

**Seasons**  
**Lesson Two**  
**The Shadow Knows**

- Standard II: Students will understand how Earth's Tilt on its axis changes the length of daylight and creates the seasons.
- Objective 1: Describe the relationship between the tilt of Earth's axis and its yearly orbit around the sun.
- Indicator b: Explain the Earth's axis is tilted relative to its yearly orbit around the sun.
- Supplies: For each group of students:  
-Worksheet "The Shadow Knows"  
-1-inch diameter ball of clay  
-Flashlight  
-2 protractors  
-2 rulers  
-Small stick  
-Meter stick with a 1-foot diameter taped to one end

Directions:

1. Review of what was learned about the last session by reviewing the worksheet.
2. Tell the students that 200 years ago and beyond, people noticed these things but couldn't explain why. Scientists began to experiment and make models to understand why these things happened.
3. Our first experiment has to do with the seemingly movement of the sun (not from east to west) during the year getting lower in the sky at noon, month to month, from July to December and visa-versa. The sun seems to get lower in the sky toward the southern horizon each month. In other words, there is a progressive angle increase of the sun toward the southern horizon. (Show this by putting a sun on a stick how it gets lower and lower in the southern horizon.)
4. The opposite happens from the months of January to June where the sun seems to get higher in the sky toward the middle of the sky at noon from month to month.
5. Today, we are going to find out what happens to our weather, temperatures, shadows, and the amount of time we have sunlight when the sun gets lower in the southern horizon and higher toward the middle of the sky.
6. Look at the sunrise and sunset chart. Discuss what is happening to the numbers from January 1 to the middle of June. Discuss what is happening to the numbers from the middle of June to the middle of December. Discuss what is happening to the daylight during these two areas.

Beginning of the Activity

1. Split the ball of clay into two parts. Roll them into balls.

2. Press both pieces of clay next to each other and flatten them out a bit, but not too much.
3. Put the small stick upright into one of the pieces of clay.
4. Put the protractor into the other piece of clay having it go upright that is on a 90-degree angle.
5. Put the ruler next to it upright at the same angle as the protractor. Put the flashlight at the same angle at 10 inches. Turn on the light so it shines on the little stick. Measure the length of the shadow.
6. Write down the length of the shadow.
7. With the other protractor, measure the protractor that is in the clay so it goes to 75-degrees.
8. Put the ruler next to it upright at the same angle as the protractor in the clay. Put the ruler at the same angle at 10 inches. Turn on the light so it shines on the little stick. Measure the length of the shadow.
9. Write down the length of the shadow.
10. Keep moving the protractor back to 60-degrees and 45 degrees. Put the ruler next to the ruler so it is at the proper angle. Put the flashlight at the same angle and at 10 inches and measure the length of the stick and write the length of the shadow for each one.
11. Write down the lengths of the shadows.
12. Answer the questions about the activity.

Name \_\_\_\_\_

### **The Shadow Knows**

The All-day Angle of the Sun **90 Degrees**

<b>Angle of Incidence</b>	<b>Shadow Lengths in Centimeters</b>	<b>Direction of the Shadow</b>
30 Degrees		
60 Degrees		
90 Degrees		
120 Degrees		
150 Degrees		

The All-day Angle of the Sun **75 Degrees**

<b>Angle of Incidence</b>	<b>Shadow Lengths in Centimeters</b>	<b>Direction of the Shadow</b>
30 Degrees		
60 Degrees		
90 Degrees		
120 Degrees		
150 Degrees		

The All-day Angle of the Sun **60 Degrees**

<b>Angle of Incidence</b>	<b>Shadow Lengths in Centimeters</b>	<b>Direction of the Shadow</b>
30 Degrees		
60 Degrees		
90 Degrees		
120 Degrees		
150 Degrees		

The All-day Angle of the Sun **45 Degrees**

<b>Angle of Incidence</b>	<b>Shadow Lengths in Centimeters</b>	<b>Direction of the Shadow</b>
30 Degrees		
60 Degrees		
90 Degrees		
120 Degrees		
150 Degrees		

**Answer These Questions About Your Activity**

1. What do you see happening to the shadow each time the flashlight is moved at the same angle of the protractor?

---

---

2. What do you see happening to the shadow each time the flashlight is moved at the different angles of the protractor?

---

---

3. Why is this happening?

---

---

4. What are your conclusions about shadows of the data above?

a. \_\_\_\_\_

---

b. \_\_\_\_\_

---

5. The same thing happens to tall objects outside as we go from summer to winter. How do the conclusions above help you understand more about the earth as it is going around the sun?

a. \_\_\_\_\_

---

b. \_\_\_\_\_

---

6. What is causing the sun to seem like it is moving each month nearer down in the sky?

---

---