EQ: What are the motions of the moon and Earth and how do they affect what we see and experience?
E1d. Explain the motion of objects in the day/night sky in terms of relative positions.
E1e. Explain that gravity is the force that governs the motion in the solar system.
E2c. Relate the tilt of the Earth to the distribution of sunlight throughout the year and its effect on climate.
What are the two main motions of the Earth?
What are the two main motions of the Earth?

- Rotation
- Revolution or orbit
Rotation

- The Earth rotates on its axis
- Each rotation takes one day, or 24 hours
- Rotation gives us day and night
The Earth is tilted at an angle of 23.5°.

The Earth’s axis is always pointed toward Polaris, the North Star.

As the Earth revolves, or orbits, around the sun, the tilt on the axis gives us seasons.
What are the two main motions of the moon?
What are the two main motions of the moon?

- Rotation
- Revolution or orbit
- The moon rotates once on its axis in the same time that it takes to revolve around the Earth—about 29.5 days
- On Earth, we always see the same side of the moon
Modeling moon motions

- Use a quarter and a penny to model the motions of the moon
- Have the penny to always face the quarter as it revolves around it
- How many times did the penny turn as it moved around the quarter?
- What do the penny and quarter represent in your model?
What keeps the Earth and the moon in orbit?
What keeps the Earth and moon in orbit?

- Gravity
- Inertia
Gravity

- Isaac Newton’s law of universal gravitation
- The strength of the force of gravity between two objects depends on the masses of the object and the distance between them.
Gravity

- In other words, gravity depends on mass and distance

- Mass—the amount of matter in an object
Larger, more massive objects have a stronger gravity.

The moon is only $\frac{1}{6}$ the size of Earth; thus the moon’s gravity is $\frac{1}{6}$ the Earth’s gravity.
Weight—a measure of the force of gravity

Since the moon has less mass, your weight would be less on the moon than on Earth because the moon has less gravity; however, your mass would not change.
The distance between objects also impacts the amount of gravity between them.

If the Earth were closer to the Sun, the amount of gravity would increase.
What would increase the force of gravity between two objects?
What would increase the force of gravity between two objects?

- An increase in mass or a decrease in distance
What would happen to the force of gravity between Earth and the moon if the distance between them decreased?
Gravity

- The force of gravity between them would increase.
- For a science fiction “what if that happened,” read Life As We Knew It or The Dead and The Gone.
What keeps the Earth and moon in orbit?

- Gravity
- Inertia
Newton’s first law of motion

An object at rest will stay at rest and an object in motion will stay in motion unless another force acts upon it
Inertia

- Newton’s first law of motion
- In other words, objects resist changes in motion, a factor called inertia
- Objects with more mass have more inertia
Why does a baseball continue to move after a pitcher lets go of it and stops applying force?
Why would the ball eventually hit the ground?
Gravity and Inertia

- Newton concluded that gravity and inertia work together to keep Earth in orbit around the sun and the moon in orbit around Earth
Because Earth is tilted 23.5° on its axis as it revolves around the sun, we experience...
Seasons!

- When the Northern Hemisphere is tilted toward the sun, we experience summer.
- The sun is higher in the sky, and we have more hours of daylight than darkness.
- The opposite is true in the Southern Hemisphere.
Seasons

- When the Northern Hemisphere is tilted away from the sun, we experience winter.
- The sun is lower in the sky, and we have fewer hours of daylight than darkness.
- The opposite is true in the Southern Hemisphere.
**Seasons—Solstice**

- Solstice—twice each year, the sun reaches its greatest distance north or south of the equator
- Summer Solstice is June 21 in the Northern Hemisphere
- The longest day of the year!
Winter Solstice is December 21 in the Northern Hemisphere
The shortest day of the year!
The opposite occurs in the Southern Hemisphere:
winter solstice—June 21
summer solstice—December 21
Seasons—Equinox

- Equinox—“equal night”—day and night are about 12 hours long everywhere on Earth
- Occurs twice each year, halfway between the solstices
Seasons—Equinox

- Vernal (spring) equinox occurs around March 21 in the Northern Hemisphere—the beginning of spring
- Autumnal equinox occurs around September 22—the beginning of fall in the Northern Hemisphere