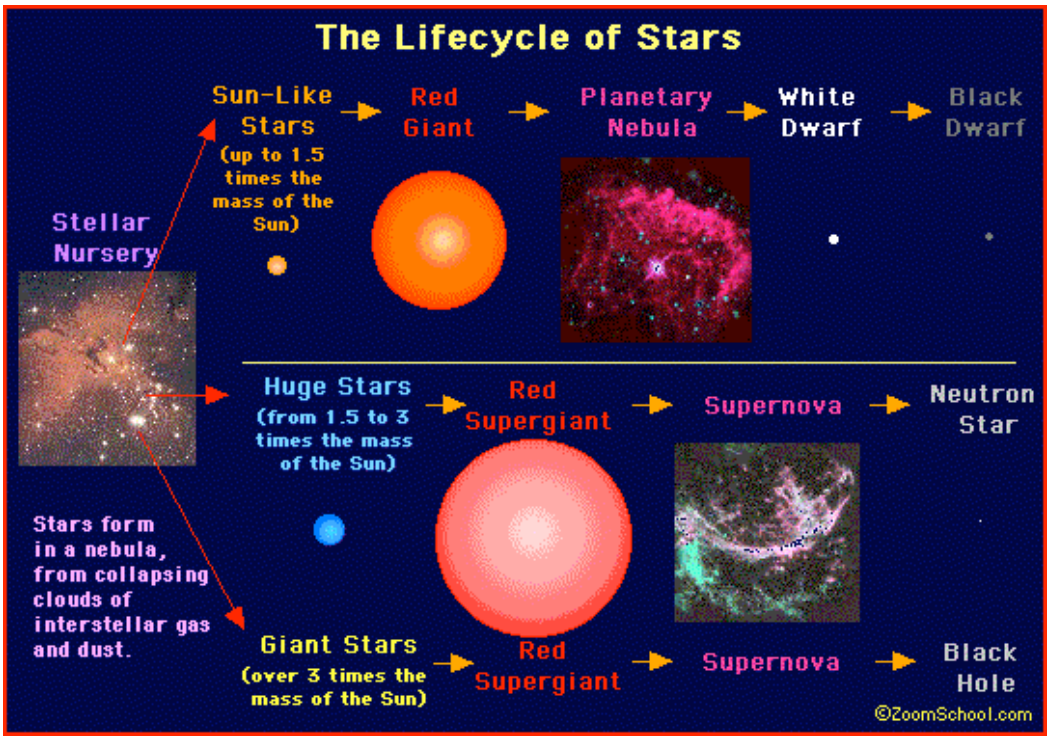
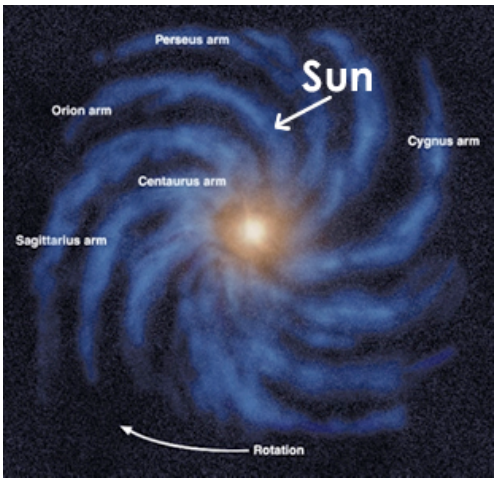
Using photographs of Supernova 1987A, and, if possible, a photograph of the large Magellanic cloud taken before the explosion explain that supernovas represent the "death" of stars that exceed a certain mass. In a few seconds, a supernova can release more energy than it previously did in its entire existence.

