on their investigation. They will discover that different materials absorb and trap heat differently.

1.After Materials Managers have collected the materials for their groups, instruct students to make covers of different colors for three of the cups (white construction paper, black construction paper, and aluminum foil). All three covers should be about the same size and shape. The fourth cup will be used without a cover. An easy way to make a cover is to roll a sheet of paper into a tube that fits around the cup. Fold and tape (or staple) the top of the tube and place it over a cup (see illustration on the slide).

2.Once students have made covers for three of their cups, have each Materials Managers pick up supplies for the experiment. Ask students if they have ever made S'Mores using marshmallows and chocolate squares. Explain that for this activity, they will be using solar energy to make S'Mores!

3.Each student should create one S'More by spreading a small amount of marshmallow cream or frosting on a cookie, and then placing a chocolate candy on top. Direct students to place their cookies on a plate or tray and to cover each cookie with one of the cups. (If the experiment will be conducted outside, have students tape the cups to the plate).

4.Within their groups, have students discuss the cover treatments and predict which treatment will result in the most softened or melted chocolate. Have them rank their

predictions, using a scale of 1–4, in which 1 = least softened and 4 = most softened.

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Image Reference

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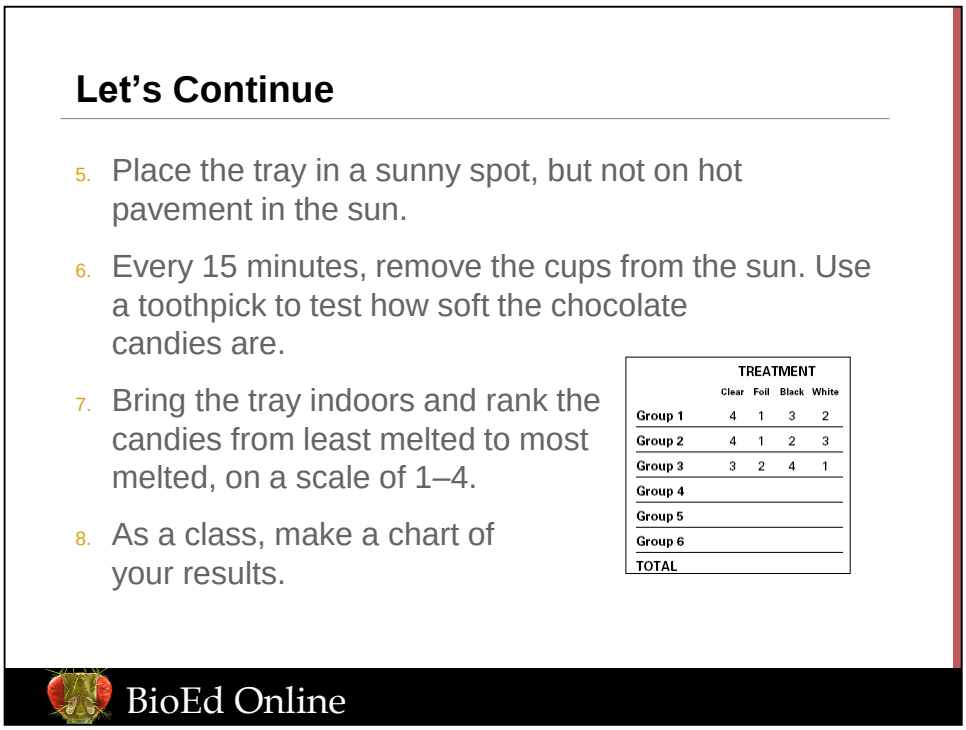

Let's Continue

1.Have students place their plates and cups in a sunny spot near a window, or outside in direct sunlight, preferably on a lawn. **(Do not place the plates on hot pavement in the sun. The heat from the already-warm surface will affect the results.)**

2.Instruct students to make their first observations after about 15 minutes, using a toothpick to test the softness of the candies. Depending on the air temperature, some of the chocolate candies may begin to soften by this time.

3.Have students continue to make observations at 10–15 minute intervals, until at least one of the candies has become very soft. *Some chocolate candies will hold their shape even when they are very soft.*

4.Tell students to bring their plates indoors (or away from the window) and observe the condition of the chocolate candy under each cup. Ask students to rank their candies from least melted to most melted (1 for least softened or melted, 4 for the most softened or melted.

5.Make a chart on the board and let each group report its results.

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Image Reference

Chart by M.S. Young © Baylor College of Medicine.

