ACTIVITY 3

Soak up the Sun

(Heat absorption)

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Safety

Please note that while following the precautions in this guide can help teachers foster inquiry in a safe way, no guide could ever predict all of the problems that might occur. Good supervision and common sense are always needed.

A Day at the Beach

Investigate how the temperatures of water and sand change throughout the day.

Safety

Spilled water or sand can make the floor slippery, so be sure to clean up immediately after any spills. Be careful when working with light bulbs. Some bulbs get very hot, so do not touch them.

Materials

- 2 identical containers
- 2 lamps
- 2 thermometers
- Sand at room temperature
- Water at room temperature
- Timer or stopwatch

Setting up the experiment

1. Fill one container with sand (at room temperature) to a depth of about 1-cm.

2. Fill the other container to an equal depth with water (at room temperature).

3. Lay a thermometer in the bottom of each container. The bulbs should be covered by the sand / water.

4. Position a lamp 15-cm directly above each thermometer bulb. Make sure that you can read the thermometers without disturbing the setup. You may need to use a stack of books to prop up the containers so they are the correct distance from the lamps.

5. Make a table for recording time and temperature, like the one shown.

6. Write down which container you think will heat the fastest, and why.

Time (minutes)	**Water Temperature** (°C)	**Sand Temperature** (°C)
0		
2		
4		
6		
8		
10		
12		
14		
16		
18		
20		

Turn off lamps (at 10 minutes)

Collecting Data

Two data collectors should record the temperatures of the sand and water. A third should keep track of the time and tell the data collectors when to measure the temperature.

1. Start the stopwatch and turn on the lamps.

2. Record the temperature of the sand and water every two minutes.

3. After 10 minutes, turn off the lamps.

4. Record the temperature of the sand and water every two minutes for the next 10 minutes.
While data for the last 10 minutes is being recorded, predict which pan will cool faster. The first 10 minutes of data could be helpful in making a hypothesis.

5. Graph the data for the water and sand on the same graph.

Discussion Questions

■ Did the water or sand heat faster? Did this match your prediction?

■ Did the water or sand cool faster? Did this match your prediction?

■ Using your results, can you explain why pools often feel warm long after the sun has gone down?

■ Why is the sand at the beach so hot in the afternoon, while the water remains cool?

■ How might having a large lake or an ocean nearby change the climate of an area? Think about spring and fall.

■ Do you think your results would have been different if the sand and water were heated with a Bunsen burner or a hot plate? Why or why not?

■ How does a real beach differ from our set-up?

FOR THE TEACHER

A Day at the Beach

(Level 1)

Investigate how the temperatures of water and sand change throughout the day.

Materials

- 2 identical wide and shallow containers
  Disposable pans, like those in the baking isle of the grocery store, work well

- Sand at room temperature (enough to cover the bottom of your container to a depth of 1-cm)
  Small bags of sand are available at most craft stores.

- Water at room temperature (enough to cover the bottom of your container to a depth of 1-cm)

- 2 identical lamps with 60w bulbs
  Desk lamps from retail stores such as Target or Wal-Mart work well and are available for around $10 each.

- 2 thermometers*
  "Metal Back Student thermometers" such as those included in the kit range from 20 to 230°F/–30 to 110°C and are available at science supply stores such as Science Kit & Boreal Labs (Item # WW6644400) for about $3.50 each.

- Timer or stopwatch

Discussion

Data collection for this activity takes 20 minutes, so you might want to have three students collect data while the rest of the class works on another assignment. Creating more than one setup of this experiment requires a lot of extra materials, so we recommended performing it as a class experiment.

If you have extra containers and lamps, your students can study other materials – such as playground gravel, wet sand, or potting soil.

The sand should both heat and cool faster than the water. This is because water has a higher specific heat capacity than sand – meaning that it takes a lot of heat, or energy, to raise the temperature of water one degree, whereas it takes comparatively little energy to change the temperature of sand by one degree.

The high specific heat capacity of water also explains why it cools slower. More heat must be removed from the water to lower the temperature by one degree than must be removed by the sand to lower its temperature by one degree. The materials also absorb different amounts of heat due to their colors, but the main factor at play is heat capacity, so changing the heating method should not change the qualitative results.

This activity provides an excellent opportunity to discuss error analysis. Encourage students to make a list of things that could make a scientist doubt their results, and have them discuss how the results might change if the set-up was changed. They might consider things like:

- Whether the water circulated during the test and how this would affect the comparison.

