Teacher Page

What Effect Does Color Have on Temperature?

Source: https://www.metlink.org/experiments-with-an-infrared-thermometer/

Click here for an introductory video to this activity that you can show your students.

Please read the background information about how IR thermometers work. This can be found by following the source link above. WARNING: You may want to cover the laser pointer.

Students should be familiar with the electromagnetic spectrum or at least the concept of color (absorbed / reflected light) in the visible spectrum.

Time Required: 45 min - 1 hour, depending on the objects used and indoor/ outdoor location

Materials needed for this activity:

- IR Thermometers. Remind students that they don't need to touch the objects to take their temperature, but you should be cognizant of the proper distances for temperature detection based on the size of the object you are measuring.
    - ⇨ The infrared thermometers have an optical resolution of 12:1 distance to spot ratio. This means that they can measure the temperature of an object which is at least 1/12 of the size of the distance the thermometer is away from the object. So, the temperature of an object 1m high and 1m wide can be measured from up to 12m away.
- Objects of different colors but the same material. These could be almost anything - construction paper, plastic sheets, different colored T-shirts, cars in a parking lot, etc. Use whatever materials you have on hand or have access to. Be creative!
- A light source - light bulbs (not fluorescent or LED) or sunlight. If outside, this activity works best on a sunny day that is not too hot.
- Spray bottles or containers with water for wetting the objects
- Umbrellas or pieces of cardstock / cardboard for shading the objects

NGSS Standards:
MS-PS3-4, MS-PS4-2, HS-PS4-3, HS-PS4-5

PA Science & Technology Standards:
3.2.7.B5, 3.2.7.B6, 3.2.8.B6, 3.2.10.B5

Student Handout Name _____

What Effect Does Color Have on Temperature?

Pre-lab questions:

1) What causes us to see objects as having different colors?

2) What effect, if any, would objects' different colors have on their temperature?

3) Consider a crosswalk. Why would the "stripes" have different temperatures?

4) What are some conditions other than color that would affect the temperature of objects in the environment?

5) Define the term "albedo".

Procedure:

→ Follow your teacher's directions for using the IR thermometer correctly! ←

Using the IR thermometer, compare the temperature of different colored objects. Be sure to select objects that are made of the same material (cloth, metal, plastic, brick, etc.) and under the same light (sun, IR lamp, indoor light). Once you have recorded initial temperature readings, extend the experiment by moving the same objects to a new location (i.e. a shaded area) or wetting the objects and recording their tempera If the object cannot be moved (like a car) use an umbrella or other solid object to create shade. Allow 5-10 minutes for the temperature to stabilize before taking a new reading. Analyze the results to develop a conclusion about the effects of color on temperature.

Student Handout Name _____

Results:

Trial 1 - Initial Readings

Object	**Color**	**Material** (metal / paper/ cloth / brick)	**Condition** (light / shade / dry / wet)	**Temperature**

Trial 2 - Extended Readings (Repeat the experiment with the same object under different conditions.

Object	**Color**	**Material** (metal / paper/ cloth / brick)	**Condition** (light / shade / dry / wet)	**Temperature**

Student Handout Name _____

Analysis and Conclusion:

1) As a general rule, what effect did color have on the temperature of the objects in this experiment?

2) If an object is seen as RED, what color(s) of light would it reflect & absorb? Based on the wavelength for red light, would you expect this color to be warmer (higher energy) or cooler (lower energy)?

3) Considering your answer to #2, why is there a difference between the temperature or dark and light-colored objects under the same light?

4) Explain why the same object would have a different temperature if it is dry vs. wet. Consider the properties of water before stating your answer.

5) Based on your results, why is the color and composition of roofs, parking lots, etc. a concern in combating climate change?

6) How does the amount of snow & ice cover on the earth affect the temperature of the earth's surface? How does this relate to climate change?