

# Earth in the Universe

Date:

**6.E.1 Understand the earth/moon/sun system, and the properties, structures, and predictable motions of celestial bodies in the Universe.**

6.E.1.1 Explain how the relative motion and relative position of the sun, Earth and moon affect the seasons, tides, phases of the moon, and eclipses.

6.E.1.2 Explain why Earth sustains life while other planets do not based on their properties (including types of surface, atmosphere and gravitational force) and location to the Sun.

6.E.1.3 Summarize space exploration and the understandings gained from them.

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## Round and Round They Go!

### How are Earth, the moon, and the sun related in space?

- Earth \_\_\_\_\_ on its \_\_\_\_\_ and \_\_\_\_\_ around the sun.
- A body that orbits a larger body is called a \_\_\_\_\_.
- \_\_\_\_\_ bodies that travel around planets are natural satellites called \_\_\_\_\_.
- \_\_\_\_\_ is the force that pulls all bodies that have mass toward other objects.
- Earth's \_\_\_\_\_ pull on the moon keeps the moon in orbit, forming the Earth-moon \_\_\_\_\_.
- The \_\_\_\_\_ between Earth and the moon is roughly \_\_\_\_\_ km (238,000 mi).

### What does the moon look like from Earth?

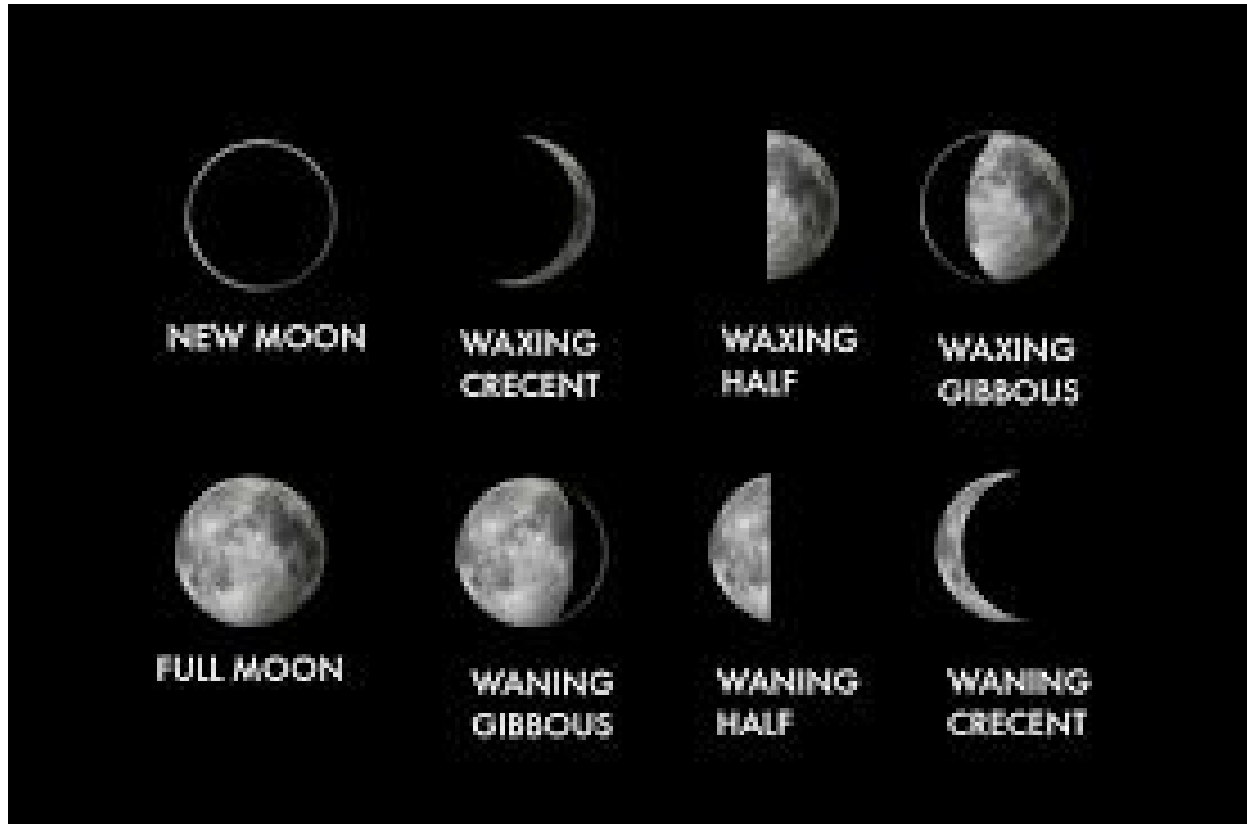
- The \_\_\_\_\_ is only \_\_\_\_\_ from Earth when it \_\_\_\_\_ sunlight.
- Only \_\_\_\_\_ side of the moon, often called the \_\_\_\_\_ side, \_\_\_\_\_ Earth.
- The moon \_\_\_\_\_ once on its \_\_\_\_\_ for every \_\_\_\_\_ days it takes to \_\_\_\_\_ around Earth.

