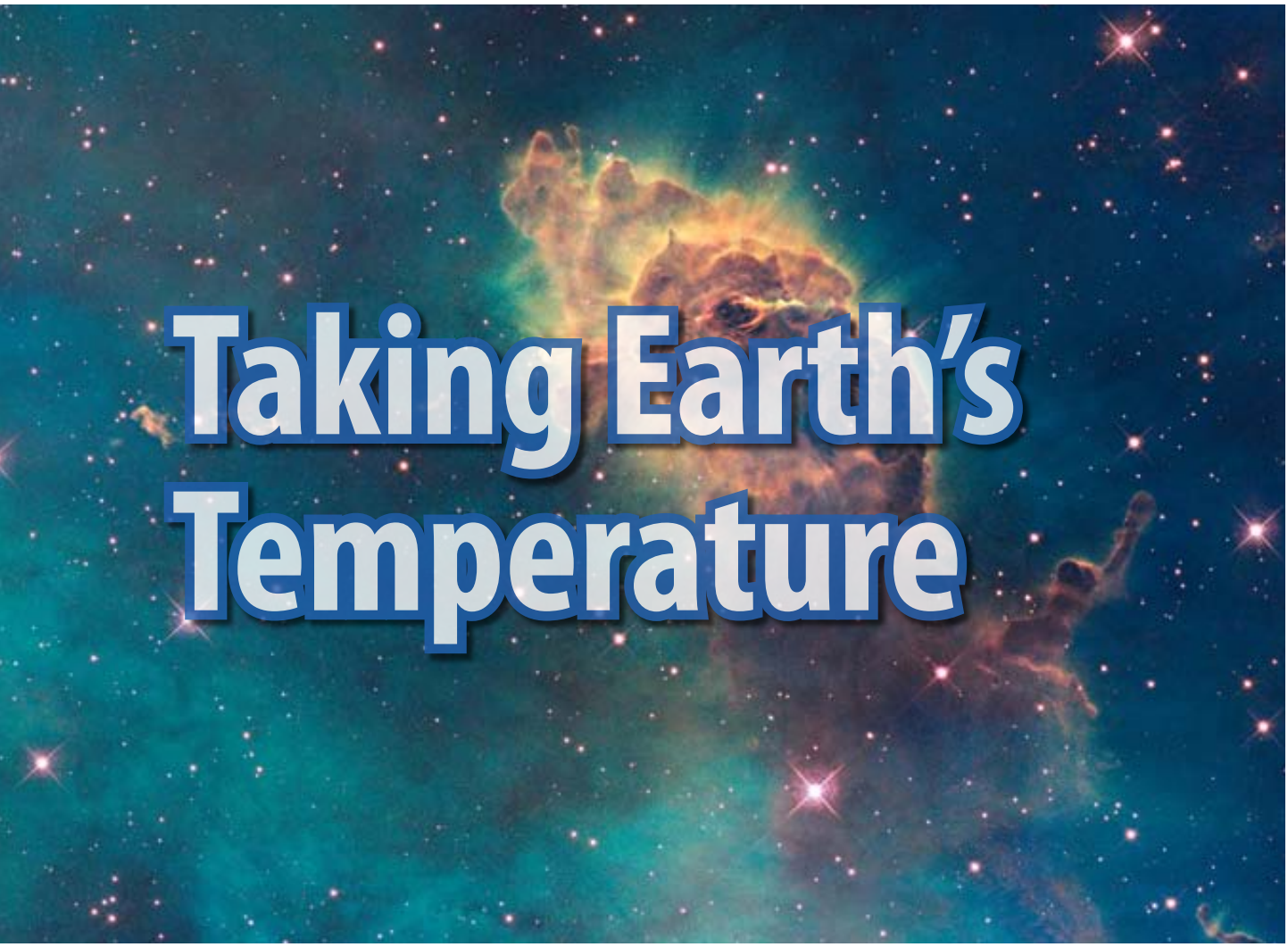
Activity Guide



The GLOBE Program

NASA@ My Library

STAR net
Science-Technology Activities & Resources For Libraries

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Overview

Taking Earth's Temperature

Participants are introduced to a type of energy, infrared radiation, which we can't see with our eyes but we can feel as heat. Then, they explore their outdoor environment using an infrared thermometer (also known as an IR thermometer) to measure the temperatures of concrete, asphalt, grass, and bare soil. Participants consider how the temperatures of different surfaces might have an influence on a global scale.

Credit: NASA, Langley Research Center

Key Concepts

- By taking careful measurements, patrons can record differences in temperature between concrete, asphalt, grass, soil, and other surfaces in their local environment.
- NASA takes measurements of Earth from space, using satellites. (Scientists refer to this as "remote sensing.")
- By taking measurements of Earth from space, NASA scientists study changes in Earth's dynamic systems – to help us learn more about climate, weather, and even the health of our crops!

Intended Audience:
Families or other mixed-age groups
School-aged children
Tweens
Teens
Adults

Preparation Time:
10-20 minutes

Activity Time:
10-20 minutes

Materials

- 1 or more infrared thermometers
- Batteries (fully charged)
- Optional: 1 thermometer (to compare with air temperature) per 6 learners
- Optional (recommended): poster-sized paper and markers to record observations as a group
- Optional: paper, pencils or pens, and clipboards to record observations individually

Tip: Infrared thermometers can be purchased from various online retailers starting at around $25 and up. Some example models include: Etekcity Lasergrip 800, Kintrex IRT0421, and Omega OS543. You may be able to borrow infrared thermometers from heating and cooling specialists or auto mechanics. Infrared thermometers are commonly used in those jobs.

