Exploring Sun-Earth Connections
Lesson Plan

Subject Area: Science

Grade Levels: The lesson can be adapted for grades 4–10 (ages 9–16).

Time: Two 45-minute class periods; time to record data on 5 successive days

Lesson Objectives:

Students will:
• Investigate the relationship between the Sun and Earth.
• Develop an understanding that Earth rotates on its axis.
• Develop an understanding that the Sun provides essential light and heat for Earth.
• Gather data to explain scientific phenomena.
• Build data literacy skills by creating dynamic, visual plots.
• Explain their findings in writing and visual slide shows.

Standards:

National Science Education Standards:

Science as Inquiry – Content Standard A
All students should develop
• Abilities necessary to do scientific inquiry.

Earth and Space Science – Content Standard G
All students should develop understanding of
• Earth in the solar system.
• Energy in the earth system.

Common Core State Standards:

Common Core State Standards for Mathematics:

Mathematical Practices
• Use appropriate tools strategically.

Measurement and Data
• Represent and interpret data.

College and Career Readiness Anchor Standards for Writing:

Standard 6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Overview:
Many natural scientific phenomena occur in regular, predictable patterns. In this lesson, students will collect and analyze outside temperature and shadow length data. They will explore the connections between the Sun and Earth and formulate questions and answers with the aid of InspireData’s data visualization tools. Rather than learning about the concepts in a textbook, students will be able to collect first-hand data on scientific phenomena from the natural world and animate changes over time. This can help them understand in a more profound way concepts like Earth’s rotation and our dependence on the Sun for essential light and heat. Discoveries will be documented in annotated slide shows.

Preparation:
• This lesson requires the InspireData® software application published by Inspiration Software, Inc. You can download a 30-day trial at http://www.inspiration.com/InspireData.
• Gather enough long, straight sticks or stakes for teams of two or three students to share.
• Gather enough thermometers, clipboards, and single sheets of paper for each team to share.
Lesson:

1. On a sunny day, have your students grab a pencil and take them outside. Ask them this question: How could they “shake hands” with each other without touching? After a student guesses that they could do it with their shadows, have everyone “shake hands” in this way with at least one person. Then ask them to hypothesize about what time(s) of day it would be easiest to do this. What time(s) would it be hardest? A student should guess that about 12 noon it would be hardest because the shadows would be the shortest, and early and late in the day would easiest because the shadows would be the longest. Next ask the students to hypothesize about why this is the case and what hours in the day they would expect it to be warmest and coldest.

2. Explain to students that they will be gathering data to test their hypotheses and explore the relationship between the Sun and Earth. Divide them into teams of two or three students and give each team a straight stick (or stake). Have the teams select a location that is out of the way and receives sunlight all day where they will place the stick straight up in the ground. It must be in a location that will not be in the shadow of a building at any hour that students will be collecting data throughout the day. The ideal location is also on very flat ground.

3. Pass out the clipboards, paper, and thermometers to the teams, and have them collect (and clearly label) the following data:
   - Time of day
   - Height of the stick above the ground in centimeters or inches (to the nearest tenth)
   - Length of the shadow on the ground in centimeters or inches (to the nearest tenth)
   - Air temperature in the shade
Circulate among the students, answering questions as they arise.

4. Return to the classroom or computer lab and open the Sun-Earth Connection database: InspireData Starter>Databases>Science>Sun-Earth Connection.
5. Examine the data contained in the Sample Data tab to show students the type of table they will be building.

6. Select the Database Template tab and explain that students will be working with their partner to be sure that data is gathered each day and entered into the table for five days. Data should be measured each hour from 9 a.m. until 3 p.m. and then entered into the database. Ask for a team to volunteer to enter the temperature and measurement data they already collected.

7. At the end of the five-day data collection period, show students the Sample Data tab again and point out the table notes and Possible Investigations. Explain that students will be investigating the questions with the data they gathered in the Database Template tab.

8. Demonstrate how to click the Plot View button on the Toolbar to switch to Plot View and analyze the data. Your demonstration should include how to select plot types via the buttons on the Toolbar. Demonstrate how to define the x/y axes in the plots (e.g.,
in the **Axis plot** tool, click on **X Axis** and choose a field such as Data>Time hourly). Tell students that they should create at least one plot that will address each question, and demonstrate for students how to record explanations of plots and answers in the **Notes** area at the bottom of the screen. Click on ![Notes button](image) in the lower right to open the area. Be sure to show students how to capture a slide for each plot, including their notes, by clicking the **Slide Sorter** button ![Slide Sorter button](image) and then the **Capture Slide** button ![Capture Slide button](image).

9. Ask one or two teams to share their slide shows including their analyses of the data with the class. Next, discuss the findings with the class, including an exploration of questions such as the following:

- What are the different patterns in the data between the shadow and temperature plots?
- Can they describe and explain the patterns that were observed?
- What about the relationship between the Sun and Earth explains the observations?
Adaptations/Extensions:

- Have older or more advanced students problem solve a way to calculate the angle of the Sun each day using the Pythagorean theorem or another means. A variety of methods are explained online. Data can then be added to the database and analyzed to explore the relationships between sun angle and the other variables.

- Students can create a sundial to tell time based on the position of the Sun. A variety of methods are discussed online, or they could devise their own system based on their observations of shadows.

- Students may add additional fields, such as one to track cloud cover in percent of the sky, to the database. This data can then be analyzed with other fields such as temperature.

- For younger or beginning students, gather and analyze more of the data as a whole class, at least until students understand the process.

- Students can use Inspiration® or Kidspiration® to record their observations and conclusions about the relationship between the Sun, Earth, shadows, temperatures, and sun angle.

- Students can enhance their plots by adding other InspireData features and computations.

Pass out the “Learn to Use Plots” handout in InspireData for student reference (Help>Documentation>Handouts>Learn to Use Plots).

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