## It's Just a Phase!

### How does the appearance of the moon change?

- As the moon \_\_\_\_\_ around Earth, the portion of the moon that \_\_\_\_\_ sunlight back to Earth changes.
- The \_\_\_\_\_ are changes in the moon's appearance due to its position in orbit around Earth.
- Lunar phases cycle \_\_\_\_\_ and begin with a \_\_\_\_\_ moon.
- The \_\_\_\_\_ moon is \_\_\_\_\_ to see because Earth, the moon, and the sun are \_\_\_\_\_ up, making the moon unlit.

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- As the moon \_\_\_\_\_ in its orbit, it \_\_\_\_\_ more sunlight, and its \_\_\_\_\_ shape grows larger.
  - The moon \_\_\_\_\_, or \_\_\_\_\_, until half of the near side is in sunlight. This is the \_\_\_\_\_ *quarter*.
  - The \_\_\_\_\_ *phase* is when the near side is more than half-lit but not fully lit.
  - When the moon is \_\_\_\_\_ lit, it is called a \_\_\_\_\_ moon.
  - The \_\_\_\_\_ portion of the moon \_\_\_\_\_, or \_\_\_\_\_, during the \_\_\_\_\_ week of the cycle.
  - When the \_\_\_\_\_ side is only \_\_\_\_\_-lit in sunlight, it is three-quarters through the cycle. The phase is called the \_\_\_\_\_ *quarter*.
  - When the moon is seen as \_\_\_\_\_ crescent shapes, the cycle is almost complete.
  - When the moon is again unlit as a \_\_\_\_\_ *moon*, the cycle is \_\_\_\_\_.



## Exploring Eclipses

### How do lunar eclipses occur?

•An \_\_\_\_\_ is an event during which one object in space casts a shadow on another object.

•A lunar eclipse \_\_\_\_\_ when the moon moves through Earth's shadow.



•The \_\_\_\_\_ is the darkest part of a shadow. Around the umbra is a spreading cone of lighter shadow called the \_\_\_\_\_.

•\_\_\_\_\_ a lunar eclipse, the moon is a \_\_\_\_\_ moon.

•The moon \_\_\_\_\_ into the \_\_\_\_\_ shadow and \_\_\_\_\_ less bright.

•When the moon \_\_\_\_\_ into the \_\_\_\_\_, the moon is in total \_\_\_\_\_.

- A \_\_\_\_\_ lunar eclipse occurs when the moon moves completely inside the umbra.
- If the moon misses all or part of the umbra and a part stays lit, it is called a \_\_\_\_\_ lunar eclipse.
- You do \_\_\_\_\_ see lunar eclipses each month because the moon's orbit is tilted by about \_\_\_\_\_ relative to Earth's orbit.

