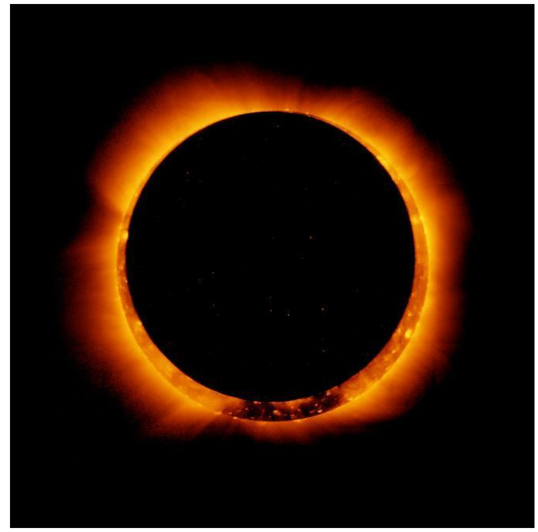
Eclipse Demo



This activity will demonstrate how solar and lunar eclipses work and can be used to demonstrate how we observe planets in other solar systems.

(image on right: Credit NASA/JAXA)

Number of Participants: 2-4

Audience: 8+

Duration: 5 minutes

Difficulty: Level 2

Materials Required:

- Beach Ball or similarly sized yellow object (The Sun)
- Tennis Ball (The Earth/Planet)
- Ping Pong Ball (The Moon)
  - o or 3 balls that are similar in sizes
- Washers to keep the balls in place

Setup:

**these are all written from the viewer's perspective*

Solar Eclipse Setup (Figure 1)

1. Place the Beach Ball (Sun) on the left
2. Place the Ping Pong Ball (Moon) in the middle
3. Place the Tennis Ball (Earth) on the right

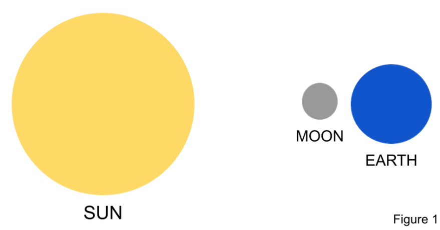


Figure 1

Lunar Eclipse Setup (Figure 2)

1. Place the Beach Ball (Sun) on the left
2. Place the Tennis Ball (Earth) in the middle
3. Place the Ping Pong Ball (Moon) on the right

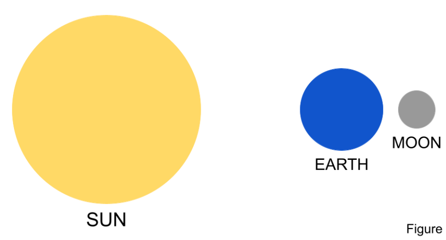


Figure 2

Transiting Planets Setup

1. Place the Beach Ball (Sun) in the center

2. Using either the Ping Pong Ball or the Tennis Ball (Planet), pass this ball in front of the Beach Ball (Sun) to show how we detect transiting planets.

Presenter Brief:

The presenter should have an understanding of the differences between solar and lunar eclipses, what an exoplanet is, and how we detect them..

Vocabulary:

- Eclipse: when a celestial body passes between the observer and a light source
- Transit: when a celestial body passes between a larger object, usually a star, and the observer
- Light curve: amount of light seen from an object over time; displayed as a graph and is used to finding transiting planets

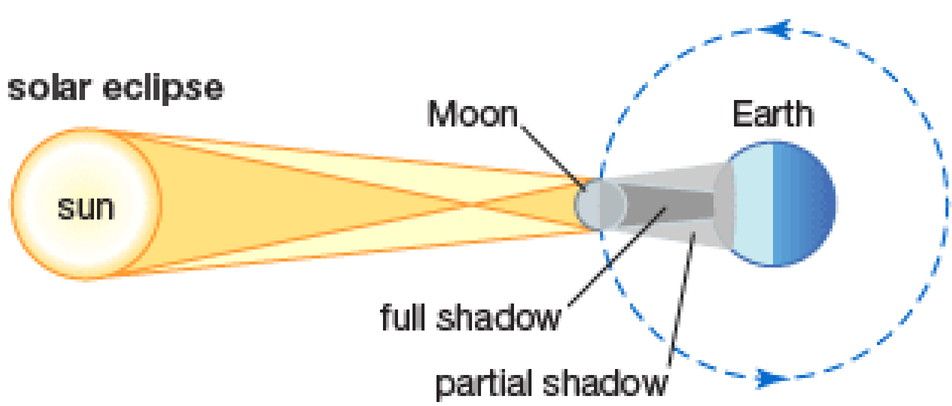
Physics & Explanation:

Elementary (ages 5-10):

➼ The shadow cast from the Moon by the Sun can fall on the Earth. This is called an eclipse.

The Earth orbits the Sun and the Moon orbits the Earth. When the Moon moves directly in between the Earth and the Sun, the Moon casts a shadow. Most of the time the shadow misses Earth but when the shadow does land on Earth, it's called an eclipse!

➼ During a solar eclipse, the moon covers the Sun to observers on Earth.