Ideally, have one infrared thermometer for every two to four participants, or combine this activity with other activities as learning stations. See below for related activities.

Preparation

- Decide if you want the laser pointer on. Most infrared thermometers have an optional laser pointer to help you see where you are pointing the thermometer. You may turn the laser pointer off and/or cover it with tape. Alternatively, allow the use of the laser pointer to take aim, but make sure that facilitators are monitoring their use.
- Test that the infrared thermometer is measuring accurately. This can be done by testing the temperature of ice water. Ice water should be 32° F (0° C). An infrared thermometer is measuring correctly if it reads the temperature of the ice water bath within the range of 28-36° F (+/- 2° C). If the infrared thermometer shows a temperature of more than 36° F (+2° C), or less than 28° F (-2° C), try changing the battery. If the calibration still is off, the thermometer needs to be replaced.

Credit: Space Science Institute

- Go outside and take note of the different types of surfaces that participants could measure. Look for a bare soil, short grass, tall grass, concrete, asphalt, sand, forest litter, or other types of surfaces. Make sure to have a safe route for participants to enter and exit the building. A satellite image of your location might be helpful (you can see satellite imagery of your location using Google Maps Satellite View).

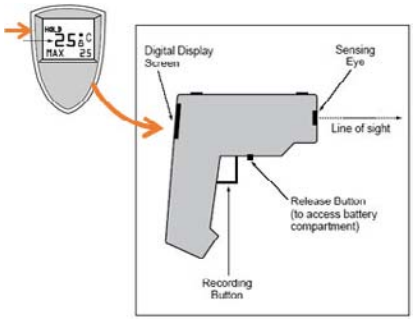
Procedure

1. Set the stage. Say:

- Imagine that you are outside on a hot day and you are barefooted. What surfaces would you want to walk on and why? Why are some surfaces cool to your touch? Why are some hot to your touch? Where did the hot surfaces get their energy? Those surfaces received this energy from the Sun and can become quite hot.
- All matter (you, a table, cars, apples, and the ground) emits energy. At the temperatures we usually experience in our daily life on Earth, that energy is emitted as infrared radiation. We can use a special infrared-detecting thermometer to measure this energy and tell us the temperature of the object.
- Warmth rising off Earth's landscapes influences – and is influenced by – weather and climate patters. Scientists track these changes using information from satellites. Satellite information can also help commercial farmers choose which crops need extra water during the summer to cope with the heat or find where to look for frost damaged crops in the winter.
- You can use an infrared thermometer to measure the infrared energy (heat) coming from different surfaces outside.

2. Demonstrate how to use the infrared thermometer.

- **Warn participants that the laser beam should NOT be aimed directly at eyes** or off surfaces where it could reflect into anyone's eyes.
- Hold your arm at arm's length and point the instrument at the ground. Briefly press the Recording Button to record the temperature.
- Be sure to have the instrument's Sensing Eye pointed directly at the surface you want to measure. Be careful to not inadvertently record the temperature of your shoe or the surface in your own shadow.



3. Give participants time to try measuring various surfaces with the infrared thermometer.
See the facilitation guide, *Using an Infrared Thermometer to Measure Surface Temperatures from Afar*, for tips.

4. Invite participants to go outside and investigate what happens to different surfaces when they are exposed to the Sun.

- Once outside, look for a bare soil, short grass, tall grass, concrete, asphalt, sand, forest litter, or other surfaces to measure. (Any surface can be used!)

Procedure (continued)

- Optional (recommended): invite participants to record the type of surface and temperature they record for that surface on poster-sized paper. Encourage participants to compare their measurements with others.'
- Optional: invite participants to draw a map of the area and note where they took their observations and record their temperature measurements.
- Prompt participants to take different measurements that will help them investigate questions such as:
  - How does surface temperature compare with current air temperature?
  - How do the temperatures compare for different surfaces?
  - How does surface temperature vary with surface soil color?
  - How does surface temperature change for different cover types (grass vs. asphalt for instance) on a cloudy day?
  - How does the surface temperature change for different cover types when it is wet versus when it is dry?

5. Conclude.

Have a discussion about how the temperatures of different surfaces might have an influence on a global scale. Explain that NASA and other scientists use temperature measurements of different surfaces to help them answer the following science questions:

- How do urban areas affect the temperature around them?
- What is the contribution of changing land use and land cover on local energy budgets?
- How are land surface temperatures changing over the long-term?
- How accurate are data from NASA satellites?

Extensions

Everyone can be a citizen scientist and share observations of their environment with NASA scientists! You can collect and share surface temperature measurements as part of a worldwide citizen science effort through *The GLOBE Program* (www.globe.gov). To join this effort, you'll need to become GLOBE Trained at:
http://www.globe.gov/get-trained/protocol-etraining

Then, follow the GLOBE Surface Temperature Protocol and enter the data into the GLOBE database.
https://goo.gl/esyqmm