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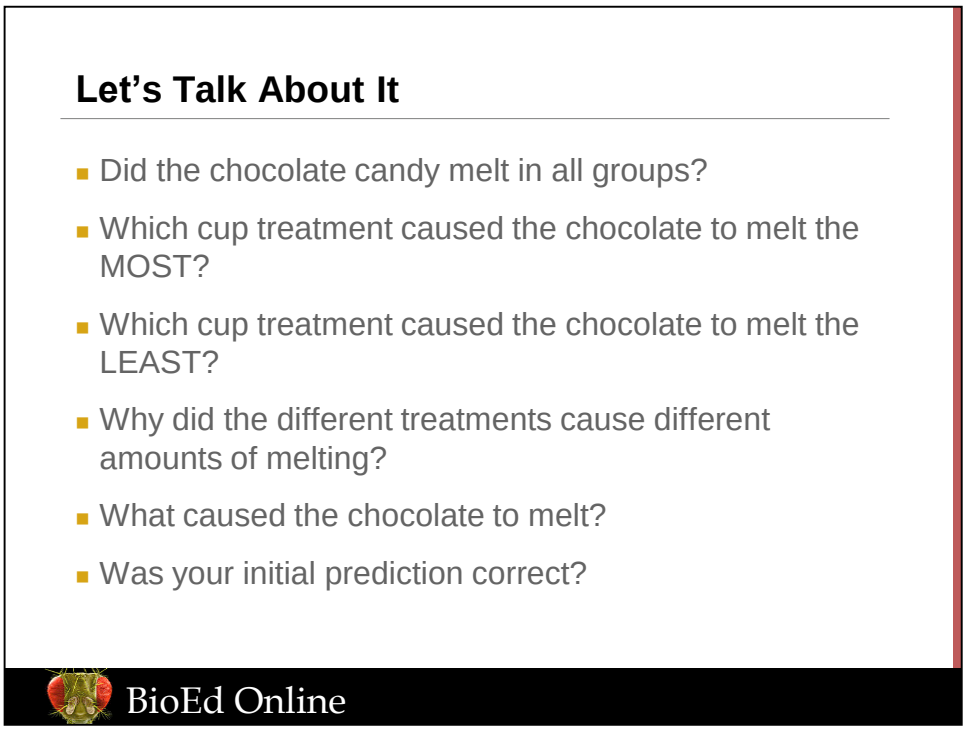

Let's Talk About It

This activity allows students to observe that some transparent materials allow light to pass through, but do not let heat escape. It introduces concepts underlying the greenhouse effect and provides background information about climate change.

Add all of the points allotted to each cup treatment. In most cases, the clear cup will receive the most points (result in the most melted chocolate), followed by the white cover, and then the black cover. The foil cover will have the fewest points (least melted chocolate). Because the observations are subjective, there usually will be some discrepancies among the results reported by each group. Use this as an opportunity to mention the importance of conducting an experiment more than once.

Let each student eat his or her S'More, while you discuss the experiment results with the class.

Ask students, *Which treatment melted the chocolate the most? Which treatment melted the chocolate the least? Why do you think this is?* Help students understand that more light energy was able to pass into the clear cup, where it was trapped. Much of this energy was transformed into heat. The cup covered with foil reflected light energy away. The white paper reflected some light energy away. The black paper absorbed more energy than the white paper or the foil.

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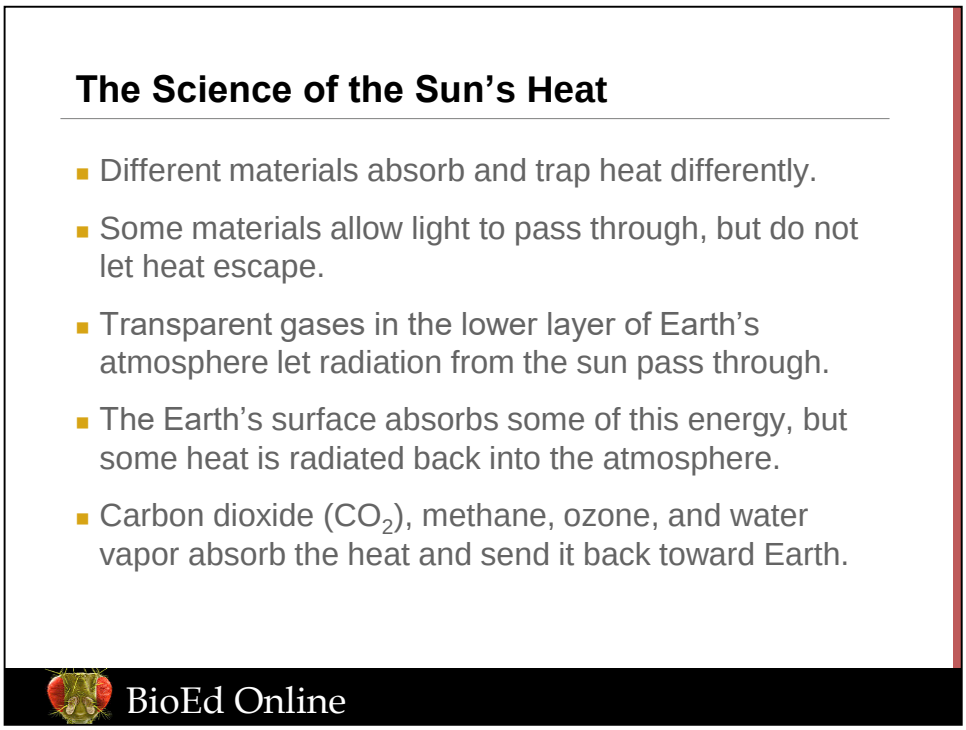