### How do solar eclipses occur?

- When the moon is \_\_\_\_\_ between the sun and Earth, the \_\_\_\_\_ of the moon falls on a part of Earth and causes a \_\_\_\_\_ eclipse.
- When the sun's light is \_\_\_\_\_ blocked by the \_\_\_\_\_, it is a \_\_\_\_\_ solar eclipse.
- \_\_\_\_\_ the umbra, but \_\_\_\_\_ the penumbra, people see a \_\_\_\_\_ solar eclipse.
- The \_\_\_\_\_ umbra makes a shadow that is never more than a few hundred \_\_\_\_\_ across.
- A \_\_\_\_\_ eclipse \_\_\_\_\_ only a part of Earth and can only be seen in particular areas.
- A \_\_\_\_\_ solar eclipse happens somewhere on Earth every \_\_\_\_\_ to \_\_\_\_\_ years.
- Why is a total solar eclipse visible over only a small portion of Earth?



## A Rising Tide of Interest

### What causes tides?

- \_\_\_\_\_ are daily changes in the level of ocean water.
- Tides are \_\_\_\_\_ by the difference in the gravitational force of the sun and moon across Earth.
- The \_\_\_\_\_ in gravitational force is called the \_\_\_\_\_.
- Because the moon is \_\_\_\_\_ to Earth, the moon is mainly responsible for Earth's tides.
- \_\_\_\_\_ on the side of Earth \_\_\_\_\_ to the moon bulges toward the moon.
- A \_\_\_\_\_ is created on both the near side and the \_\_\_\_\_ side of Earth.

### What are high tides and low tides?

- \_\_\_\_\_ *tide* is a water level that is higher than the average sea level.
- \_\_\_\_\_ *tide* is a water level that is lower than the average sea level.
- \_\_\_\_\_ bulges move around Earth following the motion of the moon.

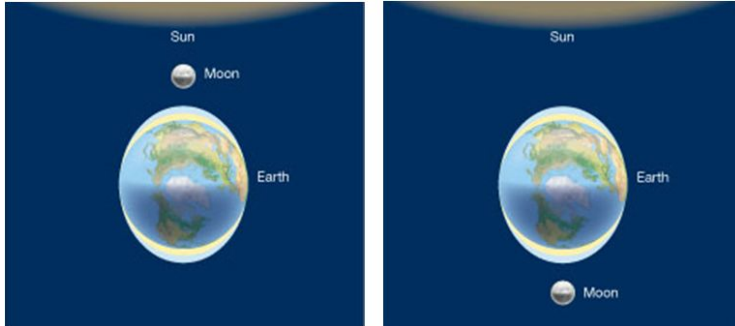
## Tide Me Over

### What are two kinds of tidal ranges?

- The \_\_\_\_\_ tidal force is \_\_\_\_\_ than the \_\_\_\_\_ tidal force, which results in different tidal ranges.
- A \_\_\_\_\_ is the difference between the levels of ocean water at high tide and low tide.
- \_\_\_\_\_ are tides that have the largest daily tidal range.
- \_\_\_\_\_ tides happen when the sun, moon, and Earth form a \_\_\_\_\_ line.

•Spring tides \_\_\_\_\_ during the new moon and full moon phases every \_\_\_\_ days.

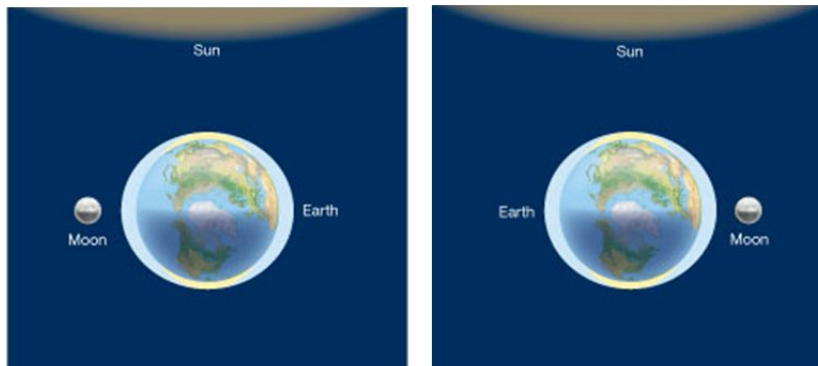
•What causes the large tidal range of a spring tide?