- Whether the lamps had the same heat output.

- What would happen if the containers had equal masses of sand and water.

Suggested resources

"Costal Versus Inland Temperatures." Bigelow Laboratory for Ocean Sciences.
http://www.bigelow.org/virtual/handson/coastvsinland.html
A similar activity with more emphasis on coastal versus inland climate.

"Specific Heat Capacity." Wikipedia.
http://en.wikipedia.org/wiki/Specific_heat_capacity
Includes background on specific heat capacity and a table of values for common materials.

Cold Floors

Explore the way a material feels to the touch and compare this to its actual temperature.

Materials

1. Put your hand on each of the materials. Write down which feel cool and which feel warm. Rank the materials in order from coldest to warmest.

2. Flip over the sheets one by one and record the temperatures.

Discussion questions

- Were you surprised by the temperature readings? If so, how were they different than you expected?
- Why do the temperatures not match how the surfaces feel?
- If you were re-doing a room in your house, would these results affect the type of floor you put in? If so, how?

FOR THE TEACHER

Cold Floors

(Level 1)

Explore the way a material feels to the touch and compare this to its actual temperature.

Materials

■ Self adhesive liquid crystal thermometers, or an infrared thermometer
Liquid crystal thermometers are commonly used for measuring the temperature of terrariums and are available at an aquarium or pet store for a few dollars.
Infrared thermometers are available for $35+ from science supply stores such as Science Kit & Boreal Labs (www.sciencekit.com) and Edmund Scientific (www.scientificsonline.com).

■ Pieces of several of the following (pieces should all be larger than your hand)
• Steel • Floor tile • Carpet • Wood • Plastic • Cardboard

■ Ice cubes (optional)

Notes on the activity

■ Metal sheets can warm up rather quickly from repeated touching, so you may want to have several on hand.

■ Not all liquid crystal thermometers are well calibrated. Be sure that they all have the same reading at room temperature before attempting this activity. A more expensive but effective alternative is an infrared thermometer, which can quickly and easily measure surface temperature.

Required preparation

1. Stick one liquid crystal thermometer to the back of each piece of material
.
2. Place all materials, thermometer-side down, on a large piece of insulating material, such as cardboard. Allow them to come to room temperature.

Discussion

All of the thermometers should be at room temperature, despite some of materials feeling warmer to the touch than others. The way a material feels depends on its ability to conduct heat. Heat travels quickly through metals, for example, and slower through materials like carpet and wood.

When two objects with different temperatures come in contact with one another the heat will flow from the warmer object to the colder object. This is why your coffee cools off to room temperature if you don't drink it fast enough. In this activity, when your hand comes in contact with the piece of flooring, heat flows from your hand to the object since your skin is the warmer object.

Touching metal will cause it to heat up, but that heat is quickly spread out through the metal. This takes heat away from the contact surface between your hand and the metal, thereby carrying away body heat and leaving the surface of the metal feeling cold. Touching carpet will also cause it to heat up, but since carpet doesn't conduct heat as well as metal, the heat from your hand will remain on the surface of the carpet and it will soon reach the same temperature as your hand.

The direction of heat flow is always from the warmer object to the cooler object. This idea can be emphasized by comparing the results of touching metal with your hand (your hand is the warmer object) and touching metal to a piece of ice (the metal is now the warmer object – see addition)

Discussion (continued)

You may wish to have students rank the heat conductivities of the materials. They can check their answers by looking up the heat conductivity of the materials on the internet.

This is a good way to introduce the idea that all materials in a given environment eventually come to the same temperature. Also notable is that hot metals are more dangerous than other materials at the same temperature because they will transfer heat to your hand more quickly.

The results of this activity can also motivate a discussion of why scientists prefer to use numerical measurements, rather than their senses alone, to make scientific observations.

Optional addition

1. Place all materials on a large piece of insulating material, such as cardboard.

2. Have students predict which material will melt an ice cube the fastest based on what they felt when touching each material and the results of the thermometer readings.

3. Have them verify by touch that all the ice cubes are really ice and have similar mass.

4. Place one ice cube at the center of each material. Allow the ice cubes to melt without touching or moving them and observe differences in melting time.

Discussion Question

■ Why does a piece of metal melt an ice cube faster than a piece of wood, even though the metal felt colder originally?

