Our Friend, the Sun

Summary

Group activities help students understand the role of the sun as the source of heat and light for living things on Earth. They will also understand the role of friction in creating heat.

Group Size

Small Groups

Materials

Solar Panning

- *Solar Panning*

  Thermometers
  Aluminum loaf pans
  Spray paint
  Graduated cylinder
  Plastic wrap
  Tape
  Scissors

Greenhouse Model

  2-liter bottles
  Yarn
  Thermometers
  Potting Soil
  Water
  Spoon
  Funnel
  Tape
  Permanent Marker
  Sunny area

Additional Resources

Books

Energy Makes Things Happen, by Kimberly Brubaker Bradley (Let's-Read-and-Find-Out Science); ISBN 0-06-445213-1

Experiments With the Sun and the Moon, by Salvatore Tocci (A True Book Series); ISBN 0- 516-22605-3

Heat Wave, by Helen Ketteman; ISBN 0-8027-7577-2 Sun, by Dana Meachen Rau; ISBN 0-7565-0440-6

The Sun, by Dan Elish (Space Group 2); ISBN 978-0-7614-2048-4

The Sun, by Margaret J. Goldstein (Lerner Publications Company); ISBN 0-8225-4647-7

The Sun: Our Nearest Star, by Franklyn M. Branley (Let's-Read-and-Find-Out Science); ISBN 0-06-445202-6

The Sun, by Isaac Asimov (Isaac Asimov's 21st Century Library of the Universe); ISBN 0- 8368-3242-6

What if the Polar Caps Melted? by Katherine Friedman (What If? Series); ISBN 0-516-23914-7

Media

All About Light, Physical Science for Children Series, (Schlessinger Science Library) Library Video Company VHS DK7109, DVD DV8854

Bill Nye the Science Buy Series Three -- The Sun, (Disney Educational Productions) Library Video Company VHS DN2248, DVD DW0599
All About the Sun -- Space Science for Children, (Schlessinger Science Library) Library Video Company ISBN 1-57225-234-0

Background for Teachers

The sun is an average-sized star that has been burning for about 4.6 billion years. The distance from the sun's center to its surface is about 695,500 kilometers (432,000 miles), approximately 109 times the radius of Earth. The interior of the sun reaches temperatures of more than 15,000,000 degrees C, (27,000,000 F). It is a nuclear furnace producing energy, free of pollution. Although 4,000,000 tons of the sun's matter turns into energy every second, only one-billionth of the sun's light and heat ever strikes Earth.
The sun is the center of our universe. Earth and other planetary systems revolve around the sun. The sun appears to move across the sky from east to west because of Earth's counterclockwise rotation. As Earth rotates and the part of Earth we are on turns towards the sun, we see it appear to rise above the horizon. We also experience seasons and varying amounts of daylight, caused by the 23 12 degree tilt of the Earth as it revolves around the sun. The moon does not produce any heat or light. The moon's light we experience on Earth is reflected sunlight off the moon's surface.
The sun is Earth's main source of heat and light. Heat and light from the sun's rays is called solar energy and is essential for life on Earth. The warming of Earth's atmosphere is called the greenhouse effect. Earth's climate is warming in response of atmospheric accumulation of heat-trapping gases, such as carbon dioxide (CO2). CO2 is produced from power plants and burning fossil fuels, and it is responsible for about half of the warming of the climate. The other main gases responsible for the greenhouse effect are nitrogen oxide (N40) produced by automobile exhaust, methane (CH4) produced by decaying plants and animals, rotting garbage, humans and animals passing gas, chlorofluorocarbons (CFCs) found in refrigerators, air conditioners, foamed plastics, and other man-made products.
Over the past few centuries, people have been burning more amounts of fuel, such as wood, coal, oil, natural gas, and gasoline. The result, some experts believe, will be Earth heating up and undergoing global warming. Some scientists believe the build up of CO2 in the atmosphere may be caused by deforestation, which reduces the number of trees available to absorb CO2. Some solar scientists are considering whether the warming exists, wholly or in part, by a small increase in the Sun's energy output. An increase of only 0.2% in the solar output could have the same effect as doubling the carbon dioxide in Earth's atmosphere. Many fear that the rise in temperature of the Earth's atmosphere will disrupt weather patterns, causing the polar icecaps to melt and release more water into the oceans. This increase in the water level might cause the ocean's saline concentration to weaken, threatening marine species and flooding coastal areas.