- \_\_\_\_\_ are tides that have the smallest daily tidal range.
- \_\_\_\_\_ tides happen when the sun, moon, and Earth form a \_\_\_\_\_ angle.

•During a \_\_\_\_\_ tide, the \_\_\_\_\_ effects of the sun and moon on Earth do not add together.

•During which moon phases do neap tides occur?



### What causes tidal cycles?

•The moon \_\_\_\_\_ around Earth much more \_\_\_\_\_ than Earth rotates.

•A \_\_\_\_\_ on Earth facing the moon takes \_\_\_\_ h and \_\_\_\_ min to \_\_\_\_\_ to face the moon again.

•So, the \_\_\_\_\_ of \_\_\_\_\_ tides and \_\_\_\_\_ tides at that place happens \_\_\_\_ min later each day.

•Because the \_\_\_\_\_ cycle occurs in 24 h and 50 min intervals, it takes about \_\_\_ h and \_\_\_ min for \_\_\_\_\_ in an area to go from high tide to low tide.

•It takes about \_\_\_ h and \_\_\_ min to go from \_\_\_\_\_ high tide to the \_\_\_\_\_ high tide.

## Earth

•Earth is a \_\_\_\_\_ place because it has just the right combination of conditions to support life.



•The presence of \_\_\_\_\_ and \_\_\_\_\_ supports the growth and development of plants and animals.

•The \_\_\_\_\_ contains an \_\_\_\_\_ layer that \_\_\_\_\_ harmful solar radiation and other gases that keep Earth warm enough for life to exist.

## Gravity

### What is gravity?

•\_\_\_\_\_ is a force of attraction between objects that is due to their masses and the distances between them.

•Every object in the universe \_\_\_\_\_ on every other object.

•Objects with \_\_\_\_\_ masses have a greater \_\_\_\_\_ of attraction than objects with \_\_\_\_\_ masses have.

•Objects that are \_\_\_\_\_ together have a \_\_\_\_\_ force of attraction than objects that are far apart have.

•Gravity is the \_\_\_\_\_ force in nature, yet it is one of the most important forces in the universe.

•Gravity \_\_\_\_\_ for the formation of planets, stars, and galaxies.

•Gravity also \_\_\_\_\_ smaller bodies in \_\_\_\_\_ around larger bodies.

•An \_\_\_\_\_ is the path that a body follows as it travels around another





body in space.

## What are Kepler's laws?

•The \_\_\_th century Polish astronomer Nicolaus \_\_\_\_\_ changed our view of the solar system.

•He discovered that the \_\_\_\_\_ of the planets could best be explained if the planets orbited the sun.

•Like astronomers before him, Copernicus thought that the planets followed \_\_\_\_\_ paths around the sun.

•Danish astronomer Tycho Brahe used special instruments to accurately measure planetary motions over a period of 20 years.

•Using Tycho's data, Johannes \_\_\_\_\_ discovered what we call *Kepler's laws of \_\_\_\_\_ motion*.



•Upon plotting the orbit of \_\_\_\_\_, Kepler saw that it was a deformed circle.

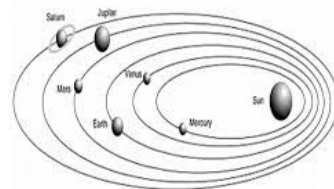
•After eight years of work, he realized that it was an \_\_\_\_\_.

•Kepler then proposed that each of the planets has an elliptical orbit, with the sun at one focus of the ellipse.

•This is Kepler's \_\_\_\_\_ law.

•When an object follows an elliptical orbit around the sun, there is one point, called \_\_\_\_\_, where the object is farthest from the sun.

### Kepler's Elliptical Orbits



•There is also a point, called \_\_\_\_\_,

where the object is closest to the sun.

