

Chapter 1: Shedding Light on Shadows

Student Worksheet

Objective: To understand and predict the daily apparent motion of the Sun.

Engage: To get your mind in the mood for shadow work, try this warm-up activity: On a blank sheet of paper draw two nickel sized circles anywhere you choose and two stick figures. The circles represent Suns or light sources. Using straight lines coming from the sun to the stick figures try to draw where their shadows should go.

Introduction: In this activity you and a partner will take turns tracing each other's shadows with a piece of sidewalk chalk. You will check back in on your shadows twice during class to see how they have changed. Your shadows will change because of the rotation of the Earth. The Earth rotates once every 24 hours, which results in a swiftly spinning Earth, about 1,000 miles per hour at the equator. This eastward rotation makes the Sun appear to rise in the east and set in the west.

Your Task: Trace your partner's shadow, make predictions, and have fun while learning!

Procedure:

1. Go outside to a sunny, paved place.
2. While your partner stands still, trace his/her shadow.
3. Make sure to trace around your partner's feet so when you trace again after some time has passed, he or she knows just where to stand.
4. Measure and record the length of your partner's shadow and the time.
5. Look at the traced shadow and make predictions of where it will be in 30 minutes. Your partner should draw a circle where he or she thinks the shadow of his or her head will be in 30 minutes.
6. Repeat **steps 2-5** for your shadow.
7. When finished find your teacher for instructions on what to do until it is time to trace your shadows again.
8. After 30 minutes go back to your shadows. Have your partner place his or her feet in the appropriate spot. Trace your partner's new shadow.
9. Measure and record the new length.
10. Guess where the shadow will be in another 30 minutes.
11. Repeat steps 9-11 for you and your shadow.
12. Check in with your instructor for further directions.

13. Repeat this process one more time before the end of class

Conclusion:

1. On a separate piece of paper, make a graph of the length of your shadow. Let the x-axis represent time, beginning with zero and increasing in fifteen-minute increments for a total of 90 minutes. Let the y-axis represent length in meters. Your first tracing can be clocked as time zero.
2. What is the predicted shape of this graph if you continued measuring until sunset? Why.
3. At what time would you expect your shadow to be the shortest?
4. How would this activity change if it were done earlier in the morning?
5. Make a sketch of yourself as a stick figure with a shadow drawn for morning noon and evening. Show how the length and direction change over the course of a day.

6. How would this activity change if it were done close to the winter solstice when the sun does not reach as high a point in the sky?

Extend:

- Place a stick in the ground. Place cardboard around the base of the stick so you can write on it to keep a record of the length of the shadow cast by the stick. Choose to measure a few times per day and see what patterns emerge.
- Study the definitions of the solstices and the equinoxes. How would the minimum and maximum length of the shadows change through these points of the year?