

SCIENCE 708

PLANET EARTH

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II. ECLIPSES

Eclipses of the sun and moon were recorded by the ancient Chinese and the Egyptians. Many of these ancient people dreaded eclipses. They looked upon them as frightful events. They thought an angry god was hiding the light from them. Some of the ancients worshiped the sun god. To them the darkening of the sun was even more frightening. They thought the sun god was hiding his face from them.

Heavenly bodies are not to be worshiped or consulted, as in astrology. The Scripture

makes this warning clear (Deuteronomy 4:19): "And [beware] lest thou lift up thine eyes unto heaven, and when thou seest the sun, and the moon, and the stars, even all the host of heaven, shouldest be driven to worship them, and serve them, which the Lord thy God hath divided unto all nations under the whole heaven."

In this section of the **LIGHTUNIT**, you will study solar and lunar eclipses. You will study the position of the sun, moon, and earth during an eclipse.

SECTION OBJECTIVES

☐ **Read these objectives.** When you have completed this section, you should be able:

9. To describe a solar and a lunar eclipse.
10. To distinguish between fact and opinion in science.

☐ **Restudy these words.**

fact
lunar
opaque

opinion
penumbra

solar
umbra

SOLAR ECLIPSE

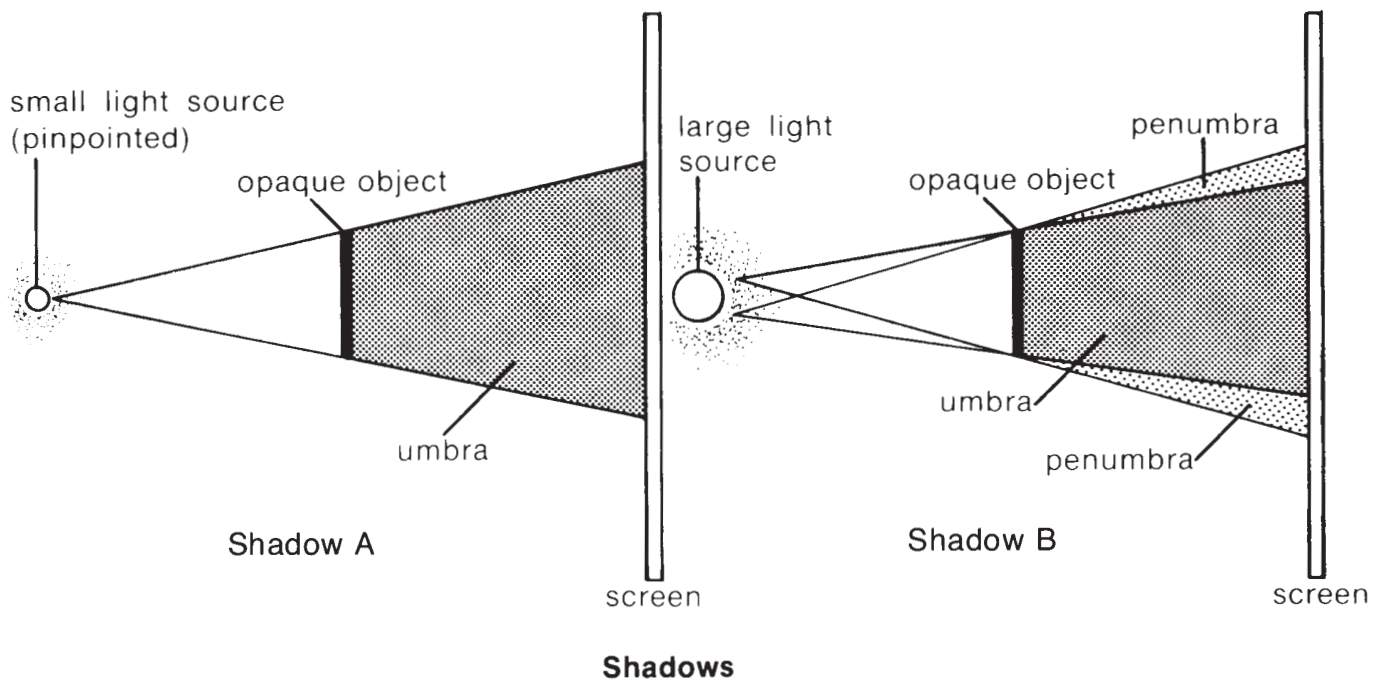
A **solar** eclipse is an eclipse of the sun. It occurs when the sun is partially or totally blacked out by the moon, which casts a shadow on the earth.

