Name_____ Period_____ Date_____

CONCEPTUAL PHYSICS **Experiment**

27.6 Light: Shadows

SUNBALLS

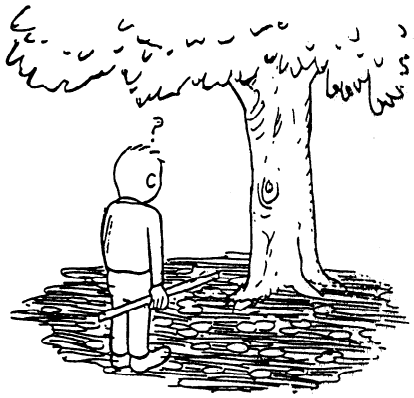
Purpose

In this experiment, you will estimate the diameter of the sun.

Required Equipment and Supplies

small piece of cardboard
meterstick

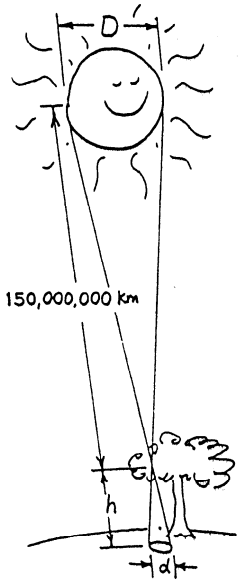
Discussion



Take notice of the round spots of light on the shady ground beneath trees. These are sunballs—images of the sun. They are cast by openings between leaves in the trees that act as pinholes. The diameter of a sunball depends on its distance from the small opening that produces it. Large sunballs, several centimeters or so in diameter, are cast by openings that are relatively high above the ground, while small ones are produced by closer "pinholes." The interesting point is that the ratio of the diameter of the sunball to its distance from the pinhole is the same as the ratio of the sun's diameter to its distance from the pinhole.

Knowing that the sun is approximately 150,000,000 km from the pinhole, careful measurement of this ratio tells us the diameter of the sun. That's what this experiment is all about. Instead of finding sunballs under the canopy of trees, you'll make your own easier-to-measure sunballs.

Procedure



Poke a small hole in a piece of cardboard with a pen or sharp pencil. Hold the cardboard in the sunlight and note the circular image that is cast on a convenient screen of any kind. This is an image of the sun. Unless you're holding the card too close, note that the solar image size does not depend on the size of the hole in the cardboard (pinhole), but only on its distance from the pinhole to the screen. The greater the distance between the image and the cardboard, the larger the sunball.

Position the cardboard so the image exactly covers a dime, or something that can be accurately measured. Carefully measure the distance to the small hole in the cardboard. Record your measurements as a ratio:

$$\frac{\text{diameter of dime}}{\text{distance from dime to pinhole}} = \_\_\_\_\_$$

Since this is the same ratio as the diameter of the sun to its distance, then

$$\frac{\text{diameter of dime}}{\text{distance from dime to pinhole}} = \frac{\text{diameter of sun}}{\text{distance from sun to pinhol}}$$

Which means you can now calculate the diameter of the sun!

Diameter of the sun = _____

Summing Up

1. Will the sunball still be round if the pinhole is square shaped? Triangular shaped? (Experiment and see!)

2. If the sun is low so the sunball is elliptical, should you measure the small or the long width of the ellipse for the sunball diameter in your calculation of the sun's diameter? Why?

3. If the sun is partially eclipsed, what will be the shape of the sunball?

Going Further

Lillian measures a sunball on the ground under a sunlit tree. The diameter of the sunball is 5 cm. From this information, calculate the height of the opening between the leaves of the tree that casts the sunball?