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Everything's Spinning: Planetary Motion's Effect on Lunar Phenomena

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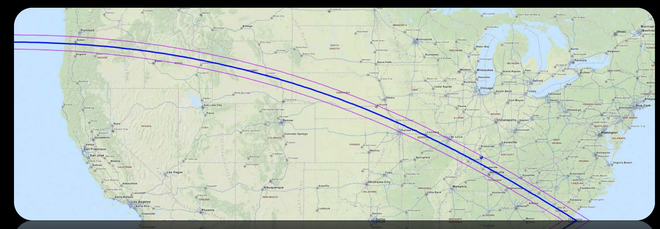
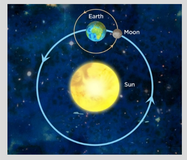


Emily Carlston | Western Oregon University

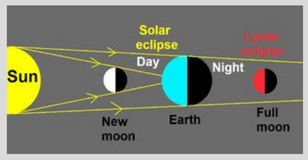
Abstract

Understanding the natural world is a key to sustaining life. Often our understanding does not go beyond what we can tangibly see and touch, with the Moon seemingly out of reach for many. Though the Moon holds a special place to those who enjoy the night sky, it does much more than just provide a picturesque view. The Moon affects the world around us in many ways during its lunar cycle, but how does it all work? The important details of this can be described using the concept of planetary motion that includes key aspects of the way the Moon and Earth interact. The concept of planetary motion can also explain how eclipses occur, the different types of orbit, and the fact that only one face of the Moon is ever visible from Earth. Eclipses, both solar and lunar, are shadows of planetary bodies such as the Moon and Earth. These shadows are created as they move past each other in space during their orbit. As complex as these ideas may seem, they are quite simple once broken down. Eclipses and other lunar phenomena will be explained in this poster using the concept of planetary motion.

What is an Eclipse?



Eclipses both solar and lunar are simply shadows created by planetary bodies as they are illuminated by the Sun and move past each other. Planetary bodies are in this case the Earth and its Moon. There are two main types of eclipses:

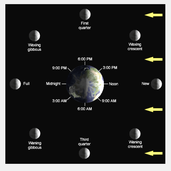


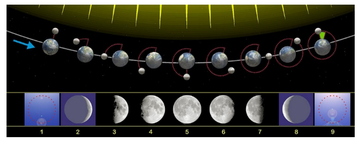
Lunar eclipses are created when Earth passes between our Sun and our Moon casting the Earth's shadow onto the Moon. These usually occur right before or right after a solar eclipse.

Solar eclipses, like the one occurring across Oregon on Aug. 21, 2017, are created when the Moon's path comes directly between our Sun and Earth, casting the Moon's shadow onto Earth.

Lunar Phases

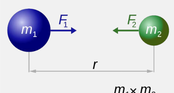
As the Moon orbits around the planet we watch the how the side illuminated changes. We explain this movement as waxing and waning. We call these changes illumination lunar phases, or phases of the Moon.



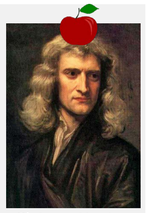


Waxing is when we see the illuminated side grow and more of the Moon becomes visible. When the Full Moon is visible this means that the Moon is on the opposite side of the Earth from the Sun so the entire face is illuminated and we can see the whole round surface. Waning occurs as the Moon continues on its path and we see less of the illuminated side. When a New Moon occurs the Moon is between the Earth and the Sun and all we can see is the shadow of the dark side of the Moon.

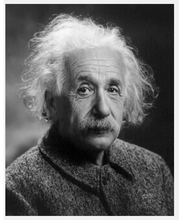
What is Planetary Motion?



To understand planetary motion, we need to first understand this guy's Law of Universal Gravitation. Newton states that every object in the universe has a gravity that is proportional to its mass. This means that all things are slightly pulling toward each other. The idea of gravity plays a huge role in how planets interact with each other and therefore determines a lot of their motion.