Discussion

In the original activity your hand was the warmer object. In this variation, the piece of flooring is the warmer object. The metal melts the ice cube faster than the wood because the heat in the metal travels though it to the surface in contact with the ice faster than it can in the other materials.

Suggested resources

Elert, Glenn. “Conduction.” The Physics Hypertextbook, 2006.
http://hypertextbook.com/physics/thermal/conduction/
Background on thermal conductivity and table of common materials’ conductivities.

Taylor, Stuart, Paul Walorski, and Tom Young. “Ask the Experts.” Physicslink.com. http://www.physlink.com/Education/AskExperts/ae680.cfm
Explanations of conductivity and other factors influencing how “hot” or “cold” an object feels.

Bibliography

“Cold Metal.” Exploratorium Snacks. http://www.exploratorium.edu/snacks/cold_metal.html

Colored Filters

Explore how looking though colored filters changes what you see.

Safety

1. Never look directly at the sun or other bright light sources.

2. Flip over the sheets one by one and record the temperatures.

Materials

■ Red, blue and green primary color filters

■ Additional color filters

■ This page, printed in color

Instructions / discussion questions

■ Look at an object with lots of different colors, such as a painting, through each filter. How do the colors change when you look at them through a filter?

■ Find objects that look the same as white objects through each filter. What color are they without the filter?

■ Look at the colors below through each filter and describe what you see. What causes these changes in appearance?

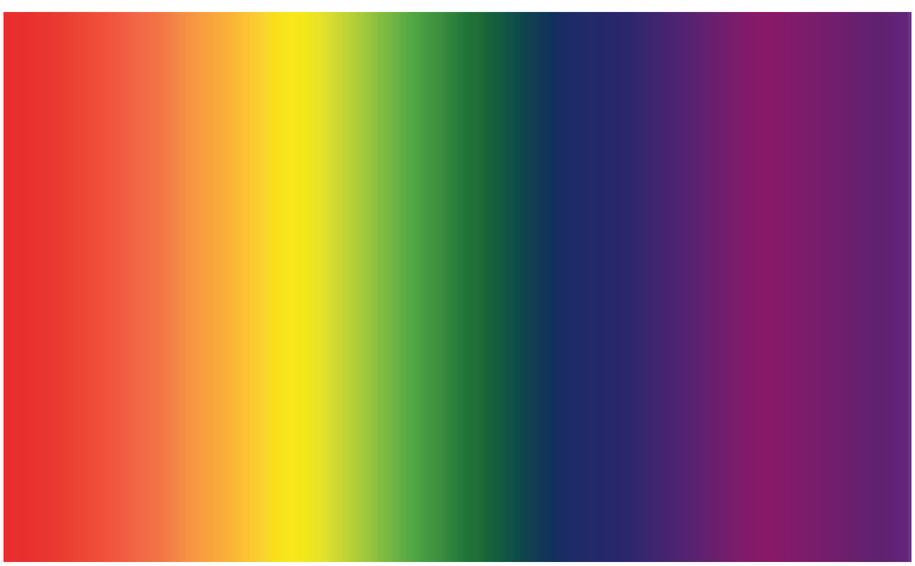


Image courtesy NASA

FOR THE TEACHER

Colored Filters

(Level 1)

Materials

- Red, blue and green primary color filters
  Theatre supply stores sell large sheets of lighting gels for a few dollars that work very well. You can also get these from science supply stores.

- Additional color filters
  Such as a book of gel samples from a theater supply store.

- Previous page, printed in color

Instructions

Divide students into groups. Give each group three filters, one of each color. Have students look around the room through the filters and pay attention to how objects' appearance change depending on which filter is used.

Discussion

We see because objects reflect light into our eyes. Objects have color because they reflect some colors more than others. For example, a red apple reflects red light but absorbs most blue and green light, so it looks red. A blue object reflects blue and absorbs green and red.

Color filters absorb all of the light that goes through them except for one color – the color that they reflect. For example, the green filter absorbs red and blue light, but reflects and transmits (lets through) green light. This is why when you look through it you see the world in shades of green: objects reflecting a lot of green light (green objects) look brighter than those reflecting less green light (red or blue objects).

Red and blue objects look dark through a green filter because the filter absorbs most of the light that they are reflecting. Yellow and cyan objects appear as different shades of green because they reflect some green light and some red (yellow objects) or blue (cyan objects), but the filter blocks every color except green. White light is a mixture of all colors, so when viewed through a filter, a white object will appear a light shade of the color of the filter.

