An important part of scientists’ work is discussing and presenting their results and ideas to other scientists. It begins with informal discussions and eventually leads to formal presentations and written papers in scientific journals. When scientists present their work, other scientists review their ideas and comment on them. With this exchange, human knowledge moves forward—from discovering planets to curing diseases, and from exploring the past to thinking about the future.

In this activity, you will review the work of another scientist—a middle school student named Tyler. His class is studying the Earth, Sun, and Moon. Everyone in the class has to do a project, and Tyler’s is on sunlight and shadows.

How can Tyler improve his investigation?

**CHALLENGE**

**MATERIALS**

For each student

1. Student Sheet 71.1a, “My Ideas About the Day, Year, Seasons, and Moon Phases: Before”
2. Student Sheet 79.1, “My Moon Observations”
Yesterday was the first hot day this year. It gets hot much earlier here than it did when we lived in Chicago.

We had an early dismissal day, and Emily came home from school with me. She wanted to sit outside in the shade of the little tree in our backyard. We just planted the tree last year, so I didn’t think there would be enough shade. But she was right; there was just enough room for both of us in the shade.

It was kind of annoying though. We had to keep moving to stay in the shady spot. I asked my science teacher why the shadow moved. She explained that it was a phenomenon—a simple or amazing event related to how the world and universe work. She suggested I investigate this question for my science project. I plan to start making observations this weekend.

**Talking It Over 1**

a. Why do you think Tyler’s shady spot keeps moving?

b. During a single day have you ever noticed a change in position of:
   - your shadow?
   - the shade from a tree or other object?
MARCH 18
PROCEDURE: Today I began collecting data about the shadow from
the tree. I decided to check which way the tree’s shadow was moving
twice in the morning and three times in the afternoon.

RESULTS: Here are pictures of my results.

CONCLUSION: I saw that the tree’s shadow moved from left to right
across our backyard. I also observed that it changed in size. As it got
later in the afternoon, the shadow from the tree became much longer.
Tomorrow I am going to measure the shadow.
PROCEDURE: Today I will measure the length of the tree's shadow and note its direction in the morning, at noon, and in the afternoon.

First Observation:
MARCH 19, CONTINUED

At first I just drew a picture and measured the shadow length in feet. Later I remembered that scientists use meters. To make it easier to see, I used an arrow to show the tree’s length and direction. I also added my observations of the weather, because the wind and clouds made it hard to measure the shadow at noon. I decided to put all these observations in a table so I could compare the data.

RESULTS: My results are shown below and on the next page.
### SHADOW OBSERVATIONS

<table>
<thead>
<tr>
<th>Time</th>
<th>Shadow Direction</th>
<th>Shadow Length</th>
<th>Shadow Direction</th>
<th>Shadow Length</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-morning</td>
<td></td>
<td>5 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noon</td>
<td></td>
<td>4 feet</td>
<td>3 feet</td>
<td></td>
<td>A little windy and cloudy, so shadow came and went.</td>
</tr>
<tr>
<td>Early afternoon</td>
<td></td>
<td>5 feet</td>
<td></td>
<td></td>
<td>No clouds, no wind, very hot</td>
</tr>
<tr>
<td></td>
<td>I noticed the shadow was moving. This morning it pointed toward the garage on the left side of our backyard, but now it's pointing toward the back fence and a little to the right.</td>
<td>5 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late afternoon</td>
<td>The shadow has moved again and points toward the fence to the right of our backyard.</td>
<td>11 feet</td>
<td>3.3 m</td>
<td>No clouds. No wind. Sun is almost behind the tall trees.</td>
<td></td>
</tr>
<tr>
<td>6:00 p.m.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No shadow. It was getting dark and chilly because the Sun just set.</td>
</tr>
</tbody>
</table>

**SUMMARY:** The length of the shadow really does change during the day. It gets especially long in the afternoon.
TALKING IT OVER 2

a. Based on the data he collected, how could Tyler improve his summary of his results?

b. How could Tyler improve his data collection?

ANALYSIS

1. a. What do you think is causing the changes in the direction of the shadow from Tyler's tree from early to late in the day?

    b. What do you think is causing the changes in the length of the shadow from Tyler's tree from early to late in the day?

2. What data would you collect to test your ideas?

3. Do you think Tyler's measurements would be the same if he made them at the same times of day the next month? Explain why or why not.

4. Reflection: In hot weather Tyler likes to sit in his favorite shady spot under his tree. How does the Sun affect you each day?