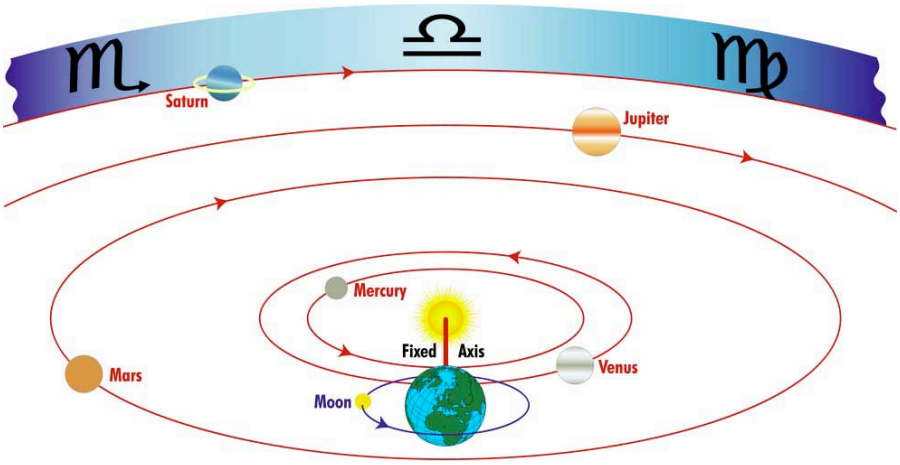
What have you learned about stars in Section 1/Chp 19. Hypothesize how a star's magnitude, temperature, mass, density, and composition are interrelated. How does a star's age determine its type. When its nuclear fuel begins to be used up, the star changes. Throughout their life cycles, stars vary in magnitude, temperature, mass, density, and composition.

"The H-R Diagram." These transparencies show the H-R Diagram and include descriptions of the stars and tips on interpreting the diagram. Remember that the lower a star's magnitude, the brighter the star is. By looking at the H-R diagram, you should be able to identify the sun as a main-sequence, yellowish dwarf star with medium brightness and a surface temperature of about 6,000°C. Describe other stars in the diagram in a similar manner.

Create a flowchart describing the life of a star. Refer to the H-R diagram. Your chart should indicate that stars are formed when gas and dust are drawn together by gravity and nuclear fusion begins; that they enter the main sequence when they mature; and that they then may become a red giant, a supergiant, or eventually a white dwarf.







Three important concepts to understand are:

* Orbits are not perfect circles, but usually ellipses (Kepler's First Law)
* During an objects orbital path, its speed will change (Kepler's Second Law)
* The objects speed depends on the size of the orbit (an application of Newton's Third Law)

Orbits and the Solar System

The solar system consists of the Sun; the nine planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto; 61+ satellites of the planets, a large number of small bodies (comets and asteroids), and the interplanetary medium. The above diagram shows the relative sizes of the orbits of the nine planets (the orbits of Mercury, Venus and Earth are not labeled). The orbits of the planets are ellipses with the Sun at one focus. The orbits of all except Mercury and Pluto are very nearly circular. The orbits of the planets are all more or less in the same plane (called the ecliptic and defined by the plane of the Earth's orbit). The ecliptic is inclined only 7 degrees from the plane of the Sun's equator. Pluto's orbit deviates the most from the plane of the ecliptic with an inclination of only 17 degrees. They all orbit in the same direction (counter-clockwise looking down from above the Sun's north pole); all but Venus and Uranus also rotate in that same sense.

The Sun is the brightest object in our sky and the largest object in our solar system. The Sun is actually a star that is 93 million miles (that's 150 million kilometers) from the Earth. The Sun is about 4.5 billion years old and is one of more than 100 billion stars in our galaxy. Our galaxy is called the Milky Way Galaxy. The Sun is one of many stars in the part of our galaxy called the Orion arm. The Earth and eight other planets move around the Sun in paths called orbits. Lighter objects orbit heavier ones, and the Sun is the heaviest object in the solar system. The Sun is more than 300,000 times heavier than the Earth.

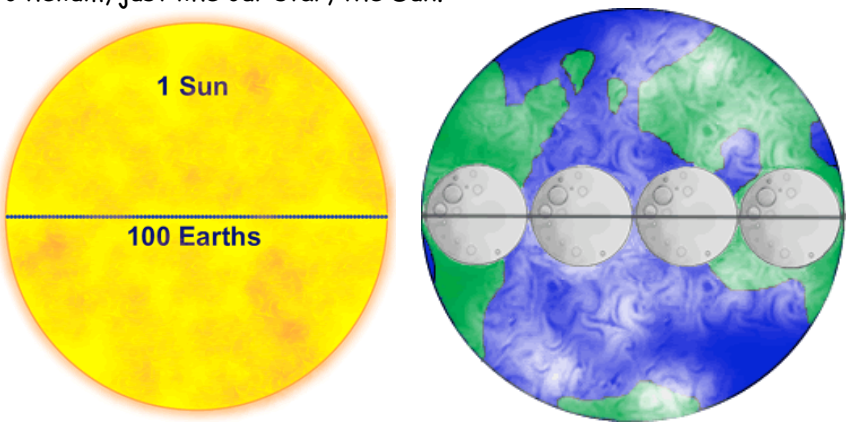
The Sun is very large compared to the Earth. The diameter of the Sun is 100 times more than the diameter of the Earth! And, even at that size, it is just a medium-sized star compared to others.