Suggested resources

Crump, Lorraine I. "I Can See a Rainbow!" SMILE Program.
http://www.iit.edu/~smile/ph9203.html
Another color mixing activity which includes several activities related to why the sky is blue and rainbows.

"RGB World: Understanding Color." RGB World, Inc., 2006.
http://www.rgbworld.com/color.html
Background on the two types of color mixing as well as reflection and absorption.

Bibliography

"Colored Shadows." Exploratorium Snacks.
http://www.exploratorium.edu/snacks/colored_shadows.html

Colored Secret Messages

Explore how colored filters can be used to create and decode secret messages.

Materials

- Red, blue and green primary color filters
- Secret messages printed in color
- Additional color filters
- Computers with Microsoft Word (optional)

Instructions

1. Look at the secret messages below.

2. Predict which filter will make each message clear.

3. Go through your filters and find one that lets you read each message.

Discussion questions

- Why is it difficult to read the messages?
- How is the color of the filter that lets you to read the message related to the colors in the message?

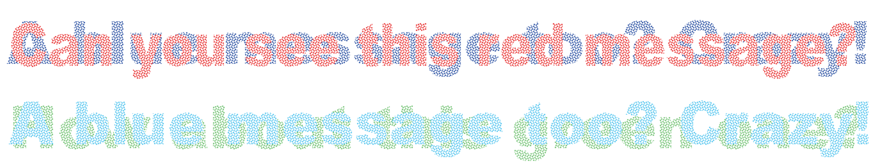
Camouflaged secret messages

People often have red eyes in pictures because light from the camera's flash reflects off of the blood vessels in the back of the eye.

Oceans and lakes look blue because they reflect the blue of the sky.

Plants look green because they reflect green light. They use red li ght to make their food, so a green filter will make them grow very slowly.

Overlapping Secret Messages



Make your own camouflaged secret messages

1. Open Microsoft word.

2. Create a text box and type your message.

3. Right click on the edge of the text box and select the “format” option.

4. Under “colors and lines” select “fill” and go to “fill effects” to see the pattern choices (option titles may variety with Microsoft version).

5. Look through the filter you want to be the key to your message and choose a pattern and color that is hard to see through without the filter but nearly invisible with the filter.

6. Change the color of the text to a color other than the filter color.

7. Test that your message is only visible when using the filter.

Make your own overlapping secret messages

1. Open Microsoft word

2. Use word art (on the “Drawing” toolbar) to write your secret message (choose a bold style without a shadow).

3. Use word art to create a different message, we’ll call this message 2

4. Right click on message 2 and choose “format”

5. Under “colors and lines” select “line” and choose “no line”

6. In the same menu, select “fill” and then choose “fill effects” to see the pattern choices.

7. Look through the filter you want to be the key to your message and choose a pattern and color that is hard to see through without the filter, but nearly invisible with the filter.

8. Using the same procedure, change the secret message so that it has no outline and is filled with a pattern that is easily visible through the filter.

9. Click and drag the secret message so that it is on top of message 2 (you may need to change the layout of the secret message to “behind text” under the “format” menu in order to do this.). The secret message should be difficult to read without the filter and easier using the correct color filter.

FOR THE TEACHER

Colored Secret Messages

(Level 2)

Materials

- Red, blue and green primary color filters
  Theatre supply stores sell large sheets of lighting gels for a few dollars that work very well.

- Additional color filters
  Such as a book of gel samples from a theater supply store.

- Secret messages printed in color

- Computers with Microsoft Word (optional)

Discussion: Camouflaged messages

Each text message is covered by a pattern of a different color. To see through the pattern, you have to use the colored filter that matches the color of the pattern.

The pattern should "disappear" when viewed through the matching filter for the same reason that red objects and white objects look similar through a red filter. The red light from a white-colored object passes through the filter to your eyes, but the other colors are blocked. This makes the white object appear a light shade of red. Therefore, looking through a red filter at a red pattern on a white background lessens the contrast between the pattern and the background. This makes the hidden message appear dark and easy to read.

Games, such as Outburst (by Get Together Games), sometimes use this technique to keep the words on game cards hidden. They include a color filter so that at the appropriate time the players can read the words.

Discussion: Overlapping messages

Each of these messages is really two overlapping messages made from different colored dots. When viewed through a filter of one of the colors, the dots of that color disappear for the reasons given above, leaving the other message readable.

