Measuring the Diameter of the Sun

Grade Level: 5th - 7th; **Type:** Math/Astronomy

Objective:

The goal of this experiment is to measure the diameter of the sun. During the process of this experiment, the student will become familiar with working with ratios. This experiment can be repeated to calculate the diameter of the moon as well.

Research Questions:

- What is the diameter of the sun?
- What is the diameter of the moon?

By knowing the distance of the sun from the earth and setting up simple ratios, students can calculate the diameter of the sun. The sun is approximately 93,000,000 miles (149,600,000 kilometers) from the earth.

Students will make a simple viewing apparatus from which they will produce an image of the sun using a pinhole viewer and a cardboard upon which the image is reflected.

The ratio of the diameter of the sun to the distance to the earth is proportional to the ration of the diameter of an image of the sun to the distance between the image of the sun produced by a pinhole and the cardboard the image is reflected upon.

A/B = C/D

A is the diameter of the sun (km).

B is the distance between sun and earth (149,600,000 km).

C is the diameter of image (mm).

D is the distance between the image and the pinhole that produced it (mm).

Solving for A is simply a matter of multiplying B and C and dividing that product by D.

This is expressed as:

(B * C) / D = A

Materials:

Most supplies are probably already available at home.

- Yardstick
- Two pieces of cardboard (shirt cardboards work well, as do sections of cardboard cut from pizza boxes
- Masking tape
- Aluminum foil
- Exacto knife
- Metric ruler

Experimental Procedure:

1. Cut two pieces of cardboard approximately 8” x 8”. One of these will be your pin hole and the other will be your screen.
2. Very carefully, cut a 2 cm x 2 cm square in the center of one of the pieces of cardboard.
3. Cut a 3" * 3"square of aluminum foil. Place the foil over the 2cm * 2cm square and tape into place. The tape should cover just the edges of the foil and not intrude over the central hole. Prick a small hole in the center of the foil with a needle. This is your pinhole.
4. Cut a 2” slit into bottom center of both pieces of cardboard.
5. Insert the yardstick into the slit you made into the pinhole piece and tape into place. The pinhole piece of cardboard should be perpendicular to the yardstick.
6. Insert the opposite end of the yardstick into the slit you made on the screen piece of cardboard. This piece of cardboard should be able to move freely up and down the yardstick, remaining perpendicular to the yardstick and parallel to the pinhole piece of cardboard.
7. Point the pinhole end on the yardstick at the sun. Slide the screen piece of cardboard until you see an image of the sun reflected on the screen.
8. Using a metric ruler, measure the diameter of the image in millimeters. Measure the distance between the two pieces of cardboard.
9. Set up your ratios as explained in the introduction. Calculate the diameter of the sun.
10. This apparatus can also be used to calculate the diameter of the moon.

Terms/Concepts: Ratio and Diameter

References:

Books

Golub, Leon and Jay M. Pasachoff. Nearest Star: The Surprising Science of Our Sun Harvard University Press (2002)

Simon, Seymore: The Sun. Harper Collins (1989)

Websites

Stanford University Solar Center: Solar News

http://solar-center.stanford.edu

St. Andrew’s: Aristarchus of Samos (This is an excellent biography of the Greek mathematician who first calculated the sun’s diameter)

Author: Cy Ashley Webb