The Sun is very hot with the temperature of the surface at about 11,000 °F (Fahrenheit) or 6093 °C (Celsius). The Sun is made mostly of two gasses: hydrogen and helium. The Sun is always working to change hydrogen to helium. The Sun makes the light that we see and the heat that we feel when we are outside during the day. The Sun is one of many stars in our galaxy. Our sun is an average star. Some others stars are much bigger and others are much smaller. All of the other stars in the sky are much further away from us than the Sun. Their long distance away from us is the reason they look like tiny points of light in the night sky.

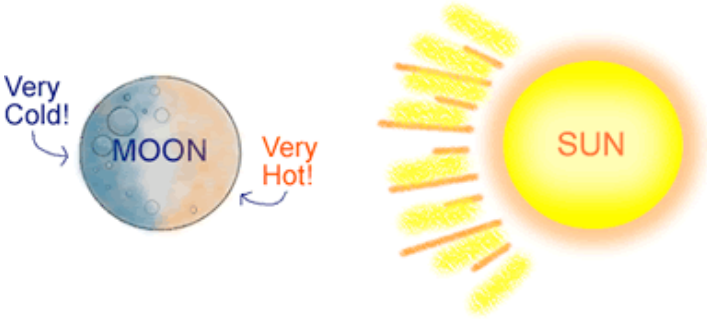
We measure the distance of stars from Earth in light years. A light year is the distance that light travels in one year. Since light travels at a speed of 186,000 miles/second (300,000 kilometers/second), a star that is one light year away is actually 5.8 trillion miles (9.5 trillion kilometers) from us! The Sun is only 8 light minutes away. That means that light from the Sun takes 8 minutes to get to earth. By comparison, if your friend turned on a very bright flashlight in North Carolina, you would see the light in about 1/60th of a second. The closest star to us, other than the Sun, is Alpha Centauri, and it is 4 light years away. The most distant stars we can still see without a telescope are about 1000 light years away!

All the stars we see at night from Earth are also stars in our Milky Way Galaxy. There are over 100 billion stars in our Galaxy, but on an average dark night we can only see about 1000 to 1500 of them! Stars produce light and heat by changing hydrogen into helium, just like our star, the Sun.

PLANET	DISTANCE (A. U.)
Mercury	0.39
Venus	0.72
Earth	1.00
Mars	1.52
Jupiter	5.20
Saturn	9.54
Uranus	19.20
Neptune	30.10
Pluto	39.40



The Moon

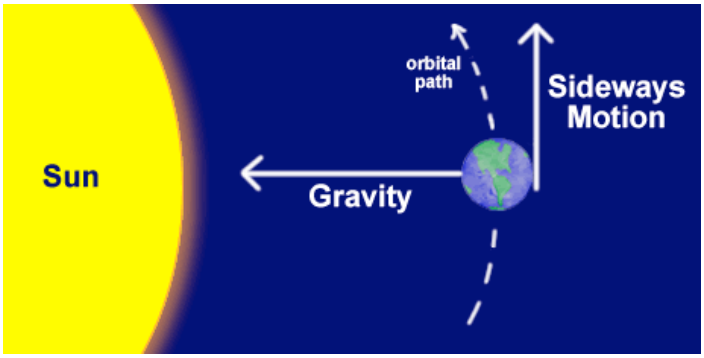


The Moon is the second brightest object in the sky after the Sun, but it is not a star. The Moon is about 1/4 the diameter of the Earth and is made of rocky material. Most lunar rocks are between 3 and 4.6 billion years old. Many scientists believe that the Moon formed when the Earth ran into a very large object (perhaps as big as the planet Mars.) They think the Moon formed from the broken material. The Moon is the only natural satellite of the Earth and travels around the Earth in an orbit. The Moon orbits the Earth because it is so much lighter than our planet The diameter of four Moons is equal to the diameter of the Earth. The Moon is about 240,000 miles (386,000 kilometers) away from Earth. The temperature on the Moon is much colder, but strangely also much hotter than on Earth. It can get as hot as 212 °F (100 °C) and as cold as -233 °F (-147 °C)! This large temperature range happens because the Moon has no atmosphere. On Earth, our atmosphere helps to control the temperature on our planet. Since the Moon has no atmosphere to help with temperature control, it is very hot where the Sun shines on the Moon and it is very cold where the Sun does not shine on the Moon! Because of the way the Moon rotates, the lunar South Pole never gets any sunlight.