Shadows. The earth and the moon cast shadows into space. We are totally unaware of these shadows until an eclipse occurs. The word *eclipse* means *darkening of a heavenly body*. When a shadow is cast and a darkening effect occurs, it is called an eclipse.

Have you noticed that some shadows are lighter on the edges than they are in the center? When the source of light is small

and pinpointed, the shadows are clearly defined. If the source of light is large (relative to the object being projected), the shadows will be lightly shaded around the edges.

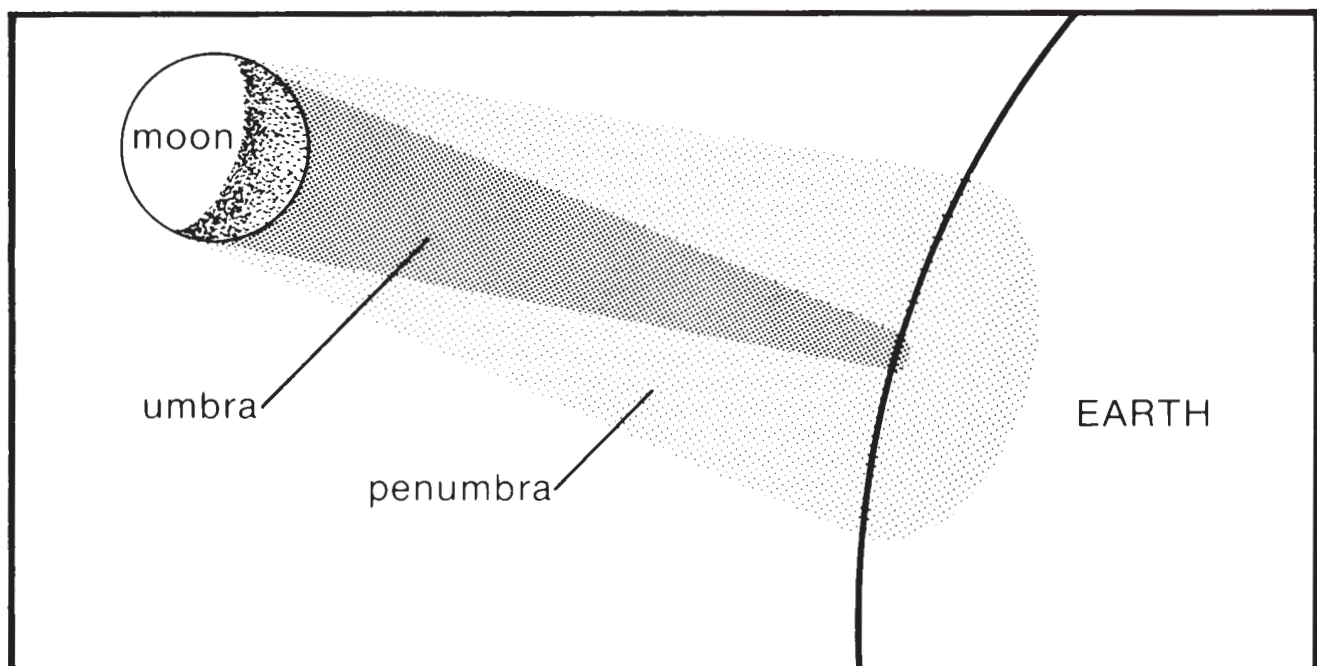
The dark part of the shadow is called the **umbra**. All rays of light are cut off from the umbra. The **penumbra**, or lighter part of the shadow, receives some rays of light and thus has lighter edges. A penumbra is formed when the source of light is large and the **opaque** object is relatively small. An opaque object is one through which no light can pass.



Shadow A forms a clearly defined shadow. Shadow B forms a dark center surrounded by a lightly shaded shadow.

Solar eclipse. During a solar eclipse, the sun is darkened. The moon casts a shadow on the earth. The moon is small compared to the earth. Its shadow covers only a small

part of the earth. Inside the umbra the sun is totally darkened. This condition is a total eclipse. Within the penumbra, only a partial eclipse is seen. Those outside of the shadows do not see an eclipse. Those living within the umbra will see a total eclipse. Those within the penumbra will see a partial eclipse.



