

Building a Sundial 5th Grade

Kaarina Lokko and Sharon Sells

References:

- “Making a Sundial” www.globe.gov/tctg/atla-sundial.pdf?sectionId=22 (accessed April 2, 2007)
- Sunshine in your pocket!
<http://www.lmsal.com/YPOP/Classroom/Lessons/Sundials/dialprint.html> (accessed April 2, 2007)
- www.wikipedia.com

Benchmarks & Objective:

- ES-1: Describe how night and day are caused by Earth’s rotation.
- ES-3: Describe the characteristics of Earth and its orbit about the sun (e.g. elliptical orbit, tilted axis and spherical planet).

Materials:

Small scale

- Tooth picks
- Transparencies
- Nails
- Hammer (for adult use only)
- Permanent markers
- Rulers
- Compasses

Large scale

- Long stick or pole
- Rocks/other place markers

*tooth picks with grooved ends sit nicely in a center hole

Also flashlight and ball on stick for additional reinforcement (a plain stick will also work).

Target Concept:

- Students should understand how time was kept before the advent of clocks.
- They should observe that with the rotation of the earth around its axis, the shadows change during the day.
- Also, with the changing of seasons the apparent time also changes.

Initial Introduction:

Ask students about time: How do we tell time; how many hours are in a day, etc.

Excerpt from Wikipedia.com “The factor of 60 comes from the Babylonians who used factors of 60 in their counting system. The hour had been defined by the ancient Egyptians as either 1/12 of daytime or 1/12 of nighttime, hence both varied with the seasons. Hellenistic astronomers, including Hipparchus and Ptolemy, defined the hour as 1/24 of a mean solar day. With the development of pendulum clocks keeping mean time (as opposed to the apparent time

displayed by sundials), the second became measurable. The duration of a beat or half period (one swing, not back and forth) of a pendulum one meter in length on the earth's surface is approximately one second.”

Procedure:

Start with the introduction.

Ask students which direction the sun rises and which side it sets. Have the students predict what direction the shadow will fall in the morning versus what direction it will fall in the evening. Have students predict when the shadow will be longest, and when shadow will be shortest.

Let the students write down their predictions on the accompanying worksheet. Review instructions with students (see worksheet).

Go outside with the students and let them nail down their transparencies, find and mark north with an arrow, and mark their first time. Go back periodically, preferably every hour to mark the time and make any other observations. Go back the next day sunny day at the same times to see how well your sundials work. Bring the sundials in and measure the lengths of the shadows if you haven't already done so. Let the students answer the questions and then discuss.

Sometime during the lesson, use the ball on a stick along with a flashlight to demonstrate that the sun rising in the east will cast a shadow toward the west, etc.

Target Observations:

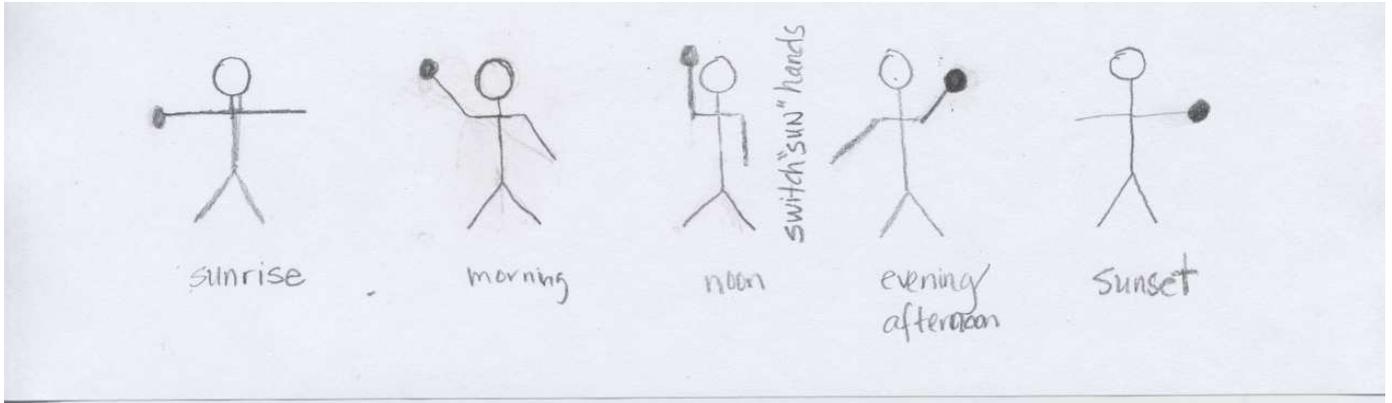
- Students should notice the sun rises in the east and sets in the west.
- The shadows produced by the sun are longest at dawn and sunset and shortest at solar noon (which is around actual noon).
- Students should observe that a shadow will point westward in the morning and eastward in the evening.
- They should be able to answer any of the questions concerning shadows and time. (especially as given by CPS)

Summary & Discussion:

Students should be able to estimate time by knowledge of direction (i.e. North, South, East, and West) and general movement of the sun. They should be able to tell that the days are caused by the rotation of the earth on its axis and the variation of day length is caused by the tilt of the earth.