Suggested Resources

Crump, Lorraine I. "I Can See a Rainbow!" SMILE Program
http://www.iit.edu/~smile/ph9203.html
Another color mixing activity which includes several activities related to why the sky is blue and rainbows.

"RGB World: Understanding Color." RGB World, Inc., 2006
http://www.rgbworld.com/color.html
Background on the two types of color mixing as well as reflection and absorption.

Bibliography

"Colored Shadows." Exploratorium Snacks.
http://www.exploratorium.edu/snacks/colored_shadows.html

FOR THE TEACHER

Soak up the Sun

(Level 2)

This extension lists variations/additions on the "Soak up the Sun" PhysicsQuest activity (pages 29-37 in the PhysicsQuest manual).Instead of trying all of the variations suggested below; you may wish to focus your students on one factor for a more in-depth discussion

Safety

Students should be careful when working with light bulbs. Certain bulbs, especially halogen bulbs, get very hot when running, so students should not touch any light bulbs during testing or for few minutes after testing. Incandescent bulbs are also very easy to break, so students should be advised to handle them with care and ask for help if one breaks. Students should be careful with the glass used in the Windows activity, as it may have sharp edges and can easily break.

Materials needed for all variations

- Core activity materials from Activity 3
- Thermometers (2)*
  "Metal Back Student thermometers" such as those included in the kit range from 20 to 230°F/–30 to 110°C and are available at science supply stores such as Science Kit & Boreal Labs (item # WW6644400) for about $3.50 each.
  - Desk lamp with 60w light bulb
  - Plain white paper
  - Graph paper
  - Colored pencils / markers
  - Stop watch or clock with second hand
  - Scissors
  - Metric ruler

Cooling Rates

Have students complete the core activity as instructed in the PhyicsQuest Student Guide, but instead of setting the thermometers aside when the five minutes of data collection has passed, two group members should collect data on the rate of cooling for each color for an additional 5 minutes. They should graph all of the data together.

Additional materials

- Another stopwatch

Discussion questions

- Which color cooled the fastest? The slowest?
- Were you surprised by the result?
- How did the cooling rate compare to the heating rate for each color?

Discussion

Students should find no clear relationship between the cooling and heating rates of the different colors. This is because although materials absorb light in the visible range of light (this is why color makes a difference), they emit heat primarily in the infrared range. The color of a material has little effect on the rate of infrared emission.

Beyond Felt

Students should create pockets from the paper, foil, and wrap, as in the core activity. They should then follow the same instructions for collecting data as in the core activity.

Additional materials

• Aluminum foil • Construction paper of various colors • Plastic wrap

Discussion questions

■ Which pockets got the hottest? Why do you think this is?

■ What factors besides color affect how well an object absorbs heat?

■ If you could create an ideal light-absorbing pocket, what would it be like?

Discussion

This variation is more of an exploration than an experiment because it introduces many different variables to the original color-based experiment – such as reflectivity, type of material, material thickness, etc. This activity is included because it is a good starting point for discussing how well different materials absorb light. This is also a good opportunity to talk with students about the importance of changing only one variable at a time in an experiment?

Comparing Light Sources

Have students place a thermometer under each of the following types of lamps and record the temperature every minute for 5 minutes (as in the core activity). Make sure that the distance from the bulb to the thermometer is the same for all trials.

Additional materials

• Incandescent desk lamp • Fluorescent desk lamp •Halogen desk lamp

Discussion questions

■ Which light source heated the felt the fastest? The slowest?

■ How does the brightness of the lamp compare to its ability to heat the felt? Does the brightest lamp give off the most heat?

■ If a lamp was not very bright, but the felt heated quickly, what would that tell you about its efficiency? In other words, is a large or small part of the lamp's energy going into producing light? Into producing heat?

■ Is this a good test of how much heat different types of light bulbs give off? What other factors might have influenced your results.

Discussion

■ **Incandescent light bulb**

Probably the most common type of light bulb used in homes, incandescent light bulbs light up when an electric current travels through a thin wire filament (see Activity 2, Extension 5). This causes the filament to radiate light, much of which is infrared light, or heat. Incandescent bulbs are the least efficient type of bulb in terms of energy need per amount of visible light produced.

■ **Halogen light bulb**

Halogen light bulbs use a chemical process involving halogen gas to increase the lifetime of the filaments, but this only works if the bulb is allowed to get very hot. Although this increases the efficiency of the light bulb it also produces a lot of heat.

