CREATE A SCALE MODEL OF ECLIPSES

Brief Description

Students will use a scale model to represent the Earth-Moon system and create eclipses. Ideally, this activity is done outside with the true sunlight. Otherwise, it can be done indoors with a lamp.

Level: End of primary school, and secondary school
Preparation time: none
Duration: 20-30 minutes
Keywords: eclipse, Earth, Moon, Sun, lunar eclipse, solar eclipse, scale model

Educational Goals

- Discover the actual dimensions of the Earth-Moon system Model and the positions of the Earth, the Moon, and the Sun during lunar and solar eclipses.
- Model eclipses and achieve eclipse alignment accuracy.

Materials

Ideally, students complete this activity in teams of 2-3; prepare sufficient eclipse sets for each team.

Each scale set must contain:

- ❒ One-meter ruler
- ❒ 2.5 cm diameter ball for Earth
- ❒ 0.7 cm diameter ball for the Moon
- ❒ 2 paper clips
- ❒ Adhesive tape

For the balls, we recommend using modeling clay and having the students make them. You can also find Styrofoam balls of these sizes at dollar stores, in decoration/craft supplies.

Introduction

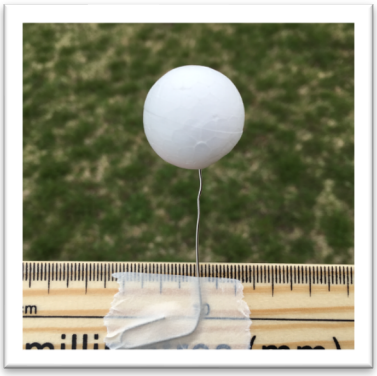
Eclipses are caused by a play of shadows between the Earth and the Moon. In this activity, students will model eclipses by creating shadows. Perfect alignment is difficult to achieve, helping the students understand why eclipses don't happen every month.

Preparation

Make sure you have all the necessary materials.

Process

1. Assemble the Model
   a. If you are using modeling clay for the Earth and Moon balls, you can start by asking the students to create an Earth of the correct size (2.5 cm). Then, ask them guess the size of the Moon relative to this ball by drawing the Moon on a piece of paper. In general, students will imagine the Moon as being larger than it really is! Once you have told them how big the Moon is to scale, you can also ask them how far it should be from Earth. For our model, the distance is 75 cm, but students will probably guess much less!

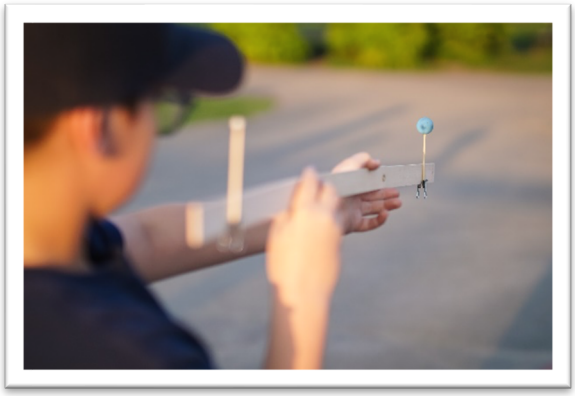


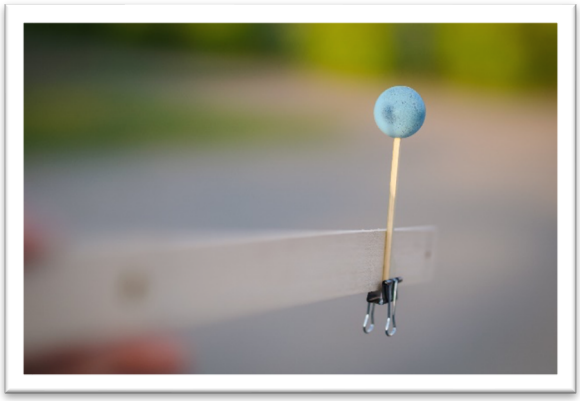
   b. Form teams and distribute materials.
   c. To place the balls on the ruler, unroll a paper clip, stick the ball on one end and tape the other on the ruler.