- Today, we know that the \_\_\_\_\_ of the planets are only \_\_\_\_\_ elliptical, but the orbits of objects such as Pluto and \_\_\_\_\_ are \_\_\_\_\_ elliptical.
- Kepler found that a planet moves \_\_\_\_\_ at aphelion, sweeping out a narrow sector on the ellipse.
- Conversely, a planet moves \_\_\_\_\_ at perihelion, sweeping out a thick sector on the ellipse.
- As a planet moves around its orbit, it sweeps out equal areas in equal times. This is Kepler's \_\_\_\_\_ law.
- Kepler looked at how long it took for the planets to orbit the sun. He also observed the sizes of their orbits.
- He discovered that the \_\_\_\_\_ of the orbital period is \_\_\_\_\_ to the \_\_\_\_\_ of the planet's distance from the sun.
- This principle is Kepler's \_\_\_\_\_ law.

### What is the law of universal gravitation?

- Using Kepler's laws, Sir Isaac \_\_\_\_\_ became the first scientist to mathematically describe how the \_\_\_\_\_ of gravity behaves.
- He reasoned that \_\_\_\_\_ is the force that accounts for both the fall of an apple from a tree and the movement of the moon around Earth.
- In 1687, Newton formulated the *law of \_\_\_\_\_ gravitation*.
- The law of universal gravitation states that all objects in the universe \_\_\_\_\_ each other through \_\_\_\_\_ force.
- The \_\_\_\_\_ of this force \_\_\_\_\_ on the product of the \_\_\_\_\_ of the objects.
- Gravitational force is also \_\_\_\_\_ proportional to the square of the distance between the objects.

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## How does gravity affect planetary motion?

- If a ball is attached to a string and is swung around, it moves in a circular path.
- The inward force that causes an object to move in a circular path is called \_\_\_\_\_.
- If the string breaks, the ball will move off in a straight line. When the string is intact, the centripetal force prevents the ball from flying off.
- When planets orbit the sun, a force similar to centripetal force prevents them from moving out of their orbits and into a straight line.
- The \_\_\_\_\_ gravity is the force that \_\_\_\_\_ the planets moving in \_\_\_\_\_ around the sun.

## Space: The Final Frontier

### How did space exploration begin?

- In October of \_\_\_\_\_, the Soviet Union launched the first satellite, \_\_\_\_\_, into low Earth orbit. It was the start of the "Space Age."
- In response, the United States launched its first satellite, \_\_\_\_\_ I, on January 31, \_\_\_\_\_. This started the Space Race.
- In the same year, the National Aeronautics and Space Administration, or \_\_\_\_\_, was formed.

## From Earth to the Moon

### How have people explored space?

- \_\_\_\_\_ crewed spacecraft do not orbit Earth because they do not reach the required speed and altitude. They spend only a short time in space.
- The first crewed suborbital spaceflight missions were NASA's Mercury project in \_\_\_\_\_.
- These \_\_\_\_\_ included the suborbital flights of Alan B. Shepard, Jr., on May 5, 1961, and Virgil I. Grissom on July 21, 1961.

- \_\_\_\_\_ crewed spacecraft completely orbit Earth. On April 12, 1961, Soviet air force pilot Yuri A. Gagarin became the first person to orbit Earth.
- On July 21, \_\_\_\_\_, John H. \_\_\_\_\_, Jr., became the first \_\_\_\_\_ to orbit Earth.
- On June 16, \_\_\_\_\_, Soviet cosmonaut Valentina V. Tereshkova became the first \_\_\_\_\_ to fly in space and orbit Earth.
- The United States developed the \_\_\_\_\_ program with two-person crews, partly to see if astronauts could spend longer periods of time in space.
- The Soviet Union extended their existing Vostok program to include multiperson spaceflights.
- On March 18, \_\_\_\_\_, Soviet cosmonaut Alexei A. Leonov performed the first walk in space. On June 3, 1965, Edward H. White II became the first American to do so.
- On September 12, \_\_\_\_\_, President John F. Kennedy committed the United States to land a man on the moon before the decade ended.
- In \_\_\_\_\_, the \_\_\_\_\_ 11 spacecraft took astronauts Neil \_\_\_\_\_, Edwin "Buzz" \_\_\_\_\_, and Michael \_\_\_\_\_ to the \_\_\_\_\_.
- While Collins orbited the moon in the spacecraft, Armstrong and Aldrin \_\_\_\_\_ on the moon's surface in a lunar module on July 20, \_\_\_\_\_.
- The \_\_\_\_\_ is the \_\_\_\_\_ nation that has sent astronauts to the moon.
- \_\_\_\_\_ moon landings took place during the \_\_\_\_\_ program of the late 1960s and early 1970s.
- In total, \_\_\_\_\_ astronauts have walked on the moon.

