Reasons for the Seasons Symposium: Sun's Height Above the Horizon

RESEARCH TEAM ASSIGNMENT SHEET

Research Goal

Your assignment is to determine what effect the changing height of the Sun above the horizon will have on the Earth's seasons.

Background

As you may have noticed, each morning the Sun is near the horizon when it rises and then climbs higher in the sky. It reaches its highest point above the horizon around noon and then gets lower in the sky until it is again near on the horizon at sunset. The highest point that the Sun reaches above the horizon around noon changes throughout the year. In the United States and other countries at the same latitude, the Sun is highest in the sky around noon on a date astronomers call the summer solstice (June 20–22). The Sun is lowest in the sky around noon on the winter solstice (December 20–22).

In this research activity, you will simulate the Sun's changing height above the horizon at noon using a flashlight to represent the Sun. You will then use the data you collect to determine what effect this may have on Earth's seasons. Be sure to keep a log in your astronomy lab notebook of the steps you follow throughout the activity and include any results and conclusions.

MATERIALS

- Penlight-style flashlight
- ¼ in. × ¼ in. graph paper
- "Angle Indicator Sheet" with Height of Sun at Noon Chart
- Manila folder
- 2 large paper clips
- Space to work that is relatively dark
- "Reasons for the Seasons Symposium: Sun's Height Above the Horizon Research Team Assignment Sheet"
- Tape or glue
- Several thick books

Procedure

1. Find a table in a darkened space where you can lay out your materials.
2. Open the manila folder and paper clip the graph paper to the inside of the right half of the folder, as shown in the diagram (see next page).
3. Tape or glue the "Angle Indicator Sheet" to the inside of the left half of your folder as shown in the diagram. The sheet should be folded at the bottom so that the 0° line is on the fold of the manila folder.
4. Set up the folder so that the right half is flat on the table and the left half is at a 90° angle, as shown in the diagram. Either someone can hold the folder open so it forms a 90° angle or a few stacked books can be used to hold the left side in place—a small piece of tape can help to keep the left side of the folder next to the books.

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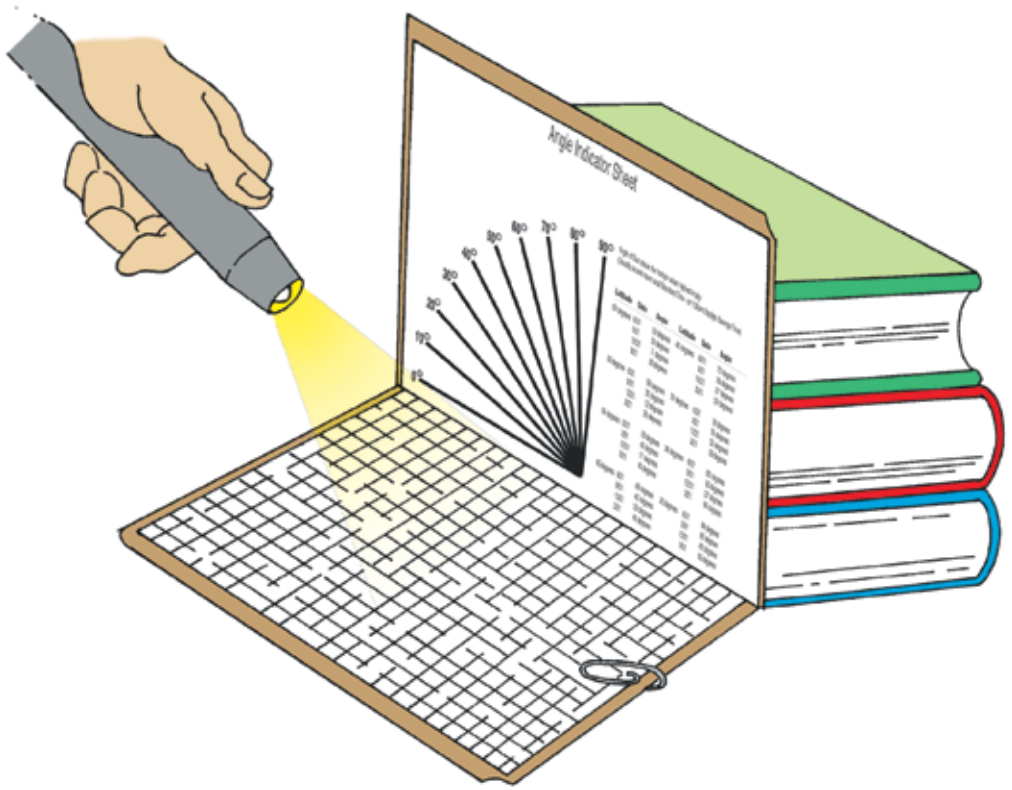

5. Identify the latitude of your location by looking on a world map or searching online. Then find the closest latitude listed on the Angle of the Sun Above the Horizon Chart on the "Angle Indicator Sheet." This chart gives the height of the Sun above the horizon for your latitude at different times of the year in the Northern Hemisphere.

6. To simulate the Sun shining on the Earth at noon, turn on the flashlight and place it at the end of the angle line for the height of the Sun above the horizon at noon on the summer solstice, as shown in the diagram above. You will need to develop a way to be sure the flashlight is always

    a. held pointing straight along the angle line; and

    b. the same distance out from the "Angle Indicator Sheet," so that the entire flashlight beam falls on the graph paper.

    Draw an outline of the flashlight beam on the graph paper.

7. Remove the graph paper, being sure to record what date the outline represents (e.g., summer solstice).
8. Have one team member count the number of squares covered by the flashlight beam. Be sure to develop a method to account for partially covered squares. Record the results in your astronomy lab notebook. Repeat the count of squares several times and get an average.
9. Repeat the process for other times of the year, and produce a graph in your astronomy lab notebook that represents the area covered by the flashlight beam at different times of the year. (Remember which things you need to keep the same, as explained in step 6.)
10. (*Optional*) If you have time, record the percentage change in the area covered by the flashlight beam between the first date and each of the rest of the dates. Record this in your astronomy lab notebook. This can be calculated using the following formula:

$$\frac{\text{(area covered by light on first date - area covered by light on second date)}}{\text{area covered by light on first date}} \times 100 = \text{\% (percentage) change}$$

11. Remembering that the flashlight represents the Sun, have a discussion among members of your group to predict what effect the changing height of the Sun above the horizon at noon will have on Earth's seasons.
12. Using appropriate visual aids, prepare a presentation for the rest of the class that explains the research activity you performed and what conclusions you reached. Be sure to include the following:
    - The problem you explored
    - The procedure you followed
    - The data you collected, including any graphs
    - The conclusions you reached