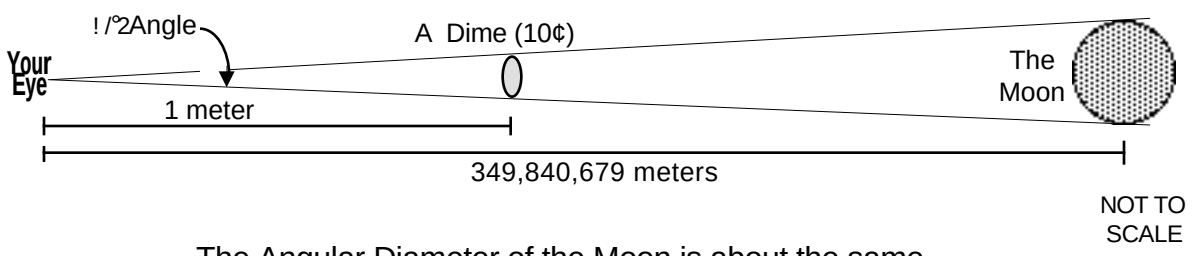
Date _____ Per. _____

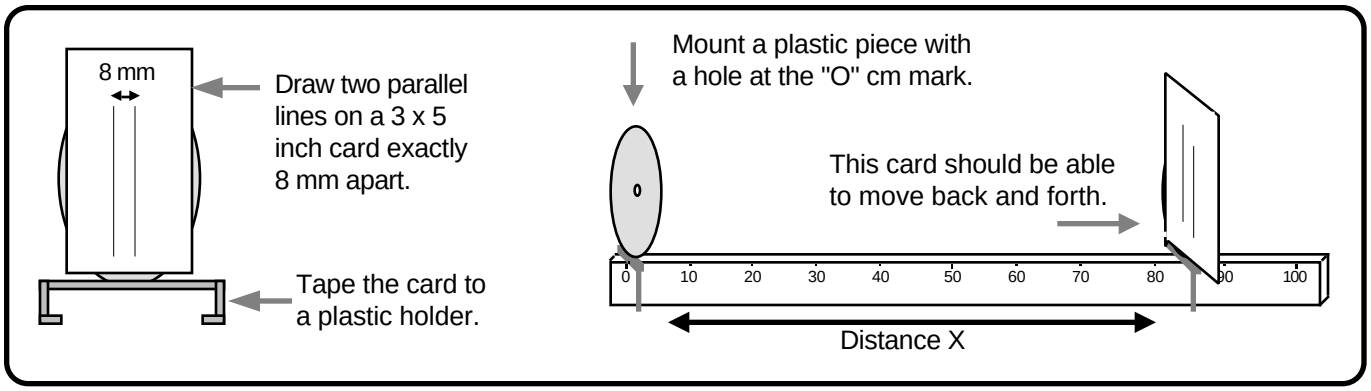


The Angular Diameter of the Moon is about the same as the angular diameter of a dime at arm's length.

When we think of size, we usually think of units such as meters or liters. But we can measure the apparent size of an object in in degrees of angle. The diagram above shows that the apparent size of the moon is about half the apparent size of a dime held at arm's length. That's about ½° of angle.

The angular size of an object depends upon two factors: (1) How large it really is, and (2) How far away it is. The stars are probably the largest objects you have ever seen. But, because they are so extremely far away, most of them appear as tiny points of light in the night sky.

As in other measurements, you will need an instrument to make your observations more precise. Your first task will be to make the instrument shown below.



To make the apparatus:

(1) Obtain a 3 x 5 inch index card. Carefully draw two lines 0.8 cm apart as shown on the left side of the diagram above. Tape the card to the holder.

(2) Mount a second plastic piece right at the "0" end of the meter stick. Slide he 3x5 card piece onto the other end as shown above. It should slide freely.

To use the instrument (on a *sunny* day), point the "0" end toward the sun so that the plastic piece casts a shadow on the 3 x 5 card. Note a small, circle of light. That's an image of the sun through the tiny hole.

Move the card holding the 3 x 5 card until that circle of light exactly fills the 8 mm between the lines you drew. Finally, read and record the distance between the two plastic pieces. Then repeat the whole procedure two more times to get more accurate results.

Distance "X": Trial 1 _____, Trial 2:_____, Trial 3:_____

What is the average of the three trials? Average X: _____

Angles are measured in units of degrees, minutes and seconds. A full circle has 360°. Each degree can be split into 60 minutes (60') of arc. And each minute can be split into 60 seconds (60'').

Therefore, 60'' = 1', 60' = 1°, and 360° = a circle.

Half a degree is 30 minutes (30') of arc.

Distance between the Cards	Angular Diameter
98 cm	0°28'
92 cm	0°30'
86 cm	0°32'
81 cm	0°34'
76 cm	0°36'
72 cm	0°38'

1. Using the table above and the data from your measurements, what is the angular diameter of the sun as observed from the Earth? _____

2. Approximately what part of a degree of angle is this? _____

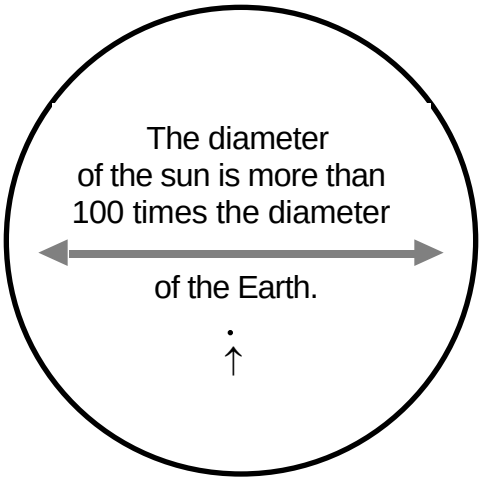
In the next step, we will calculate the real size of the sun by setting up and solving a proportion. To make the calculations easier, express all distances in meters. We have all of the measurements that we need except the distance to the sun. That distance is 1.5×10^{11} meters.

3. Substitute the correct values and solve for the unknown value here.

$$\frac{\text{Distance Between Cards (m)}}{\text{Image Diameter of the Sun (0.008 m)}} = \frac{\text{Distance to the Sun (m)}}{\text{Diameter of the Sun}}$$

As you can see from the diagram to the right, the Earth is much smaller than the sun. In fact, it would take nearly 110 Earth's to equal the diameter of the sun.

The difference in volume is even greater. About 1½ million Earth's could fit inside the sun.



4. According to the *Reference Tables*, what is the *radius* of the sun? _____ km

5. Express this number in meters: _____ m

6. Therefore the sun has a diameter of _____ meters.

7. Use the diameter value from the *Reference Tables* to calculate the percent error of the value you obtained from the proportion in the middle of this page. *Show your calculation below.*

Wrap Up:

A. What three units are generally used to measure angles? _____

B. What is the approximate angular diameter of the sun as we observe it from the Earth? _____

C. Angular diameter depends upon two factors. What are they?

_____

D. The angular diameters of the sun and the moon are not constant. They both change in a cycle by about 10% as measured at different times. Why do they change.

_____

E. How long is one complete cycle of the changing angular diameter of the sun? _____

A complete cycle for the changing angular diameter of the moon takes about _____.

F. If the sun is so much larger than the moon, why do they look about the same size in the sky?

_____

G. How would the angular diameter of the sun as observed from Pluto compare with the angular diameter of the sun as we observe it from the Earth?

_____

H. In your own words, explain what is meant by the angular diameter of an object.

_____

_____