Man-made satellites that have traveled around the Moon have found some evidence of ice scattered in some of the deep craters near the Moon's North and South Poles. This means that there is a form of water on the Moon.

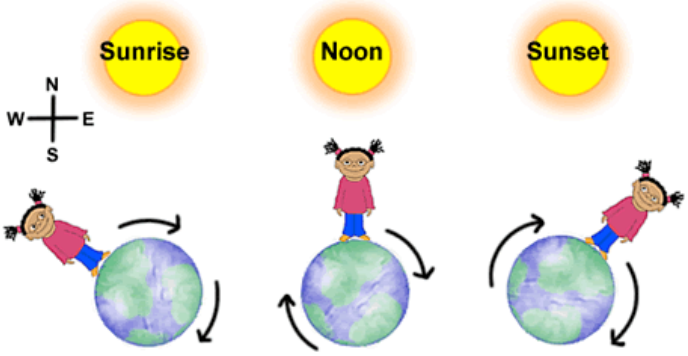
Earth Dances

The Earth revolves around the Sun every 365 days, and this is why our calendar has 365 days in a year. That means the Earth, on its orbital path, moves completely around the Sun one time each year. So why does the Earth orbit the Sun? The motion happens because of something called gravity. Gravity is a force of attraction between two objects that have mass. The object with more mass pulls things towards it. Since the Sun has much more mass than the Earth, the Earth is pulled toward the Sun.



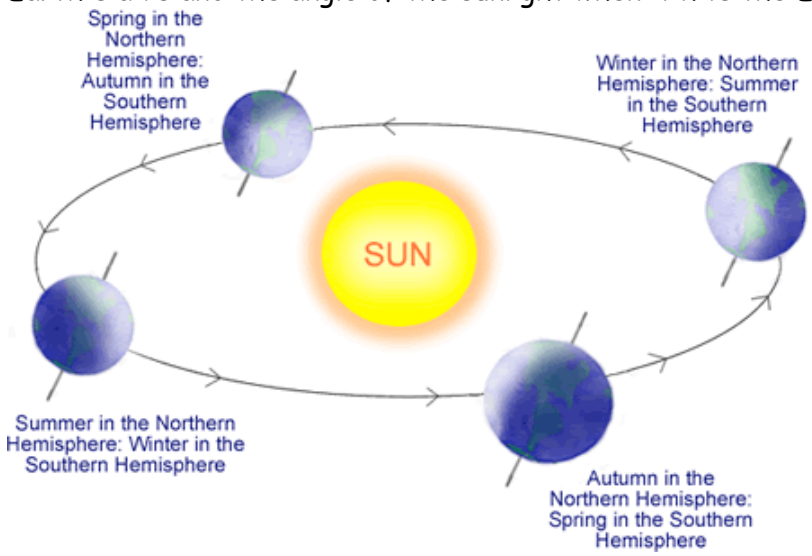
Earth's orbital path is created by two things: gravity and a sideways motion

Gravity is the same force that pulls us to the Earth and keeps our feet on the ground. If the Sun is pulling the planets, why don't they just fall into the Sun and burn up? Well, in addition to falling toward the Sun, the Earth and the other planets are also moving sideways. Without that sideways motion, Earth would fall to the center; and without the pull toward the center, Earth would go flying off in a straight line. The two forces work together to create an orbital path.



The Earth also has an axis, and it rotates on its axis every 24 hours. This is why there are 24 hours in a day. Revolution is when the Earth moves in a circle around the Sun, and rotation is when the Earth spins on its axis. Because the Earth rotates one time every 24 hours, at any point in a day, half of the Earth is facing the Sun and half of the Earth is facing away from the Sun. In North America, we have daytime when our continent is facing the Sun. North America has nighttime when our continent is on the side of Earth facing away from the Sun. So, when it is nighttime in North America, it is daytime in places on the other side of the Earth.