The Umbra and Penumbra During a Solar Eclipse

Few solar eclipses occur within one person's lifetime. Total eclipses are rarely seen. Some occur at sea. Others cannot be seen due to weather conditions. When a total eclipse occurs, birds stop singing, chickens go to roost, bats fly about as though night had come, and cattle and horses go to the barn. In some instances, the temperature drops and dew is formed.

out, the effects would not be seen until eight minutes later. Sunlight takes eight minutes to travel to planet Earth. The distance from the earth to the sun is approximately 93,000,000 miles. The distance to the sun varies because Earth's orbit is elliptical. Light travels at 186,000 miles (300,000 km) per second. The amount of time sunlight takes to arrive on planet Earth is computed as shown.

Speed of light. If the sun suddenly burned

$$\frac{93,000,000 \text{ miles from the earth to the sun}}{186,000 \text{ miles per second, the speed of light}} \text{ equals } 500 \text{ seconds}$$

One minute has 60 seconds. To change 500 seconds into minutes, divide by 60.
 $500 \div 60 = 8.3 \text{ minutes.}$



Write true or false.

- 2.1 _____ The ancients were afraid of eclipses.
- 2.2 _____ The Scripture clearly warns against worshiping the stars.
- 2.3 _____ An opaque substance allows light to pass through it.
- 2.4 _____ Sunlight takes about three minutes to arrive on the earth.



Complete these statements.

- 2.5 The speed of light is _____ .
- 2.6 The umbra is the _____ part of a shadow.
- 2.7 The penumbra is the _____ part of a shadow.
- 2.8 The average distance from the earth to the sun is _____ .

LUNAR ECLIPSE

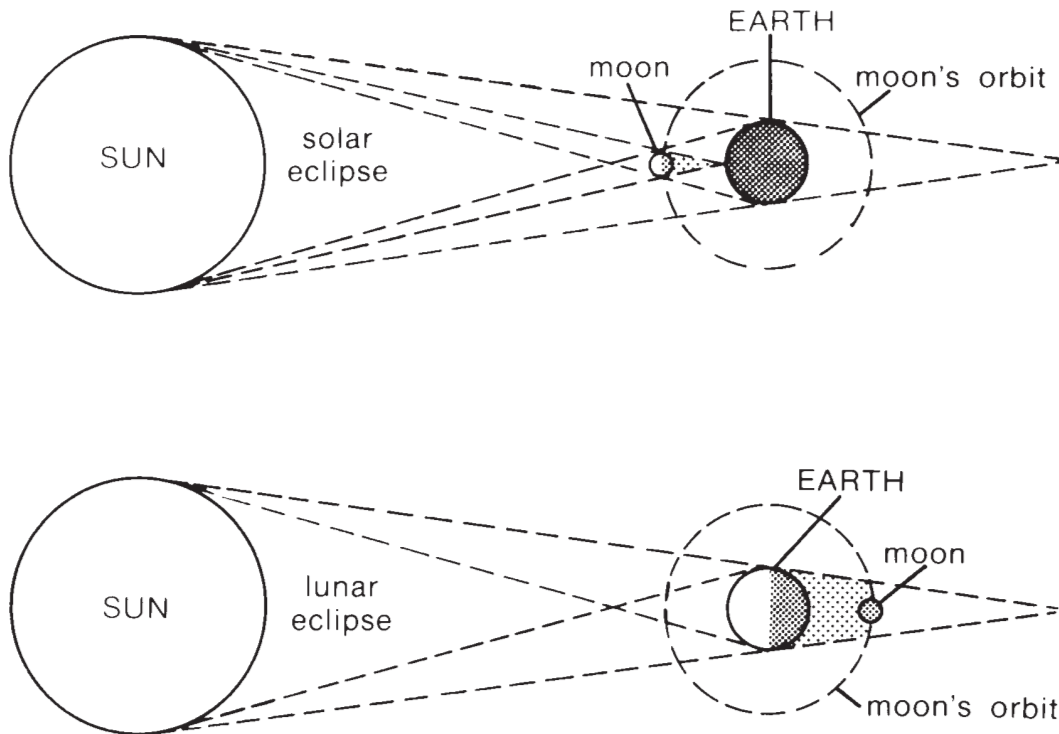
The word **lunar** means “moon.” This word is the basis of the word *lunatic*. In early times insanity was thought to be influenced by the phases of the moon. A person who was insane was called a lunatic.