The Science of Sun's Heat

In this activity, students learned the following properties of global resources.

- **Different materials absorb and trap heat differently.** Transparent materials (such as the plastic cup in this activity) act like glass windows in a greenhouse or automobile. Our atmosphere works in a similar way. It lets light and other forms of radiation from the sun pass through. Earth's surface then becomes warmer (like the seats in a car parked in the sun) as it absorbs the sun's energy.

- **Some materials allow light to pass through, but do not let heat escape**. Some of the sun's energy passes through the transparent gases in the lower layer of Earth's atmosphere. However, gases like carbon dioxide, methane, ozone, and water vapor (the so-called "greenhouse gases") absorb some of the heat and send it out again in all directions, including back toward the surface. This warms the Earth's surface and lower atmosphere. Without the warming effect of greenhouse gases, the average surface temperature of the Earth would be around -18 degrees Celsius (about 0 degrees Fahrenheit), instead of the actual temperature of about 15 degrees Celsius (59 degrees F).

Lead a discussion connecting students' observations of the S'mores to what happens inside a car parked in the sun. Like the clear plastic cup, the windows of an automobile let sunlight through, but do not allow heated air to escape. You also may want to refer to page 9 of the story, *Mr. Slaptail's Curious Contraption*. Help students understand that certain gases in the atmosphere, especially carbon dioxide, act like the clear cups in their experiment. These gases keep the surface of the planet warmer than it would be otherwise.

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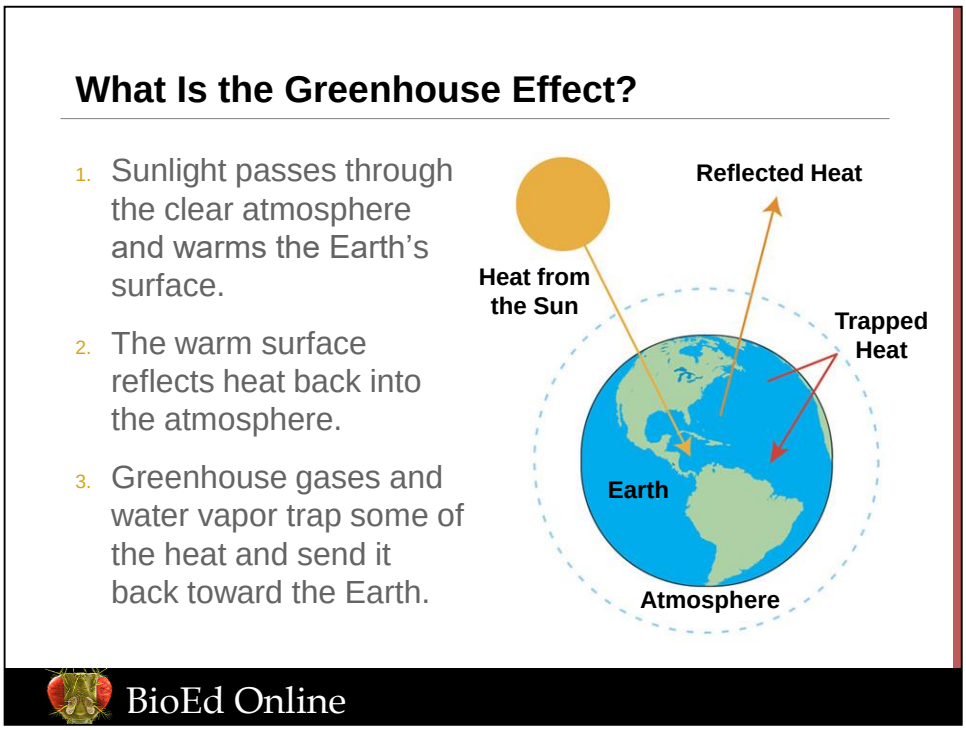
Key Words

lesson, experiment, sun, sunlight, energy, heat, temperature, solar, atmosphere, radiation, carbon dioxide, CO_2, ozone, methane, water, greenhouse effect, greenhouse gas,