Model mounted with the Earth and the Moon spaced 75 cm apart.

2. Create Eclipses
   a. Invite the students outside (or with a lamp) to create lunar and solar eclipses using the model.
      i. Lunar eclipse: the Moon should be completely in Earth's shadow.
      ii. Solar eclipse: the Moon's shadow should fall over the Earth.
   b. It is quite difficult to get a perfect alignment for successful eclipses; the lunar eclipse being easier to model than the solar eclipse. One trick is to look at the two shadows on the ground or surface and line them up. You will then see an eclipse by looking at the Earth ball or the Moon ball, depending on the type of eclipse modeled.

c. Be careful not to create shadows with your hands! If necessary, unroll the paper clips so they are longer in order to keep the balls away from the ruler.
d. Don't be discouraged if you can't produce eclipses quickly! This activity helps you realize that the alignment really has to be perfect for eclipses to occur.





Solar eclipse, with the shadow of the Moon ball on the Earth ball

3. Discussion Questions

When students successfully create an eclipse, ask them who on Earth would be able to observe the eclipse and what they would experience.

a. During a lunar eclipse, all people on the "night" half of the Earth can see the eclipse: they then see the Moon enter the Earth's shadow.
b. During a solar eclipse, only people in the Moon's shadow would see the eclipse: they see the Moon obscuring the Sun in the sky.

Taking it Further

The Moon orbits the Earth approximately once a month (every 27.3 days). Lunar eclipses always occur during a Full Moon, when the Moon enters the Earth's shadow (order: Sun-Earth-Moon). Solar eclipses always occur during a New Moon, when the shadow of the Moon falls on the Earth (order: Sun-Moon-Earth).

On the other hand, we do not have eclipses every month since the alignment is not always perfect. Most of the time, the Moon does not enter Earth's shadow during the Full Moon – instead it will pass "above" or "below" the planet. It's the same during New Moons, the shadow of the Moon does not always fall on the Earth, but either "above" or "below" it.

The reason is that the Moon's orbit is not exactly on the same plane as the Earth's orbit around the Sun. There is a difference of about 5 degrees. In general, shadows do not fall on the other object. But twice a year, the orbital planes align and it is possible to have eclipses. These are the "eclipse seasons" during which an eclipse will occur every full moon or new moon. For example, there was a solar eclipse on October 14, 2023 and the next one is on April 8, 2024, about 6 months apart.

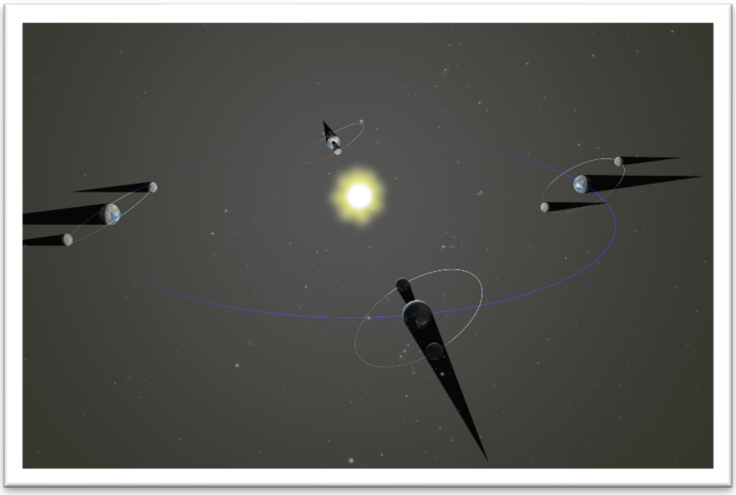


Illustration not to scale showing the inclination of the Moon's orbit relative to the Earth's orbit.

Inspiration

This activity, which is our favorite for explaining eclipses, was created by our friends at the Astronomical Society of the Pacific. We'd like to thank them! You can buy their sets with a ruler that folds on their website. For more information on the activity, see *Why Do Eclipses Happen? - The Yardstick Eclipse Demonstration*.