Intended Learning Outcomes

1. Use science process and thinking skills.
3. Understand science concepts and principles.
4. Communicate effectively using science language and reasoning.

Instructional Procedures

Invitation to Learn

Let the Sun Shine

This activity will introduce the students to the sun as they discover how life on Earth benefits from solar energy.
Prior to this activity, you must collect the following "props" and place them in a box at the front of the

room: sunglasses, teddy bear, hand fan, picture of the sun, flashlight, hand mirror, plastic stemmed flower, umbrella, Frisbee, bottle of sunscreen, "Sun", "Earth", and "Moon" nametags.
Cut apart and distribute parts from Let the Sun Shine master to the students. Allow them to read their parts in advance so they are comfortable with their actions and script.
Stand back and let them perform.

As a differentiated variation, students could make their own version of this activity using a single concept from their study of the sun. They could present concepts such as "How the sun affects plant life" or "Fossil Fuels -- A Gift from the Sun". Let them perform for another class or at a parents' night.

Extension

This activity may also be used as a culminating "celebration" for their study of the sun.
Each student will draw and label a picture representing their part from Let the Sun Shine. These pictures can be combined to make a classroom banner.
Students will journal what they have learned about the effects of the sun.

Instructional Procedures

Solar Panning

We will discover the effects of heating water in different containers using solar energy. Students will discover how container size, color, and materials change the effects of solar energy. When setting up the experiment it is important to maintain constant variables except for those that are being tested. Constant (or controlled variables) would be such things as: the amount of water measured; the amount of time used conducting the experiment, the type of ground surface, etc. Manipulated (or independent) variables are those things we change in response to our intended hypothesis, such as: the size of pans, the pan's color, the pan's material, or the pan's location in relation to the amount of solar energy available.

Each group will need 4 aluminum loaf pans: 3 identical pans and 1 different-sized pan
Spray paint 2 identically-sized pans - one black and the other white, allowing time to dry.
Using a graduated cylinder, measure and pour 150 ml (or 2/3 cup) of lukewarm water into each of your 4 pans.
Place thermometers into each pan and record your initial temperature using the Solar Panning recording sheet.
Immediately cover each pan with clear plastic wrap and tape in place, leaving the thermometer inside.
Before placing your pans in the sun, predict how each container will absorb solar energy and record your predictions on your Solar Panning recording sheet.
Choose a level, sunny location for your pans where they should be free of human interference for a 30-minute period. Place the 2 corresponding pans together where they will receive similar solar energy.
Record the temperature in each pan at 10 minute intervals and observe any changes taking place on your worksheet. Replace the plastic wrap after each temperature reading.
At the end of 30 minutes, record your final temperature.

Journal and graph the results of this activity. Share your group results as you discuss the following questions.

Did your experiment conclusions match your predictions?
Why were 2 corresponding pans needed?
Why were the pans covered?
Did the container size matter in the collection of solar energy?
How did the color of containers affect the results?
How could a different location of the pan in the sunlight change the results?
Would you expect to obtain the same results throughout different times of the year?

As a differentiation activity, allow the students the opportunity to choose the containers and variables they wish as they explore the collection of solar heat. Encourage them to present their findings in unique, meaningful ways to the class.

Extension

Use similar loaf pans of different materials (glass or plastic) and observe your results.
Experiment with colored liquids in the loaf pans. Which colored liquid absorb more solar energy?
Place one pan in direct sunlight and the other in the shade.
Record the results.
Cover one pan with plastic wrap and leave the second pan uncovered. What effect does the plastic wrap have on the rate of heat absorption?