An eclipse of the moon (lunar eclipse) occurs when the earth passes between the sun and the moon. Since the moon is small compared to the earth, the entire moon may lie within the earth’s shadow or umbra. The moon may appear red during an eclipse. Sometimes the stars appear to shine more brightly as the moon is darkened.

One of the best ways to remember the difference between a solar eclipse and a lunar eclipse is to refer to the meaning of *solar* and *lunar*. *Solar* means “sun” and *lunar*

means “moon.” *Eclipse*, as previously defined, means “the darkening of a heavenly body.” During a lunar eclipse, the moon appears darkened to observers on the earth. The moon is darkened because the earth is casting a shadow on it. When a solar eclipse occurs, the sun is darkened. The moon is casting a shadow as though it were blotting out the sun. Since the moon is so small in relation to the size of the earth, the eclipse can be seen from only a small area of the earth.

Two diagrams are shown illustrating a solar eclipse and a lunar eclipse. Carefully notice the position of the sun, moon, and earth in both diagrams.



Comparison of Lunar Eclipse and Solar Eclipse



Try this experiment.



These supplies are needed:

- a large ball about the size of a basketball to represent the earth
- a small ball about the size of a tennis ball to represent the moon
- a strong light of about 100 watts or more
- a method for darkening the classroom

Alternative method: If your classroom is difficult to darken, you may use the sunshine as a source of light. You may also want to use cardboard circles in place of balls. Cut one large circle about 8 inches in diameter to represent planet Earth. Label it Earth. Cut one small circle about 3 inches in diameter. Label it moon.



Follow these directions. Put a check in the box when each step is completed.

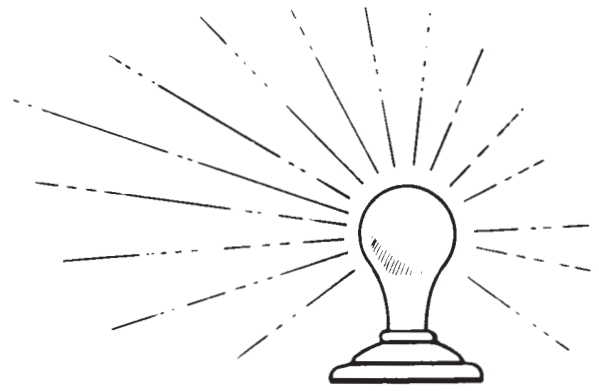
- ☐ 1. Place the large ball (basketball) about 12 feet from the light source. Then place the small ball (tennis ball) in the shadow of the large ball. If you are using cardboard circles in place of the balls, hold the large cardboard up in the sunshine. Then place the moon (small cardboard) in the earth's shadow. When you have lined up the balls or cardboard in this manner, you have made a shadow fall on the moon. This shadow represents an eclipse of the moon.
- ☐ 2. Now, shift the balls or cardboard to make the shadow fall on the basketball or largest cardboard. In effect, the sun is being darkened. If you were an observer on the earth, this condition would be a solar eclipse. When the moon comes between the sun and planet Earth, a solar eclipse occurs.



tennis ball (moon)



basketball (earth)



light bulb (sun)

Making Eclipses

The preceding illustration shows how an eclipse can be artificially made. The moon (tennis ball) is darkened by a shadow. This shadow represents a lunar eclipse (moon

eclipse). You can reverse the position of the tennis ball and the basketball to represent a solar eclipse.



Complete these activities. For 2.9 through 2.13, circle the letter of the correct response.

- 2.9 A solar eclipse occurs when (a) the sun is darkened (b) when the moon is darkened (c) **when the earth casts a shadow on the sun.**
- 2.10 Eclipse means (a) lunatic (b) moon (c) darkening.
- 2.11 A lunar eclipse occurs when (a) the moon is between the earth and the sun (b) the earth is between the moon and sun (c) the earth casts a shadow on the sun.
- 2.12 Eclipses (a) frequently (b) fairly often (c) rarely occur.
- 2.13 **Lunar** means (a) moon (b) eclipse (c) sun.
- Δ2.14 Describe the difference between a solar and a lunar eclipse with respect to the positions of the sun, moon, and earth.
