Reflect on Light and Color

Take a look at how the color of materials that cover the Earth like snow, soil, and water affect the amounts of sunlight they reflect and absorb.

What you'll need:
- 4-8 transparent containers that hold at least 1 cup (like jars or bottles)
- Materials found at the Earth's surface (ice, snow, soil, sand, grass, leaves, water, asphalt)
- A thermometer for each container or an IR thermometer
- Sunshine! (or if it's not sunny, you can use desk lamps with 150 Watt bulbs)
- A watch or stopwatch

Directions:
1. Fill each container with 1 cup of a material found on Earth's surface.
2. Place a desk lamp nine inches above each substance so that its light shines directly on it. Do not turn the light on yet. Make sure the distance between each lamp and container is the same.
3. Place a thermometer in each container and note each material's temperature.
4. Remove the thermometers and turn on each lamp (or place the substances in direct sunlight outside).
5. Using the thermometers, record the temperature of each substance every two minutes for 10-minute period. Do not leave the thermometers in the sun or under the lights between measurement readings. Make sure that you read the thermometers without shading the light if possible.
6. Graph the data you collected. What material was the warmest after 10 minutes?

Ask yourself the following questions:
- How did color influence the temperature of each substance? Why?
- What can your data tell you about the absorption and reflection of light by oceans, forests, deserts, cities, roof tops, snow-covered land masses?

Science background:
Some materials absorb most of the sunlight that hits them. Others reflect most of the sunlight that hits them. The amount of energy that is reflected by a surface is called albedo. Albedo measurements are always between 0 to 1, with light-colored or reflective surfaces being closer to 1, and dark surfaces having an albedo closer to 0. White surfaces, like snow, have very high albedos. This is one of the reasons why it takes so long for snow to melt. It reflects most of the light that falls on it! Clean white snow can have an albedo as high as .95, which means it reflects 95% of the energy that falls on it.

Because less light energy is absorbed by substances with a high albedo, their temperature is lower than substances with low albedo. That's why you can walk on the sidewalks barefoot in the summer, but the dark street pavements burn the bottoms of your feet!

Learn more online!
- **Snowstorms** https://spark.ucar.edu/shortcontent/snowstorms
- **Is Snow White?** https://spark.ucar.edu/longcontent/snow-white-maybe-or-maybe-not
- **Blizzards** https://spark.ucar.edu/shortcontent/blizzards
- **Icy Winter Weather** https://spark.ucar.edu/shortcontent/icy-winter-weather

For Teachers:

Student Learning Objective
- Students will explore how the color of materials at the Earth's surface affects warming.
- Students will collect and interpret data.
- Students will be able to explain why dark-colored materials create hotter temperatures.

Classtime
- 20 minutes for indoor activity and short discussion (plus extra time if going outside)
- Or 50 minutes for more in-depth discussion and data interpretation

Teaching notes
- Introduce this activity by asking students if they have ever noticed that wearing a black shirt or standing on blacktop pavement on a warm sunny day will make them hotter. Why? Discuss how light is absorbed and transferred into heat energy, or how it can be reflected or transmitted through certain substances such as glass.
- Since materials may start out at different temperatures, emphasize the amount of change in temperature during the experiment not the actual temperature.

National Science Standards
- A: Science as Inquiry
- B: Physical Science
- D: Earth Science