

Human Sundials

Purpose

By observing the changing in position of a shadow, students will understand the apparent motion of the Sun overhead.

Objectives

- Introduce a simple sundial
- Explore the way a sundial works
- Understand the length and position of shadows formed by the Sun help us to track the patterns of the Sun's position in the sky

Related Standards and State Goals

Illinois State Goals:

Early Elementary:

- *12.F.1a* Identify and describe characteristics of the sun, Earth, and moon as familiar objects in the solar system.
- *12.F.1b* Identify daily, seasonal and annual patterns related to the Earth's rotation and revolution,

Late Elementary:

- *12.F.2a* Identify and explain natural cycles and patterns in the Solar System (e.g., order of the planets; Moon phases; seasons as related to Earth's tilt, one's latitude, and where Earth is in its yearly orbit around the sun)
- *12.F.2b* Explain the apparent motion of the Sun and stars
- *12.F.3b* Describe the organization and physical characteristics of objects in the Solar System.

Integrated Subjects

- Social Studies

Audience

Kindergarten – 12th grade

Time Recommended

Steps 1-5: 30 Minutes

Steps 6-15: 90 minutes (total tracing time)

Materials and Preparation

- 1 Flashlight per pair of students
- Sidewalk chalk of various colors
- Watch or clock with correct time
- Globe
- Example of a sundial (You can use the Pocket Sundial Template)

Locate a large space for tracing shadows (e.g. basketball court, black top, large paved area)

Procedure

1. Have students work in pairs with a flashlight to create a shadow in the classroom.
2. In a large group, ask students what a shadow is.
3. Give the following explanation: Shadows are created by light being blocked by hitting an object that it cannot get through. Because light cannot travel through our bodies, shadows form. When we are outside, our shadows appear in different places depending on where we stand and where the Sun is in the sky.

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4. Select a pair of students to demonstrate how their shadows change while the remaining students make observations. Have one of the students hold a flashlight pointed at the second student. Have the second student move based on the following questions.
 - a. What happens to your shadow if you run in a circle?
 - b. What happens to your shadow if you curl up in a ball?
 - c. What happens to your shadow if you jump?
5. In a large group discussion, have students explain shadows. (Where are they? When do they occur? Do we use shadows for anything? How can we use shadows?) Help students understand that shadows are dark figures that result from blocking light.
6. Ask students how they believe people told time before watches and clocks were invented. Lead students to learn that sundials were the tools used to tell time and that sundials use direction and shadow to tell the time of day. Show the example sundial.
7. Take students outside to the black top or other location where you can use sidewalk chalk.
8. Explain that they are going to be part of a sundial just like the example they saw. Show students an example of a labeled sundial. Ask them what part of the sundial they think they could represent (gnomon).
9. Choose a central location on the black top. Have one student stand in the center of the space facing North. Trace that student's feet with chalk.
10. Have a student trace that student's shadow with one color of chalk and record the time.
11. Go inside and return ever 30 minutes to that same area. Have a different student stand in the same location facing the same direction. Trace that student's shadow with another color of chalk.
12. Repeat step 11 for a third time, at least.
13. After each tracing, discuss with the students what happened to their shadows. Students should also make predictions about what will happen to the shadow the next time they go out to trace.

Assessment

- After tracing the last shadow, discuss how the shadows changed over time. Students should identify the location of the shadows and the length of the shadows.
- Pose the question, "Although the Sun appears to move across the sky, is the Sun really moving?" Students should use knowledge about the Solar System to determine that the Sun's movement does not cause the change, rather, it is the Earth moving, or rotating, that causes the changes in shadow length and location. The rotation of the Earth on its axis causes day and night, which is what a sundial measures. Use a globe to demonstrate.

Grade Level Adaptations

- Kindergarten and 1st grade may consider doing only steps 1-6 and 8.
- Teachers of middle school or high school students may wish to begin with step 6.
- If you see the students for less than 2 hours per day, use multiple periods or classes of students to create the sundial. The next day, go visit the completed sundial or review photographs of the sundial.

Optional Activities

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- Younger students may benefit from playing shadow tag, so they can see the relationship between their movements and their shadows' movements.
- Telling Time with the Sun can be used as an introduction and complementary activity introducing students to Sundials.
- The Hand Clock activity extends this concept for older students.

Adler Planetarium Field Trip Connections

The following experiences* at the Adler can enhance the content covered in this lesson.

Shows:

- *One World, One Sky: Big Bird's Adventure* (Grades PreK-2)
- *Earth, Moon & Sun* (Grades 3-6)

Guided Gallery Experiences:

- *Look Up! One World, One Sky* (Preschool-Kindergarten)
- *Our Solar System* (Grades 2-7)
- *Understanding the Universe* (Grades 8-12)

Exhibitions:

- See astronomical tools including sundials in the *Universe in Your Hands* gallery located on the lower level.

* Please note that shows, classroom programs, and guided gallery experiences are available for an additional cost.