Extensions (Optional):

- Arm demonstration was also very useful for determining the length of shadows. It is good reinforcement. Your fist is the sun. At dawn, the sun is on the horizon: both arms are outstretched. As time proceeds, as the “sun” moves up the “shadow” moves down the other hand.



Building a Sundial

Name _____

Date _____

In this activity you will be building a sundial. Sundials were used in ancient times to tell time of day. You will be making observations about the apparent position of the sun in the sky and the shadow it casts on the ground. By the end of this lesson you should be able to estimate time based on what you have learned about the sun.

Predictions

1. **When do you think the shadow of an object will be longest (morning, noon, or evening)?**

2. **Why do you think so?**

3. **What direction will your shadow point at in the morning?** _____
4. **What direction will your shadow point in the evening?** _____

Materials:

- Tooth pick, transparency, nails, hammer, permanent markers, ruler, compass

Directions

1. **Find a relatively flat place outside away from anything that will cast a shadow.**
2. **Nail your transparency into the ground.**
3. **Mark north on your sheet (use an arrow to show which direction is north).**
4. **Place a toothpick in the center of your transparency.**
5. **Measure the length of the toothpick from the bottom of the transparency.**
6. **Place a dot at the end of the shadow. Mark the time.**
7. **Repeat step 5 every hour. Record your observations.**
8. **On day 2, check your sundial at the same times as previously, record any observations.**

Building a Sundial (page 2 of 2)

Name _____

Date _____

Height of toothpick (from base of transparency) _____

Time of Day	Direction of shadow (North, South, East, West, Northwest)	Length of shadow (cm)

1. When do you think the shadow of an object will be longest (morning, noon, or evening)?

2. Why do you think so? _____

3. What direction will your shadow point at in the morning? _____
4. What direction will your shadow point in the evening? _____
5. Solar noon is the time of day at which the sun is highest in the sky. Do you expect the shadow to be longest or shortest at solar noon? Explain your answer _____

6. Based on your observations, what times is solar noon? _____

Building a Sundial- ANSWER KEY

Name _____

Date _____

In this activity you will be building a sundial. Sundials were used in ancient times to tell time of day. You will be making observations about the apparent position of the sun in the sky and the shadow it casts on the ground. By the end of this lesson you should be able to estimate time based on what you have learned about the sun.

Predictions *All answers are what the student thinks will happen and his or her reasoning behind the prediction and are therefore not wrong.*

1. **When do you think the shadow of an object will be longest (morning, noon, or evening)?**

2. **Why do you think so?**

3. **What direction will your shadow point at in the morning?** _____

4. **What direction will your shadow point in the evening?** _____

Materials:

- Tooth pick, transparency, nails, hammer, permanent markers, ruler, compass

Directions

1. **Find a relatively flat place outside away from anything that will cast a shadow.**
2. **Nail your transparency into the ground.**
3. **Mark north on your sheet (use an arrow to show which direction is north).**
4. **Place a toothpick in the center of your transparency.**
5. **Measure the length of the toothpick from the bottom of the transparency.**
6. **Place a dot at the end of the shadow. Mark the time.**
7. **Repeat step 5 every hour. Record your observations.**
8. **On day 2, check your sundial at the same times as previously, record any observations.**

Building a Sundial (page 2of 2)- ANSWER KEY

Name _____

Date _____

Height of toothpick (from base of transparency) _____

Time of Day	Direction of shadow (North, South, East, West, Northwest)	Length of shadow (cm)

- 1. When do you think the shadow of an object will be longest (morning, noon, or evening)?**
Morning and evening; sunrise and sunset.
- 2. Why do you think so?** The sun is closer to the horizon so it casts a shadow along the entire height (length) of the object
- 3. What direction will your shadow point at in the morning?** West
- 4. What direction will your shadow point in the evening?** East
- 5. Solar noon is the time of day at which the sun is highest in the sky. Do you expect the shadow to be longest or shortest at solar noon? Explain your answer.** Since the sun is highest in the sky it will be shining straight down on the object so the shadow will not go far out from the object. If anything, there will be only a very small or short outline or shadow.

- 6. Based on your observations, what times is solar noon?** Answers may vary based on times measurements were taken. Solar noon should not be very far from actual noon (Literally, it would be the median time between sunrise and sunset).