■ **Fluorescent light bulb**

Fluorescent lights, which are inexpensive and more efficient than incandescent light bulbs, emit light when a chemical reaction in the bulb turns UV light into visible light. This process doesn't give off much infrared light so the bulb only becomes warm instead of hot.

Windows

In this activity students investigate how light shining through a window in a closed room affects the temperature of a room.

Have students place a thermometer in a box, cover the top of the box with the glass, and put the box in the sunlight (or directly below a desk lamp with an incandescent bulb). Then have them record the temperature on the thermometer every two minutes for a total of 10 minutes. After this, have students move the box/glass aside and put only an at-room temperature thermometer in its place. Again, have students collect data every two minutes for 10 minutes.

Additional materials

- Empty box (large enough to hold the thermometer)
- Glass or acrylic sheet (large enough to cover the box)

Discussion questions

■ Were you surprised at the temperature difference between the two situations? Why or why not?

■ Think about what you learned in this experiment – why do parked cars get so hot in the summer? On sunny winter days?

■ In what other ways do windows affect the temperature of a room?

Discussion

When light from the sun enters a room through the window it is absorbed by the surfaces in the room and radiated as heat. The glass in the window doesn't allow the heat to escape by convection (rising of hot air), so the hot air stays in the room.

In addition, infrared light can pass though windows (although you can purchase windows with a special coating to reduce this). When infrared light enters a closed room it is also trapped in the room – which causes the room to heat up.

Solar Ovens*

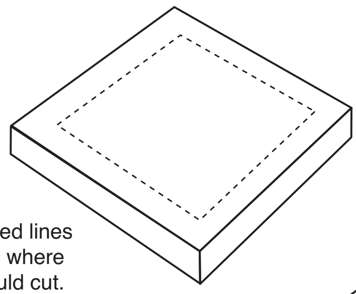
Design and build a solar oven using your knowledge of heat absorption.

Materials

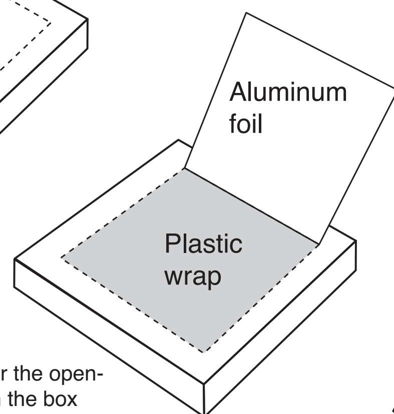
- Carboard box
- Adhesive tape
- Scissors
- Markers
- Aluminum foil
- Thermometer
- Plastic wrap
- Straw or stick
- Black construction paper
- Something to melt or cook

Make a solar oven

1. Draw a one inch border on all four sides of the top of the pizza box. Cut along three sides leaving the line along the back of the box uncut.



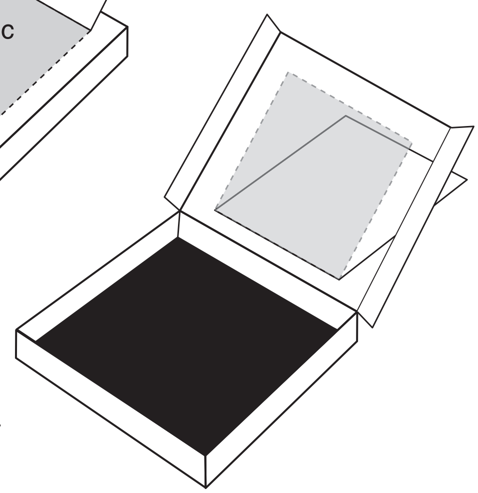
The dotted lines illustrate where you should cut.



2. Form a flap by gently folding back along the uncut line to form a crease.

3. Cut a piece of aluminum foil to fit on the inside of the flap. Smooth out any wrinkles and glue into place.

Cover the opening in the box with a piece of plastic wrap and the inside of the flap with foil

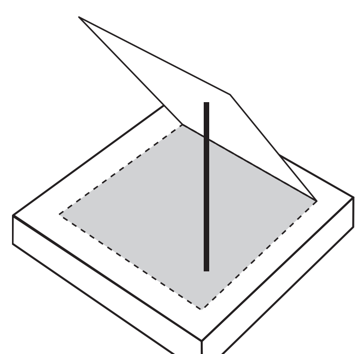


4. Measure a piece of plastic to fit over the opening you created by forming the flap in your pizza box. The plastic should be cut larger than the opening so that it can be taped to the underside of the box top. Be sure the plastic becomes a tightly sealed window so that the air cannot escape from the oven interior.