If we stood in the same spot outside for an entire day, it would look like the Sun was moving across the sky. It is really the Earth that is moving! As the Earth rotates toward the Sun, we see a sunrise, and as it rotates away, we see a sunset. The Sun appears to be directly above us in the sky at noon. In the picture above, the girl sees the Sun rise in the east because the Earth is rotating. She sees the Sun directly above her at noon, and the she sees the Sun set in the west - all because of the Earth's rotation. So, we know that the Earth's rotation causes day and night. The Earth's revolution around the Sun also causes our seasons. The different seasons on Earth are caused by two things: the tilt of the Earth's axis and the angle of the sunlight when it hits the Earth.

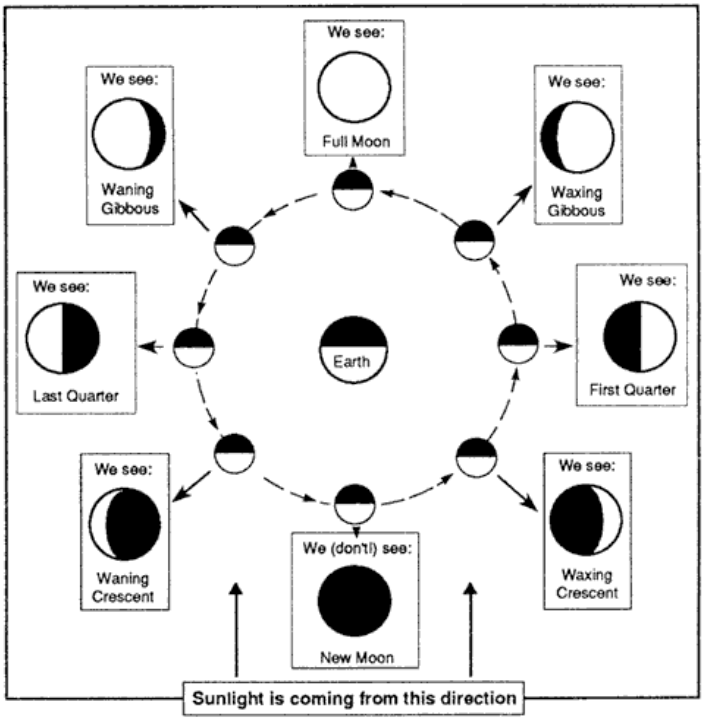


The Earth is not positioned straight up and down - it is tilted at an angle. The closer the Earth is to the Sun, the warmer it will be. So, for example, when the Earth is tipped towards the Sun, the northern hemisphere has summer. Summer in the northern hemisphere brings longer days (over 12 hours of sunlight a day!) and shorter nights. The sunlight during the summer is also hitting the Earth head on, which heats that part of the Earth. At the same time of the year, the southern hemisphere is having winter, which means less hours of daylight. The sunlight is not striking the southern hemisphere head on at that time, which causes less heating of the Earth in the southern hemisphere.

Moon Dances

We just learned that when one half of the Earth is lit up by the Sun, the other half of the Earth is dark. Because the moon revolves around the Earth and rotates on its axis at the same rate, on Earth we only see one side of the moon. The side we never see is called the "Dark Side of the Moon." This is not a very good name because the side of the Moon we never see gets light from the Sun, but we never see it. There are eight phases of the Moon, and the Moon cycles through all eight phases every 29 1/2 days. This is almost once a month.

Phase 1 - New Moon
Phase 2 -Waxing Crescent Moon
Phase 3 - First Quarter Moon
Phase 4 - Waxing Gibbous Moon
Phase 5 - Full Moon
Phase 6 - Waning Gibbous Moon
Phase 7 - Last Quarter Moon
Phase 8 - Waning Crescent Moon



What about gravity on the Moon? Gravity helps to keep the Earth orbiting around the Sun. In the same way, gravity helps to keep the Moon orbiting around the Earth. Remember, smaller objects orbit larger ones. The Moon is smaller than Earth, so the pull of gravity from the Earth is stronger. Does the Moon have gravity? Could objects be attracted or pulled towards the Moon by its gravity? Yes, but the gravity on the Moon is only 1/6 of that on the Earth. So, on the Moon, you would only weigh 1/6 of your weight on Earth.