Greenhouse Model

Explain to the class how CO2 is the greenhouse gas responsible for about half of the warming of our climate. If we put too much CO2 in the atmosphere it could contribute to Earth's temperature rise. Have the class identify problems related to global warming and list them on the board.
Take the lid off a plastic 2-Liter bottle and place the funnel in the top.
Place spoonfuls of topsoil in the funnel until the bottom of the bottle has several inches of dirt.
Pour 2 to 3 spoonfuls of water in the funnel -- just enough to moisten the soil.
Tie a 12 inch piece of yarn to one of the thermometers.
Remove the funnel from the bottle and lower the thermometer by the yarn until it is directly above the soil.
Tape the other end of the yarn to the outside of the bottle.
Replace the lid. This capped bottle will represent Earth undergoing global warming.
Repeat steps 2-7 using the other 2-Liter bottle.
Do not replace its lid. This bottle represents a planet that does not have the heat-trapping greenhouse gases.
Place your 2 bottles in direct sunlight.
Check your thermometers every 30 minutes for 2 hours and record your findings in your journal.
If using heat lamps instead of placing the bottles in direct sunlight, check your thermometers and record your findings every 10 minutes for 40 minutes.

Did you record the same temperature on both thermometers? Can you explain why these two temperature results are different? The open bottle allows heated gases to escape, providing a lower temperature than the bottle with the lid. The air above the open bottle is constantly changing, and as air in this bottle is heated and rises, it is being replaced by cooler air. The air in the closed bottle cannot circulate with air from the outside. The temperature of the air in this closed bottle continues to increase as it receives more and more solar energy.

Extensions

Curriculum Extensions/Adaptations/ Integration

As a literature connection, read the book *Heat Wave* by Helen Ketteman. Have the students write and illustrate their own imaginative endings of how they could stop a heat wave. You could compile all student entries into a class book. They could also make a variation telling how they could cause a heat wave to appear during a devastating cold spell.
After student research about the Greenhouse effect, students could write persuasive letters to businesses contributing to pollution informing them of measures they could take that would help improve air and water quality. They could write letters to government officials encouraging them to support bills and enact laws that would protect the environment.
Students could create posters that urge people to take care of Earth.

Family Connections

You can also demonstrate the greenhouse effect by taking 2 similar ice cubes. Place each ice cubes on a small plate. Over one of the ice cubes, place a clear, plastic cup. Leave the other cube uncovered. Set them both in direct sunlight. Observe the melting rate of each ice cube. Which ice cube melted more rapidly? Explain how the melting of the covered ice cube demonstrates the greenhouse effect?
Ask the students if they have ever sat inside a parked car in the sunlight with the windows closed. The heated air from the sunlight gets trapped inside the car. This is an example of the greenhouse effect. Remind students how dangerous this can be on a hot day. The temperature inside a closed car can reach over 120 degrees F (49 degrees C) in a matter of minutes.

Assessment Plan

Check student temperature charts, drawings, and journals for student understanding.
Students will share activity results orally with those in their group or with the class.
Assess student drawings and classroom banner from *Let the Sun Shine* activity.
Use a rubric for scoring the Solar Panning activity.
4 correct, complete, detailed
3 mostly correct & complete, fairly detailed
2 partially correct & complete, lacks some detail
1 incorrect, incomplete, missing important detail
0 no attempt

Bibliography

Research Basis

Lasley, T.J. & Matczynski, T.J. (1997). *Strategies for Teaching in a Diverse Society: Instructional Models*

Only teachers who utilize a variety of instructional models will be successful in maximizing the achievement of all students. Teachers need to "play to" students' strengths and to mitigate students' learning weaknesses. This can be done only through the use of instructional variety.

Danielson, C., (2002). *Enhancing Student Achievement: A Framework for School Improvement*, pp. 73

Only by building and strengthening links with other institutions in the community can schools achieve their full mission. Local individuals and organizations -- families and caregivers, public and private agencies, the business community, and colleges and universities -- should not be regarded as competitors, but rather as partners in the education of the community's children.

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