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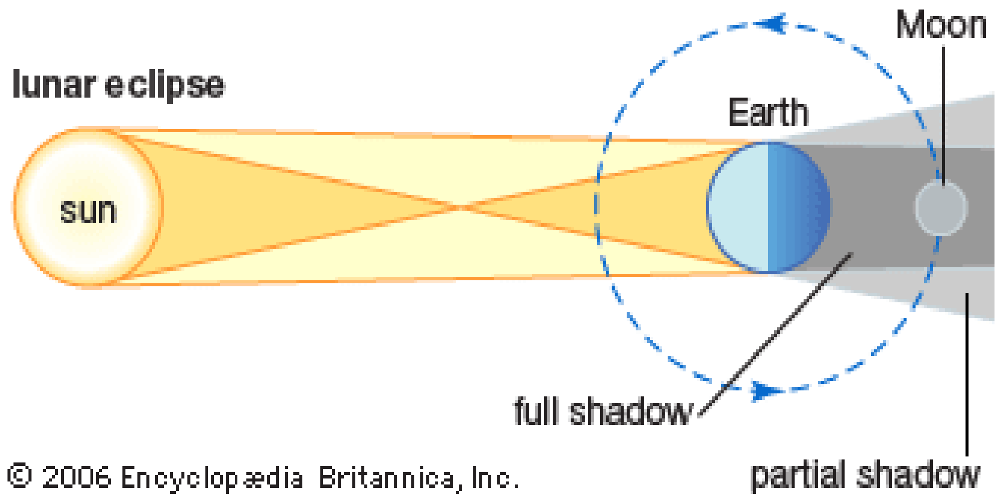
➼ During a lunar eclipse, the Moon moves into the shadow of the Earth and becomes dark.



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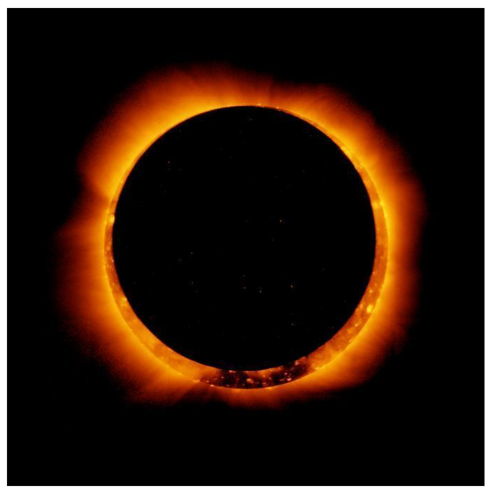
Middle (ages 11-13) and general public:

The orbital plane of the Moon around the Earth is 5° off-tilt from the orbital plane of the Earth around the Sun.

Why don't we get an eclipse every time there's a full moon (solar eclipse) or new moon (lunar eclipse)?

Well, the orbital planes are not exactly in alignment with each other. That 5° difference means that, more often than not, the shadow of the Moon misses the Earth or the shadow of the Earth misses the Moon (depending on which eclipse you are trying to see).

The distance between the Earth and the Moon varies. If the Moon is too far away, it will not completely cover the Sun from our perspective.



As the Moon orbits the Earth, its distance from Earth can vary. If the Moon is in the correct position to create a solar eclipse but is slightly too far away from the Earth, we don't get a total eclipse. We do still get a partial solar eclipse with a cool effect called the Ring of Fire!

(see right; Credit NASA/JAXA)

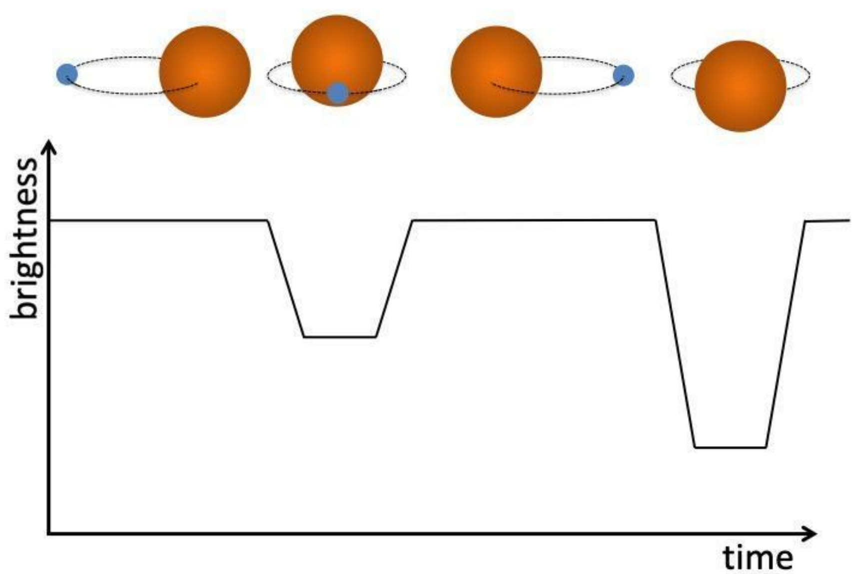
Highschool (ages 14+):

We can identify planets in other stellar systems by measuring the amount of light we get from the star of the system. We can also identify multiple star systems this way.

When we are observing a solar eclipse, we are observing a change in light here on Earth. You could plot this on a graph called a light curve which tracks how much light is observed over time.

We can take this concept and use it with celestial objects much farther away than our Sun. We use this effect to identify exoplanets and multiple star systems. We track the amount of light coming from the main star in a system. When a planet passes in front of the star, the amount of light we receive decreases. The bigger the planet, the bigger the dip in light. This is the most common way we detect exoplanets.

We can also use this method to find binary star systems. While both stars emit light, one is usually cooler and/or bigger than the other. So when the hotter (brighter) star passes in front of its cooler/bigger companion the light dips a little bit but when the cooler/bigger star passes in front of the hotter star the light dips *more*. We can track how often the stars pass in front of each other to determine if we truly are seeing a binary pair.



Credit: Dr. Todd C. Hillwig

Additional Resources:

- [Crash Course Eclipses]
- Eclipse Image Credit: [NASA/JAXA]
- Credit to Zakary Noel, Jacob Robertson and Janessa Slone for the key points and other images included in this writeup.