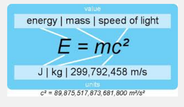


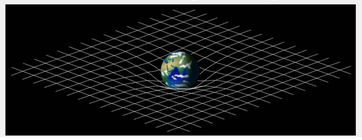
Sir Isaac Newton



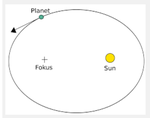
Albert Einstein

Next you will need to understand a bit about this guy, Albert Einstein. He created the Theory of Relativity that took Newton's law of Universal Gravitation one step further. His theory basically states that the planetary bodies are fruit thrown out on a blanket called space time. Space time is a continual surface all throughout the universe. The more something weighs the more is stretches the fabric creating funnel like structures and gravity was simply things rolling past and getting stuck in the dips formed by other objects.

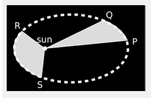




The last guy we need to learn a little bit about is Kepler and his three laws.



In the Law of Ellipses he proposes that most planetary bodies move in an elliptical (oval) motion instead of a perfect circle.



The second law, the Law of Equal Areas, it is then suggested that the area created as a planetary body moves from one point to another over a set period of time is equal to any other area created by that same length of time

Lastly the third law, the Law of Harmonies suggest that there is a mathematical ratio to the speed of an object relative to its orbit

Johannes Kepler

In the broadest sense planetary motion is the result of the effect that planetary bodies have on each other relative to each other

Viewing of the Eclipse

Step 1

Put on protective eye glasses that are approved for eclipses. The eye is sensitive and will be damaged otherwise!

Step 2

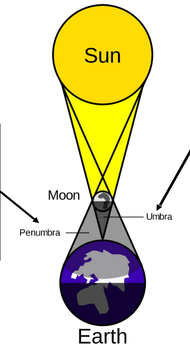
The Moon will then start to block out the Sun casting a shadow onto the Earth. Still keep those glasses on!

Step 3

Only when the Sun is completely blocked and the corona is showing is it safe for the naked eye. This will be 2-3 minutes for the eclipse this August.

Parts of a Solar Eclipse

There are multiple parts of a solar eclipse. Knowing these parts is an important key in understanding what is going on.



1

First let us talk about the Umbra, this is the darkest part of the shadow cast from the Moon onto the Earth. This is where the total solar eclipse is visible.

2

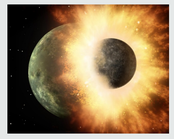
The next part of the eclipse is the penumbra which is the partial shadow where the Sun is not completely blocked and these places will experience a partial eclipse.

3

The last part of the solar eclipse is a part you will only see when you are in the Umbra and this is the Corona, which is the Sun's outermost atmosphere and is visible to the naked eye during a total solar eclipse. The diamond ring effect seen as part of the corona in this picture is the sunlight shining through valleys on the Moon's surface.

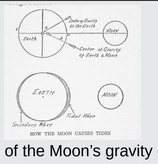
Fun Facts

We do not see total eclipses every lunar cycle because the Moon's path is on a slight tilt (~5°) meaning it rarely lines up between the Sun and Earth. Instead, its shadow misses the Earth most of the time.



The Moon was originally part of an asteroid that collided with the Earth fairly early on in Earth's history

The Moon is on an elliptical path around the Earth and is getting further away from Earth by 3.8 cm each year. In 500 million years it will have drifted far enough that we will no longer have total solar eclipses! The Moon will not appear large enough to entirely block the Sun from Earth.



The pull of the Moon's gravity on the Earth is what causes the change in the tides as the Earth rotates the tides become more attracted to the side of the Earth with the Moon on it stretching water in an elliptical around the Earth.

According to Newton's Law of Universal Gravitation human bodies are also pulling the Earth towards themselves with a very small gravitational force.

The reason we always see the same side of the Moon is because the rotation of the Moon on its axis perfectly matches with its orbit around the Earth.

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