5. Cut another piece of aluminum foil to line the bottom of the pizza box and carefully glue into place.

6. Cover the aluminum foil with a piece of black construction paper and tape into place.

7. Close the pizza box top (window), and prop open the flap of the box with a wooden dowel, straw, or other device and face towards the sun. Adjust until the aluminum reflects the maximum sunlight through the window into the oven interior.



Your oven is ready! Test how hot your oven can get using a simple oven thermometer, and try melting or cooking something tasty!

*Text and illustrations shown with this activity are based on information from "Make a Pizza Box Solar Oven" by Solar Now, Inc. The original document can be found at http://www.solarnow.org/pizzabx.htm. Text has been adapted for use as a PhysicsQuest extension

Solar Ovens*

Discussion questions

- How could you make your solar oven heat up faster?

- What is the purpose of the clear plastic? The aluminum foil?

- What are the benefits and drawbacks of using a solar oven to cook food?

FOR THE TEACHER

Solar Ovens

(Level 2)

Text and illustrations shown with this activity are based on information from "Make a Pizza Box Solar Oven" by Solar Now, Inc. The original document can be found at http://www.solarnow.org/pizzabx.htm. Text has been adapted for use as a PhysicsQuest extension.

Materials

- Shallow cardboard box
  A pizza box works well
- Scissors or box cutter
- Aluminum foil
- Plastic wrap
- Black construction paper
- Tape
- Markers
- Other miscellaneous materials such as newspaper, colored construction paper, or felt
- Thermometer*
  "Metal Back Student thermometers" such as those included in the kit range from 20 to 230°F/–30 to 110°C and are available at science supply stores such as Science Kit & Boreal Labs (item # WW6644400) for about $3.50 each.
- Straw, stick, or other object to prop up a flap of cardboard
- Something to melt or cook (marshmallows, chocolate chips, mini hotdogs etc.)

Notes on the activity

Step-by-step instructions are provided, as well as more open-ended inquiry-based instructions for more advanced classes.

Inquiry-based Solar Ovens Activity (step-by-step instructions on previous page)

Step-by-step instructions are provided, as well as more open-ended inquiry-based instructions for more advanced classes.

Divide students into small groups. Give each group a cardboard box and place the rest of the materials on a front table. Make sure there is enough of everything to go around. Tell the class that they will have 30 minutes to make a solar oven. They should spend 5-10 minutes planning and the rest of the time building. The group whose oven reaches the highest temperature after 10 minutes in the sun will be the winner.

Remind your class to use what they learned about how different materials respond to light in the core activity (and other extensions if you have performed them). Outside knowledge of other materials' properties will be helpful as well. Depending on how advanced your class is, you may want to go over some of the concepts below before the contest. You might also considering building a sample oven as an example.

- Dark colors absorb more heat than light colors
- Shiny materials reflect light (and thus heat) and can be used to "aim" light
- Transparent materials allow light in, but do not let air out
- Warm air rises

Discussion

The sun's rays come into the box through the clear plastic. Once inside the rays are absorbed by the black construction paper and are radiated as heat. The heat is then trapped inside the oven in two different ways:

1. Cardboard is a good thermal insulator so very little heat escapes through radiation

2. The clear plastic does not allow much air to escape so little heat is lost to the raising of hot air (convection).

The aluminum foil flap lets the user direct the maximum amount of sunlight into the oven to keep it hot, since aluminum is a good reflector of light.

Suggested resources

D'Alto, Nick. "S'more Energy Please!" Education Place: Experience Science.
http://www.eduplace.com/science/hmxs/ps/modd2/cricket/sect5cc.shtml
Explanation of how a solar oven works and alternate design for an oven.

Field, Simon Quellen. "Light and Optics: Make a Solar Powered Marshmallow Roaster."
Science toys you can make with your kids.
http://sci-toys.com/scitoys/scitoys/light/marshmallows/solar_roaster.html
Instructions for another type of solar cooker, this one uses a Fresnel lens.

References

"Make a Pizza Box Solar Oven." Solar Now, Inc., 2003
http://www.solarnow.org/pizzabx.htm