MISSION BRIEFING

Activity: Making a Sundial

Prep Time: 5 minutes

Activity Length: Minimum 30 minutes

Task: Participants will construct a Sundial and use it follow the path of the Sun throughout the day, determine when solar noon is in their area, and estimate the time of day.

By the end of this activity participants will

gain an understanding of the daily movement of the Sun across the sky and experience conducting a set of simple quantitative observations.

Materials

- Wooden dowel or similar pole at least 50 cm (19.5 in) long
- Shadow markers (flags, rocks, sticks, nails, etc.)
- Meter stick
- Level or plumb line (string with weight attached)
- Optional: Compass to read angles

Preparation

1. Gather and prepare all listed supplies.
2. Group participants in teams of 3 to 4.
3. Set up a spot in a clear area, free of shadows, for participants to leave their sundials. Consider roping off the area to prevent tampering with the sundials when they are not in use.
4. Review with the students how to read their rulers or meter sticks, if necessary.

Procedure

1. Select a day that will be sunny for a few hours.
2. Take student teams outside to a relatively flat spot that will be out the of the shadow of buildings and trees.
3. Place the pole in the ground, making certain that it is perpendicular to the ground using a plumb bob (a piece of string with a weight on it) or a level.
4. Measure and record the height from the ground to the top of the pole.
5. Have the participants put a #1 on the first object (rock, flag, etc.) they will use to mark the position of the shadows. Ask the participants to place the marker on the ground at the end of the shadow from the pole and

Activating Prior Knowledge

Participants may have noticed that when they arrive at school in the morning the Sun is shining on one side of the school and when they leave in the afternoon it is shining on the other side. This occurs because the Sun appears to travel across the sky each day. Before the invention of clocks, people used this motion of the Sun to determine the time by making sundials. Sundials are simple stationary vertical objects, such as a pole, placed on a flat surface. The pole is known as a gnomon (NOmon) and the flat surface as a dial. As the Sun travels through the sky, the length and position of the shadow cast on the dial by the gnomon change. The shadow is longest at sunrise and sunset and is shortest at local solar noon.

NASA Science Connections

NASA and other international space agencies monitor the Sun with a fleet of spacecraft, studying everything from its atmosphere to its surface, and even peering inside the Sun using special instruments. Some of these solar-orbiting spacecrafts include the Parker Solar Probe, the Solar Dynamics Observatory, and the Solar Terrestrial Relations Observatory (STEREO). NASA studies the Sun to better understand how its everchanging conditions can influence Earth, other worlds, and space itself. Its heat makes Earth warm enough to live on and without the light from the Sun, there wouldn't be plants or animals! We also study this star that we live with because it's the only star we can study up close!

MISSION GUIDANCE

GO

- Discuss the activity and the outcomes and expectations.
- Activity area should be flat with minimal shadows from buildings and trees.

MAYBE

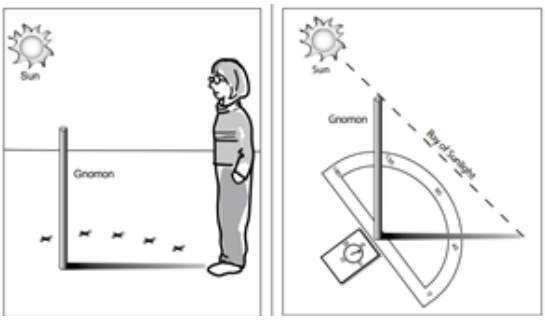
- Show the video describing NASA and the Sun
- Where Does the Sun's Energy Come From? https://youtu.be/GAGFC8-wn1g

NO GO

- Do not remove the sundial between readings. It should remain in place for the duration of the activity.
- Do not look at watches prior to reading the sundial.

Video: Where Does the Sun's Energy Come From?

GLOBE Activity



record the time from their watches.

6. The participants should measure and record the distance from the base of the gnomon to the end of the shadow in the table provided. (Optional: Have the participants measure the angle as well using a compass.)
7. Have the teams visit the gnomon at least once an hour for the remainder of your day with them. The participants should measure the length of the shadow (and the optional angle), place a new numbered marker at the end of the shadow, and record the time of day.
8. Ask the participants to use the table to determine which marker is closest to the pole. This is the time of the shortest shadow and is the observation closest to solar noon. If you have time, you could have the participants take more frequent measurements around the time of this observation on the following day to get a better estimate of solar noon.
9. Visit the sundial on another day in the same week. The student teams should bring their completed tables. Have the participants look at the shadow being cast by the pole and estimate from their tables what the time on their watches will be. Ask each student to write down their estimate. Have the participants look at their watches to find out how close their estimates were.

Challenge Questions

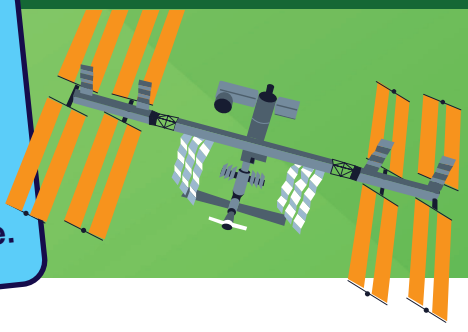
- What is the path of the sun as it moves across the sky?
- Does the path of the sun across the sky and the pattern of the shadows from the gnomon on the dial change during the year? (The answer could form the basis for a hypothesis that the participants could test experimentally.)

Extension

- Older participants can observe the changing angle of the Sun above the horizon. By measuring the height of the gnomon and the distance from the top of the pole to the end of the shadow (the hypotenuse of the triangle), participants can determine the angle of the Sun using simple geometry for similar triangles. Have the participants add a column to the table and fill in the solar elevation angle for each time they placed a marker. Observations of a flagpole and its shadow can also be tied into this type of observation.
  - When is the solar elevation the greatest? The smallest?
  - Could they have predicted this from the length of the shadows?
- Have students take temperature readings when checking their sundials. Does the temperature fluctuate between sunny and shady areas?

ISS FUN FACT!

Did you know that the space station gets all of its power from the Sun? The station is currently undergoing solar array upgrades, providing more power to support cutting-edge research in Earth and Space science.



Date_____

Description of Sundial Site_____

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Weather Conditions_____

Height of gnomon (pole)_____

Marker #	Time	Length of shadow cast by the gnomon	Optional: Compass angle of the shadow
Estimated time of solar noon