Don't Marry the Mole!

Summary

Students will demonstrate the power of solar energy by completing a variety of activities, including the create of a Pizza Box Solar Oven.

Materials

Who's Blowing Up the Balloons?

- Two plastic bottles, one painted white, I painted black
- Two balloons

Making a Pizza Box Solar Oven

- Pizza box
- Black construction paper
- Aluminum foil
- Clear plastic sheet (clear plastic window covering)
- Non-toxic glue
- Tape
- Ruler
- Marker
- Scissors
- Pencil, or string
- Thermometer

Making a Pizza Box Solar Oven

- Plastic wrap
- Corn chips
- Shredded cheese
- Salsa

Launching a Solar Hot Air Balloon

- *Solar Hot Air Balloon*
- Solar Balloon handout (pdf)

Additional Resources

Books

- *Amazing Sun Fun Activities*
  , by Michael Daley (Learning Triangle Press); ISBN 0-07-015177-6
- *How Grandmother Spider Stole the Sun*
  , Keepers of the Earth, by Michael J. Caduto and Joseph Bruchac; ISBN 1-55591-027-0
- *Crow Steals Some Daylight, Life in Polar Lands*
  , by Monica Byles; ISBN 0-590-46130-3

Background for Teachers

NASA Web site: "Our Sun"

"The sun gives us heat, light, our food, and the air that we breathe. It powers the atmosphere to give us the winds and rain. Even the coal and oil that generate electricity for light and power come from plants and animals that lived hundreds of millions of years ago and depended on the Sun for life."

"The sun heats the land, oceans, and air. It evaporates water from lakes and oceans. When the water vapor cools, it drops as rain or snow giving us the moisture we need for drinking water and for plants and animals to grow."

"Green plants use the Sun's rays to turn carbon dioxide and water into carbohydrates. At the same

time, they release oxygen that we use to breathe. This process of production of carbohydrates by green plants is called photosynthesis. The carbohydrates formed by plants are used by them to grow and we use plants for our food. Without the Sun, Earth would be a dark, cold, dead place."
The invitation to learn activity refers to the story of Thumbelina, which could be read previously during a reading period. The bottle activity demonstrates that energy from the sun can be collected and stored. White bottles reflect most of the sun's energy. Black bottles absorb the sun's energy better. As the black bottle absorbs energy, the air inside the bottle warms up and expands filling the balloon with air.
Making a Pizza Box Solar Oven is an engaging project for students because it shows that sunlight is a source of energy, and demonstrates the use of insulation in trapping heat. This is combined with something students really enjoy: making something good to eat. Solar ovens can reach temperature of 200-275 degrees, hot enough to cook food. When cooking in a solar oven, get the food in early and don't worry about overcooking. The cooking time will be at least twice as long as conventional methods. Allow about 1/2 hour to preheat.
Recipes
Tacos
Ingredients: tortillas, shredded cheese, black beans, shredded lettuce, salsa

Lay a tortilla on the tray. Cover 1/2 with cheese and 1/2 with black beans.
When the cheese looks melted and the beans are warm, spoon on lettuce and salsa, fold over, and eat.

Mini-Pizzas
Ingredients: English muffins or pita bread, pizza sauce, shredded cheese, other toppings (sliced very thin), olives, mushrooms, or pepperoni

Split the muffin or pita pocket in half. Spread on a thin layer of pizza sauce.
Put on three pieces of topping and sprinkle a thin layer of cheese.
When the cheese looks melted, enjoy.

While the food is cooking in their solar ovens, use the *Solar Hot Air Balloon* to visually demonstrate the power of solar energy. Within a few minutes the black balloon will collect enough energy to heat up the air inside the balloon enabling it to float by itself. Caution: Handle the balloon carefully or it may get away and get caught in voltage power lines, etc. (The *Solar Hot Air Balloon* is smaller, 10' x 2', less expensive, and easier to manage with students than a Solar Bag 50' x 2'.)
Tips for improving your solar oven

Use a pizza box made from corrugated cardboard, as the trapped air in corrugated cardboard will help your solar oven heat up better than a thin cardboard pizza box.
Tape over any air leaks around the edges of the pizza box, however make sure that the box can still be opened.
Use a dark metal pan or pizza tray inside your pizza box over the black paper. The dark metal absorbs solar energy and heats up hotter than black paper by itself.
Add a sheet of plastic to the top of the lid opening. This will create a layer of air as insulation between two sheets of plastic and will keep heat in the box. Be sure the plastic is tight and sealed.
Use foil covered cardboard to add extra flaps to increase the gain of your oven.

Note: Arrange for parent helpers during the class period in which you are measuring and making your flaps to ensure that students with special needs have a successful experience.

Crumble 1 to 1 1/2 inches of newspaper and stuff it around the inside edges of the box for additional insulation.
Set the oven on blacktop, brick, or cement, close to the south side of a building. Keep it out of

the wind. Tilt the oven a little to get rid of the shadows cast by the edges of the box.
Solar cooking takes time, and the sun will change position during cooking time. You may need to realign the solar oven now and then to keep the most sunlight entering the oven.

