

Changing Shadows

Giving students the opportunity to observe their shadows throughout the day gives them a chance to observe evidence of Earth's rotation firsthand. This experience will help students better connect to the text because they will have seen with their own eyes the pattern of changing shadows discussed in the text.

SAFETY NOTE: Never look directly at the Sun! Looking at the Sun can damage your eyes!

Materials

Sidewalk chalk

Watch

Changing Shadows student pages

Procedure—Day 1

Morning:

Before reading *Next Time You See a Sunset* and first thing in the morning, give each pair of students a piece of sidewalk chalk and take them outdoors to a place where they can trace their shadows. Have students spread out so their shadows do not overlap. As one partner stands very still, have the other partner trace his or her shadow. After tracing, have them write the name of the person on the feet of the shadow and the time (including a.m. or p.m.) in the head of the shadow. Next have the partners switch and repeat the same procedure. Cautioning students to not look directly at the Sun, have them point in the direction of the Sun in the sky and notice that their shadows are in the opposite direction of the Sun.

*If possible, take a photograph of one of the student's shadows in the morning, midday, and afternoon as an example to refer to the next day.

Midday:

As close to noon as possible, go outside to the same place where you traced your shadows in the morning and have students repeat the procedure with their feet in the same exact spot they were in the morning. Have students compare the size and direction of the morning shadows to the midday shadows. Students should notice that the midday shadows are shorter than the morning shadows and that the two shadows are in different directions. Have students point in the direction of the Sun in the sky and notice that their shadows are, once again, opposite the direction of the Sun.

ELA Common Core Connections

Writing: Text Types and Purposes

3: W.3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

4: W.4.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Framework for K-12 Science Education Connections

Earth and Space Sciences 1.B: Earth and the Solar System

By the end of grade 2. Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

By the end of grade 5. The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year.

Afternoon:

As late as possible in the afternoon, take your students back to the place where they traced their shadows. Have them repeat the procedure again. Have students compare the size and direction of the three shadows and notice the position of the Sun in the sky. Give each student a copy of the Changing Shadows: Part 1 student page and have them answer the four questions as they are outdoors looking at their traced shadows.

1. When was your shadow the longest? *Students should record the morning or afternoon time when their shadows were traced, depending on which one was longest.*
2. When was it the shortest? *Students should record the midday time when their shadows were traced.*
3. How did the direction of your shadow change throughout the day? *Students should recognize that the shadows were in different directions. At this point, they don't necessarily need to use the words "east" or "west." The important thing is, they notice that the shadows in the morning and afternoon were in different directions, and the midday shadow was somewhere in between.*
4. How did the position of the Sun in the sky change throughout the day? *Students should note that the Sun appeared lower in the sky in the afternoon and morning and higher in the sky at midday. Although they may not use the words "east" and "west" yet, they should describe what part of the sky the Sun was in at different times using landmarks such as the school, road, playground, and so forth.*
5. Why do you think your shadow changed throughout the day? *Answers will vary but should include the idea that as the position of the sun in the sky changed, the direction and size of their shadows changed.*

With partners or in small groups, have students discuss their ideas about why their shadows changed throughout the day. Tell students that the next day, you will be sharing a book with them that will help them understand more about this phenomenon.

Procedure—Day 2

Show students the cover of *Next Time You See a Sunset*. Read the book aloud, stop after you read page 19, which explains the changing position of the Sun in the sky throughout the day, then ask,

- How does this explanation compare to the position of the Sun in the sky yesterday when we traced our shadows? (Students should connect this explanation to their observation of the changing position of the Sun in the sky and now be able to figure out which direction is east and which is west based on their experience with the Sun and shadows.)

Continue reading and stop after you read page 23, which explains the changes in the size and direction of shadows throughout the day. Ask,

- When were your shadows the shortest? (In the middle of the day, around noon)
 - Where was the sun at that time? (Right above us)
- When were your shadows the longest? (In the morning and afternoon)

- Where was the sun at those times? (In the eastern sky in the morning and in the western sky in the afternoon)
- What causes this change in position of the Sun in the sky? Is the Sun really moving across the sky? (No, it just appears that way because Earth is rotating.)
- Do you think your shadows would look similar if you did this again tomorrow? (Yes, because Earth is always turning in the same direction.)

Next ask,

- We know the sun always rises in the eastern sky and sets in the western sky, but in which direction do the moon and stars rise and set?

Allow student time to think about this and share their ideas with partners. Then read page 25, which explains that the stars “appear” to move across the sky from east to west. Explain that from Earth, everything in the sky (moon, stars, planets) “rises” in the east and “sets” in the west because Earth is always turning in the same direction.

Finish reading the book aloud. Then give students the Changing Shadows: Part 2 student page. Have them answer the questions using their own experience and what they learned from the book. Students should be able to explain that the two people are not running at the same time of day because their shadows are very different sizes. They should infer that Person A is running in the morning or afternoon because his shadow is very long. The sun appears lower in the sky at those times of day, creating longer shadows. They should infer that Person B is running more toward the middle of the day, when shadows are shorter. The sun appears higher in the sky at those times of day, which makes shadows shorter. All of this occurs because of Earth’s rotation.

Note: It is important to note that size and direction of shadows also change seasonally. But because the objective of this lesson is for students to learn the effects and patterns caused by Earth’s rotation, I would not introduce the seasonal changes in shadows due to Earth’s tilt and revolution at this time.

Name: _____

Changing Shadows

Part 1

SAFETY NOTE: Never look directly at the Sun! Looking at the Sun can damage your eyes!

1. When was your shadow the longest? _____

2. When was it the shortest? _____

3. How did the direction of your shadow change throughout the day?

4. How did the position of the Sun in the sky change throughout the day?

5. Why do you think your shadow changed throughout the day?

Changing Shadows

Part 2



Person A



Person B

Compare the two pictures above. Do you think these two people are running at the same time of day? How do you know? Explain your thinking.