What Is the Greenhouse Effect?

Climate, the characteristics of weather in a particular region over long periods of time, determines which kinds of plants and animal life, including microorganisms, are present, which crops can be grown, how people construct their houses and, to a great extent, people's clothing and diet.

The climate of any given region depends on its distance from the equator, altitude and rainfall patterns.

Even slight changes in the world's climate affect human health and well-being in countless ways.

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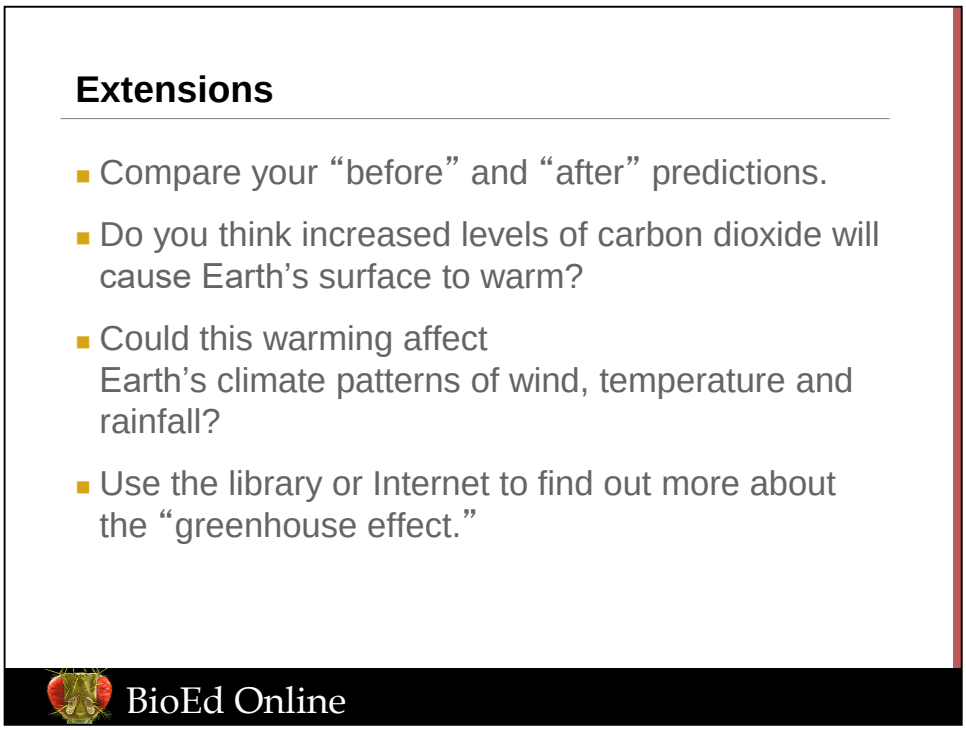
Image Reference

Illustration by M.S. Young © Baylor College of Medicine.

Key Words

lesson, experiment, extensions, sun, sunlight, energy, heat, temperature, solar radiation, greenhouse effect, greenhouse gas, climate, Earth, temperature, weather,

Greenhouse S'Mores © Baylor College of Medicine.



Extensions

Encourage students to ask additional questions and think of variations to the experiment.

Before beginning the experiment, have students create a class chart of their predicted investigation results. After the experiment, lead a class discussion comparing students' predictions to the results and possible reasons for the differences.

The levels of some heat-trapping (or "greenhouse") gases in the atmosphere (especially carbon dioxide, methane and ozone) have increased during the last several decades. Many scientists believe these will cause additional warming of Earth's surface. Ask students, *Based on what you have observed, do you think that this is a reasonable prediction?* Encourage students to find more information about this topic in the library or the Internet.

If using the student book, *Mr. Slaptail's Curious Contraption*, ask students, *Based on what you have learned in this activity, how do you think Mr. Slaptail might have improved upon the design of his water heater?*

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