



4th Grade Core Tour at the Bishop Teachers Guide to Astronomy

When discussing astronomy with students, some of the most basic concepts have some of the most far-reaching implications! Astronomy has been used for millennia as the ultimate calendar in the cosmos, making it one of the most fundamental navigation and timekeeping tools humans have ever developed. Despite modern reliance on technology and the increasing pollution of the night sky, astronomy is still a tool anyone can learn to use.

Core Idea: Earth's Place in Space and Time

Constellations

- Star patterns in the sky allow for both navigation and timekeeping.
 - As Earth orbits the Sun throughout the year, the constellations appear to shift.
- Learning what seasons coincided with the rising of constellations allowed civilizations to produce accurate calendars for agricultural, social, and other purposes.
- Learning tricks to associate star patterns can help even novice stargazers locate objects with ease.
- Stars are dozens, hundreds, and even thousands of light years away.
 - Traveling at the speed of light, it would take more than four years to reach the nearest star beyond the Sun.

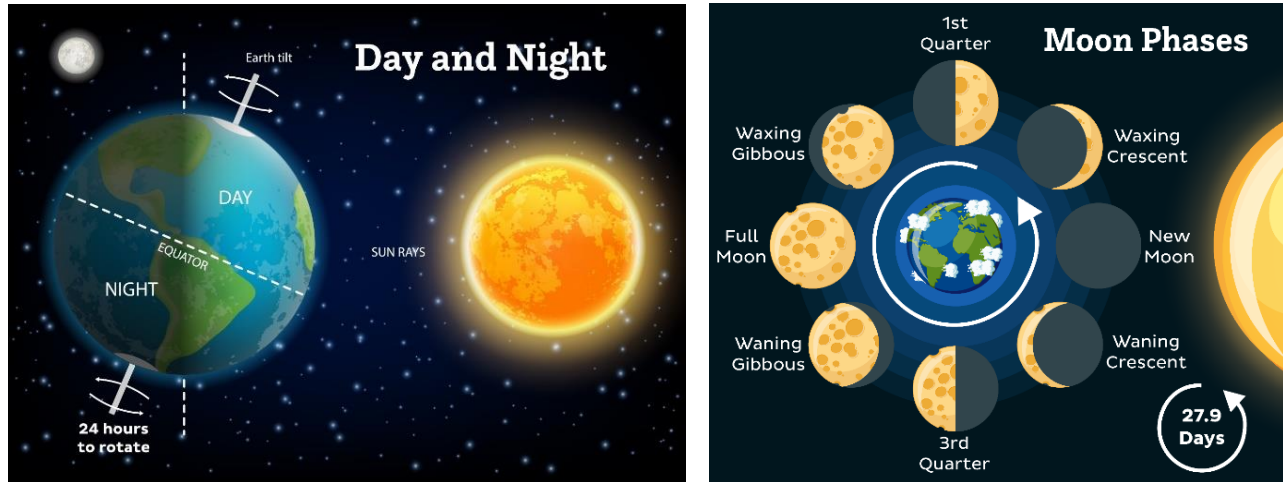
Earth's Orbit

- Earth orbits the Sun in 365 days—one year.
 - The direction of orbit is counter-clockwise.
- Earth is tilted at an angle of 23.5°.
 - The tilt of Earth leads to seasonal variations in temperature and light.
 - When an axis is more tilted toward the Sun, light and heat hit Earth at a more direct angle to the surface, so it's hotter and brighter for longer periods of time.
 - When an axis is more tilted away from the Sun, light and heat hit Earth at less of an angle, so it's colder and dimmer for longer periods of time, even though Earth remains at the same distance from the Sun.

Earth's Rotation

- Earth rotates once on its axis every 24 hours—one day.
- Objects appear to rise and fall as Earth spins.

- Relative to the northern hemisphere, Earth rotates in a counter-clockwise direction.
- Objects rise from the east, and set in the west. Most people think of the Sun as rising and setting in this way, but everything that we see from Earth's perspective shows this phenomenon.



