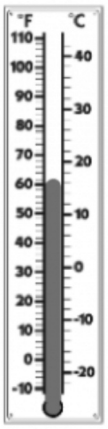
A STEM in the Park

Take Home Activity

STEM in the PARK™

Science, Technology, Engineering, and Mathematics



Solar Absorber:
Turn Light into Heat

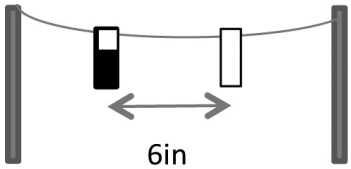
What You Need

- Two Outdoor Thermometers
  - Works best if they're the same kind
  - Bulb-style thermometers work well ($2 at hardware stores)
- Construction paper
  - Black and white (optional: others colors)
- Transparent tape
- Masking tape
- String
- Aluminum foil
- Paper and pencil

Here's your experiment

1. This experiment will work best on a sunny day when there isn't too much wind.
2. Start out with all your materials indoors and out of direct sunlight.

3. Using the black construction paper, wrap the front and back of one thermometer and use the transparent tape to hold the paper in place. Leave the front surface of the thermometer uncovered from just below the top of the colored liquid to the top of the thermometer so you will be able to read the temperature as it warms. Add some black paper to cover the rest of the back side of the thermometer.
4. Repeat step 3 using white paper on the other thermometer. Try to keep the size of the paper wrap the same as it was for the black paper.
5. Write down the temperatures on both thermometers—they should be almost the same.
6. Find a sunny spot to hang your thermometers using the string. Use the transparent tape to hang the thermometers from the string. Hang the string like a clothesline, either by tying it or using masking tape.
   a. Some good locations
      i. On a fence (cyclone, chicken wire, or wooden)
      ii. Between two garden stakes or cages
      iii. Between two lawn chairs
      iv. In the middle of an open window facing the sun, outside the screen



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b. Hang the thermometers so they are facing the sun, about 6 inches (15cm) from each other.

c. Avoid hanging the thermometers close to places where there's a lot of extra heat, such as near the walls of a building, close to the surface of a concrete patio or driveway, or next to a car.

7. Write down the temperature of the two thermometers and the time you took the measurement. Start out measuring every 3-4mins. Increase the time between measurements if the temperature is changing slowly.
8. What did you see? Was there a difference in the temperature read by the thermometers?
9. Remove the paper from both thermometers and record the temperatures again after 5-10mins. Compare the two thermometers to each other, and compare the final measurements with the last measurement while wrapped.

What's Going On?

- Thermometers are designed to measure the temperature of the air or liquid in which they are placed. They come to the same temperature as their surroundings because the air or liquid warms the thermometer by direct contact (called conduction).
- When you wrap the thermometer in paper, you make a small solar absorber. Sunlight carries energy (a form of radiation), and when the light is absorbed by the paper, it changes to heat, which warms the thermometer more than the surrounding air. This is the idea behind rooftop solar water heaters, solar pool covers, and greenhouses.
- Lighter colors reflect more of the sunlight, and darker colors absorb more. This is why darker colors heat up more than lighter ones.

Questions

- What do you think would happen if you used a color like green or blue for your solar absorber? Try it and see.
- What do you think would happen if you used aluminum foil or plastic wrap instead of paper? Try it!
- Why do you think many outdoor thermometers are colored white?
- Why do you think it was suggested to avoid doing this experiment on a windy day? How do you think wind might affect the results of the experiment?

Interesting Facts

- Sunshades in car windows keep parked cars cooler by reflecting sunlight before it is absorbed in the car.
- Many buildings in cities have black tar roofs. On hot, sunny summer days, these roofs can reach as high as 170°F* This is hot enough to cause severe burns in less than a second. Painting these roofs white can reduce their temperature on these hottest days by up to 42°F. While the roof is still hot, it is much cooler than a black roof. The cooler roof heats up the building less, reducing the need for air conditioning and saving energy.

* NASA: **http://www.nasa.gov/topics/earth/features/ny-roofs.html**

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