Intended Learning Outcomes

1: Use Science Process and Thinking Skills
2: Manifest Scientific Attitudes and Interests
3: Understand Science Concepts and Principles

Instructional Procedures

Invitation to Learn
Who's blowing up the balloons?
As an introduction to this unit, recall the story of Thumbelina. Why did the old mouse recommend that Thumbelina marry the mole? What were some of the reasons that Thumbelina was so unhappy in the mole's dark home? Why would you be happier in the warmth of the sun or than in a dark cold hole? People need the sun for many reasons. List them. Students will recommend, "Don't marry the mole!"
You will need two plastic bottles, one painted black and one painted white. Place the open end of a small balloon over the mouth of each bottle. Make sure the balloon forms an air tight seal. Place both bottles with balloons in bright sunlight.
Discuss: What do you think is going to happen? Why? Within a few minutes, you will notice the balloon on the black bottle will start to expand. The white balloon will remain limp.
Discuss: Why do you think the balloon on the black bottle expanded?
Touch the black bottle. Is it warm? Touch the white bottle. Is it cooler? Does a black object get warmer in the sunlight than a white object? What would be a good color to wear when playing tennis in the summer? What would be a good color to paint your car for staying cooler in summer?
Instructional Procedures
Making a Pizza Box Solar Oven
Discuss: Can the sun cook our food?
Make pizza box solar ovens and try it.

Tape foil to the inside bottom of the pizza box, shiny side up. This will create a trap to hold heat that is radiated from food and air inside the box.
Cover the foil with black construction paper (you do not need to go up the sides of the box). This will help absorb the incoming sunlight.
Close the box. On the top, measure and mark 1 1/2 inches from the edge, in several places. Draw a line connecting your marks and outlining the flap. Decide where the hinge of the flap will be and write "Flap, Do Not Cut!"
Cut along the front and two sides to make the flap. (Work carefully especially around the corners. Remember not to cut along the line that will be the hinge for the flap. It may help to get adult help using an X-ACTO® knife instead of scissors.)
Place your ruler along the line that marks the hinge of the flap. Carefully pry the flap open. Make the fold for the hinge carefully. (It helps to do this with a partner.)
Cut a piece of foil the size of the flap. Glue it to the side of the flap that faces into the box, shiny side up. (Flatten out all wrinkles and be sure to wipe off any glue smears with a damp cloth.)
Put the box on the plastic. Draw an outline of the box on the plastic with a marker. Cut the plastic about 1/4 of an inch inside of the outline.
Open the box and tape the plastic to the inside of the top of the box. Tape one side and then the other. Try to make it tight and smooth. Seal it all around so that warm air cannot escape from the oven interior. Close the box and open the flap.
Your pizza box solar oven is ready to use. Make Nachos!

Nachos

Ingredients: corn chips, shredded cheese, salsa

Put a single layer of chips on plastic wrap. Sprinkle on the cheese.

When the cheese looks melted, dip nachos in salsa.

Aim the oven at the sun. Adjust the flap to reflect the most sunlight into the oven. You can tell the flap is adjusted correctly by looking at the sun's reflection inside of the oven. Use pencil, ruler, or string to hold the flap at the best angle.

Caution: Never look directly into the sun. You could damage your eyes.

Place a thermometer inside the oven to measure the temperature.

Write in your science journal telling what you learned doing this project, what you liked about this project, and what you'd do differently if you were to make a new solar oven.

Launching a Solar Hot Air Balloon

While the food is cooking in the solar ovens, launch the *Solar Hot Air Balloon*. The balloon will visually demonstrate the power of solar energy.

Fill the balloon with air. Tie the balloon.

Add a long cord students have marked off in ten centimeter or one foot increments so that elevation can be measured.

As the black balloon is allowed to sit in the sun, it will heat up and begin to rise.

Start timing as soon as the balloon begins to rise. Record the elevation every minute. Use *Solar Balloon* handout to graph your results. You could also calculate the rate of change in elevation.

Rate = Total Elevation divided by Time

Discussion questions: Why did the balloon begin to rise? Did it rise at a constant rate? What is the temperature of the air outside the bag? Bring the bag back down and lay a thermometer on the bag. What is the temperature of the outside of the bag?

Extensions

Physical Education

Question: “What happens to molecules when they are heated?

Materials

Masking tape

Heat is a form of energy. As water, air, and other substances increase in temperature, their molecules start to get more energy. As those molecules move faster they bump into each other and take up more room.

Use masking tape to create a circle (or make an outline of a cooking pot).

Tell students they are going to be playing the part of water molecules.

First, they will represent a frozen pot of water. Have students crowd into the pot and stand still. There should be room for all students to stand comfortably. You may choose to make a pot for each team.

Next, tell students you are going to turn the stove on and start heating up the pot of ice. They are to start moving slowly. Everyone should keep moving but they should not push or shove and they should stay within the circle.

Now the ice is all melted and the water is starting to warm up. The students should move a little faster. They should still avoid bumping into each other and try to stay within the circle.

Now the water is boiling, steam is starting to rise out of the pot. The students should move faster and faster until they can no longer stay within the lines of the pot. (Students could do various exercises that require more and more space, e.g., jumping up and down, jumping jacks, jumping side to side, etc.)

Discuss with students how this activity relates to the movement of molecules as they are heated,

and the connection of sunlight as the energy source.

Language Arts

Read folktales about the sun.

Assign, edit, and publish student-written folktales about the sun.

Family Connections

Make and use solar hot dog cookers made from foil-covered round oatmeal boxes cut in half lengthwise. Share your experience with the class.

Students modify and enhance your solar ovens at home and get them ready for a class solar cook-off.

Cook-off question: Which oven can produce the greatest water temperature increase in 60 minutes?

Fill pie plates with two cups water at room temperature, place in solar ovens with a thermometer.

Record temperatures every ten minutes for 60 minutes.

Do you have a winner or is there a tie?

Share your solar oven with your family by cooking a family treat in the oven. Share your recipe with your class.

Assessment Plan

Edit and publish student folktales.

Note student's measurements of the flap for the solar oven, assess and assist with mathematics measurement skills.

Check student's chart and graph of solar balloon activity.

Check student's Science Journals for understanding that the sun is the main source of heat and light for earth.

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