### Where have people lived and worked in space?

- *Space* \_\_\_\_\_ are crewed space vehicles that lift off with the aid of rocket boosters and land like airplanes.



- Space shuttles \_\_\_\_\_ Earth while in space. The shuttle and its rocket boosters are reusable.
- Shuttle \_\_\_\_\_ have included gathering data, launching satellites, transporting materials, and docking with the *International Space Station*.
- Space shuttle missions began with the launch of the shuttle \_\_\_\_\_ in \_\_\_\_\_.
- \_\_\_\_ shuttles—*Enterprise, Columbia, Challenger, Discovery, Atlantis, and Endeavour*—have together completed more than \_\_\_\_\_ missions.
- Tragic accidents led to the loss of \_\_\_\_\_ and its crew in \_\_\_\_\_ and \_\_\_\_\_ and its crew in \_\_\_\_\_.
- A *space \_\_\_\_\_* is a \_\_\_\_\_-term, crewed spacecraft that orbits Earth.
- It can be \_\_\_\_\_ to launch other vehicles and carry out scientific research.
- \_\_\_\_\_ live aboard a space station for a period of several weeks or months and \_\_\_\_\_ research and experiments.
- The first space station, \_\_\_\_\_, was placed in orbit by the Soviet Union in April \_\_\_\_\_. In \_\_\_\_\_, the \_\_\_\_\_ launched its first space station, \_\_\_\_\_.
- The Soviet/Russian space station \_\_\_\_\_ was built between 1986 and 1996 and operated in low Earth orbit until 2001.
- The \_\_\_\_\_ *Space Station*, as long as a football field, was built in low Earth orbit over a period of 13 years, starting in \_\_\_\_\_.



## Just Passing By

### How have people used uncrewed vehicles to explore space?

- \_\_\_\_\_ vehicles, such as space probes and \_\_\_\_\_, are a safe way to explore distant bodies that could take years or decades to reach.
- Space \_\_\_\_\_ carry scientific instruments and \_\_\_\_\_ data back to Earth.
- Scientists have used space probes to fly by the \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_, to land on Mars, and to explore the far reaches of the solar system.

### How have people used uncrewed vehicles to explore space?

- An \_\_\_\_\_ is a spacecraft that travels to a planet and goes into orbit around it.
- Several orbiters have been \_\_\_\_\_ the features of Mars by mapping the Martian surface and collecting \_\_\_\_\_ about its chemical makeup.
- NASA's *Mars \_\_\_\_\_ Orbiter* has a powerful camera that could guide future spacecraft to make precise landings on Mars.
- A \_\_\_\_\_ is designed to land on the surface of a planet or other body and send data back to Earth.
- A \_\_\_\_\_ physically explores the body's surface by moving about.
- Landers and rovers can \_\_\_\_\_ experiments on soil and rocks, and they can \_\_\_\_\_ surface conditions such as temperature and wind flow.
- An \_\_\_\_\_ *satellite* is any human-made object placed in orbit around a body in space. Hundreds of active satellites currently orbit Earth.



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•A satellite may \_\_\_\_\_ weather data, relay TV and radio signals, assist in navigation, or study Earth's surface.

•A system of orbiting global navigation satellites has been operated by the U.S. since \_\_\_\_\_. They are used to determine \_\_\_\_\_ locations on Earth.