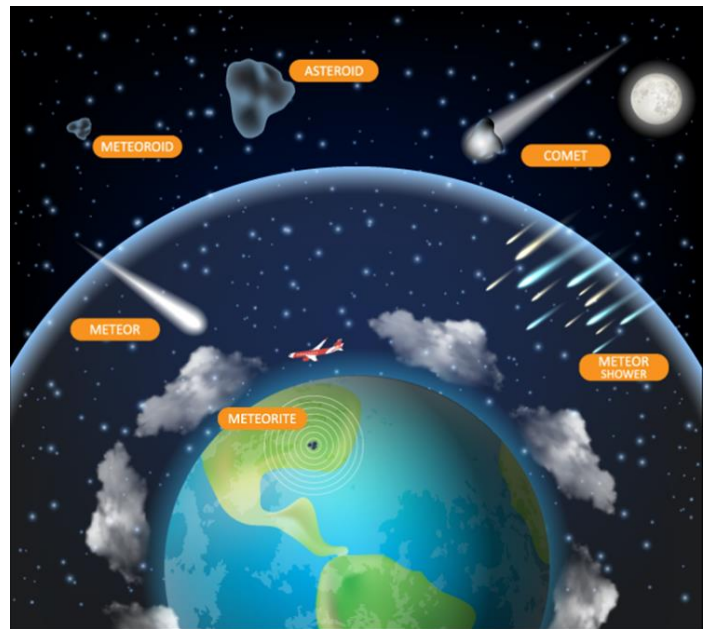
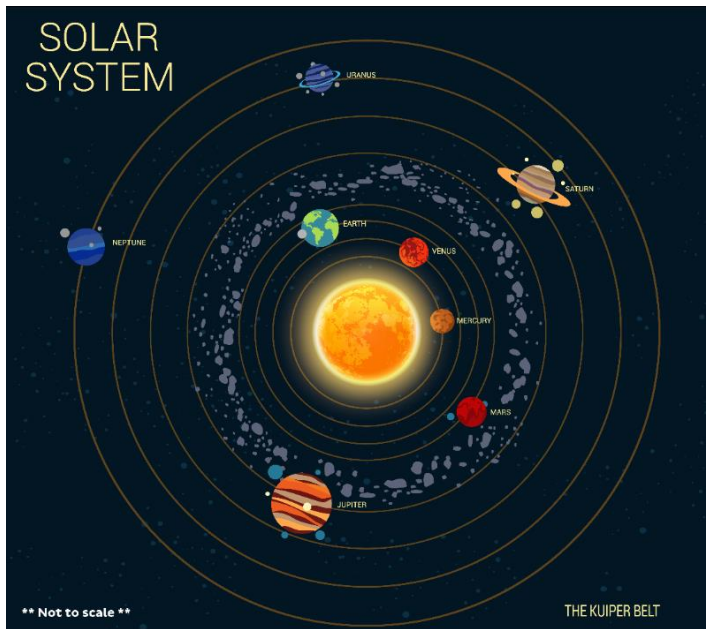
The Moon

- The Moon orbits Earth once every 27.9 days.
 - The Moon orbits in a counter-clockwise direction.
- Phases of the Moon are determined by its geometrical location relative to Earth and the Sun.
 - When the Moon makes a right angle with Earth and the Sun (an L shape with Earth at the corner) the Moon is in a 1st or 3rd Quarter phase.
 - When the Moon makes a straight line with Earth and the Sun, with Earth at the center, the Moon is in its Full phase.
 - When the Moon makes a straight line with Earth and the Sun, with the Moon at the center, the Moon is in its New phase.
- There are about 7 days between each phase, with 4 phases in each cycle, adding up to the 27.9 days. Months were derived from the lunar cycle.

The Solar System

- There are four inner rocky planets: Mercury, Venus, Earth, Mars.
- There are four outer gas giants: Jupiter, Saturn, Uranus, Neptune.
- The asteroid belt lies in the gap between Mars and Jupiter, and is the location of the dwarf planet Ceres.
- Pluto lies in the Kuiper Belt (kīpər belt), beyond Neptune.
- Earth travels around the Sun slower than Mercury and Venus, but faster than the outer planets Mars, Jupiter, Saturn, Uranus, and Neptune.
 - Mercury and Venus appear to move rapidly through the sky.
 - The outer planets appear to move slowly through the sky.
 - All the planets, and the Moon, change position among the same twelve constellations, called the ecliptic, sometimes called the zodiac constellations.

- Comets are made up of ice and dust.
 - Evidence suggests almost all of Earth’s water came from collisions with comets.
- Asteroids are made of metals, minerals, and rocks.



Key comparative statistics for the planets

(Source: <https://solarsystem.nasa.gov/>)

Planet	Distance from Sun (millions of miles)	Diameter (miles)	Moons	Rings	Orbital Period ("year" in Earth days)	Rotational Period ("day")	Axial Tilt*	Average Surface Temp (Low/High)
Mercury	38.57	3,032	0	No	88	59 Earth Days	2°	-290°F/800°F
Venus	66.91	7,520	0	No	225	243 Earth Days	3°	870°F
Earth	93.3	7,918	1	No	365	24 hours	23.4°	-129°F/136°F
Mars	135.44	4,212	2	No	687	24.6 hours	25°	-225°F/70°F
Jupiter	482.32	86,881	~79	Yes	4,333	10 hours	3°	-243°F **
Saturn	931.68	72,366	~82	Yes	10,756	10.7 hours	26.7°	-288°F
Uranus	1,933	31,518	27	Yes	30,687	17 hours	97.8°	-371°F
Neptune	2,782	30,599	14	Yes	60,190	16 hours	28°	-360°F

*Planets with minimal tilt do not have significant seasons. Uranus, with a tilt of over 90°, has extraordinarily long seasons.

** Because gas giants do not have solid surfaces and are at long distances from the sun, there are not wide ranges of temperature at the surface. Core temperatures of gas giants reach the tens of thousands of degrees.

The Milky Way Galaxy

- A galaxy is a large collection of gravitationally-bound stars, gas, and dust.
 - Stars form from hydrogen gas collapsing together due to gravity and creating immense heat and pressure that fuses atoms together.
 - Nebulae are interstellar clouds of gas and dust that signify areas of star birth or star death.
 - Star clusters are hundreds, thousands, and sometimes millions of stars tightly grouped together.
- The Milky Way has 200-400 billion stars.
 - Surveys have discovered more than 4,000 planets of varying sizes and composition orbiting other stars.
- The Milky Way is about 100,000 light years across.
- Several dwarf galaxies orbit the Milky Way.
- Andromeda, the nearest spiral galaxy to the Milky Way, is approximately 2.5 million light years away and has more than a trillion stars.