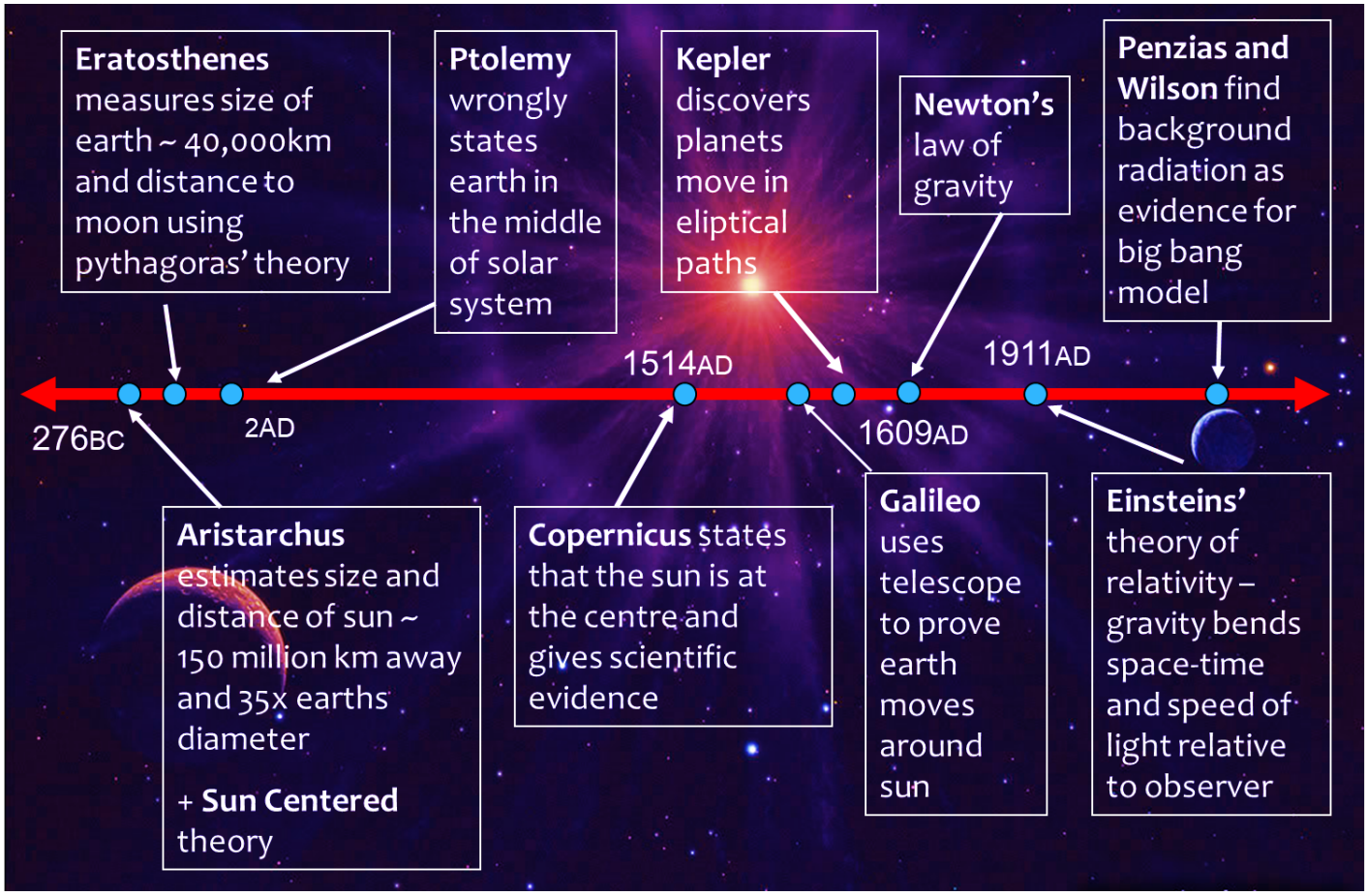
Knowledge about our Earth and its place in the Solar System has accumulated by Scientists over thousands of years

Humans have always looked up at the stars and sky and tried to make sense of what they saw. Before we started to use the process of science to explain how the world around us worked, we had many myths and legends to help us understand what we could observe and how it came to be.

Ranginui (Rangi) the Sky Father and Papatuanuku (Papa) and the Earth Mother embrace in darkness. Their children soon become restless and worn out from the living conditions. Tanemahuta (Tane) wishes to separate the mother and father. Most of the sons finally agree with the plan and the children begin to divide Rangi and Papa, even though their task is very difficult. Tane finally succeeds as he places his shoulders against the earth and his feet against the sky. Now that the separation is complete, there is a clearly defined sky and earth.



The Big Bang Theory is currently accepted explanation of the beginning of the universe

Most astronomers believe that the universe came into existence in a single moment – called the Big Bang theory. Latest research has the Universe dated at 13.8 billion years old.

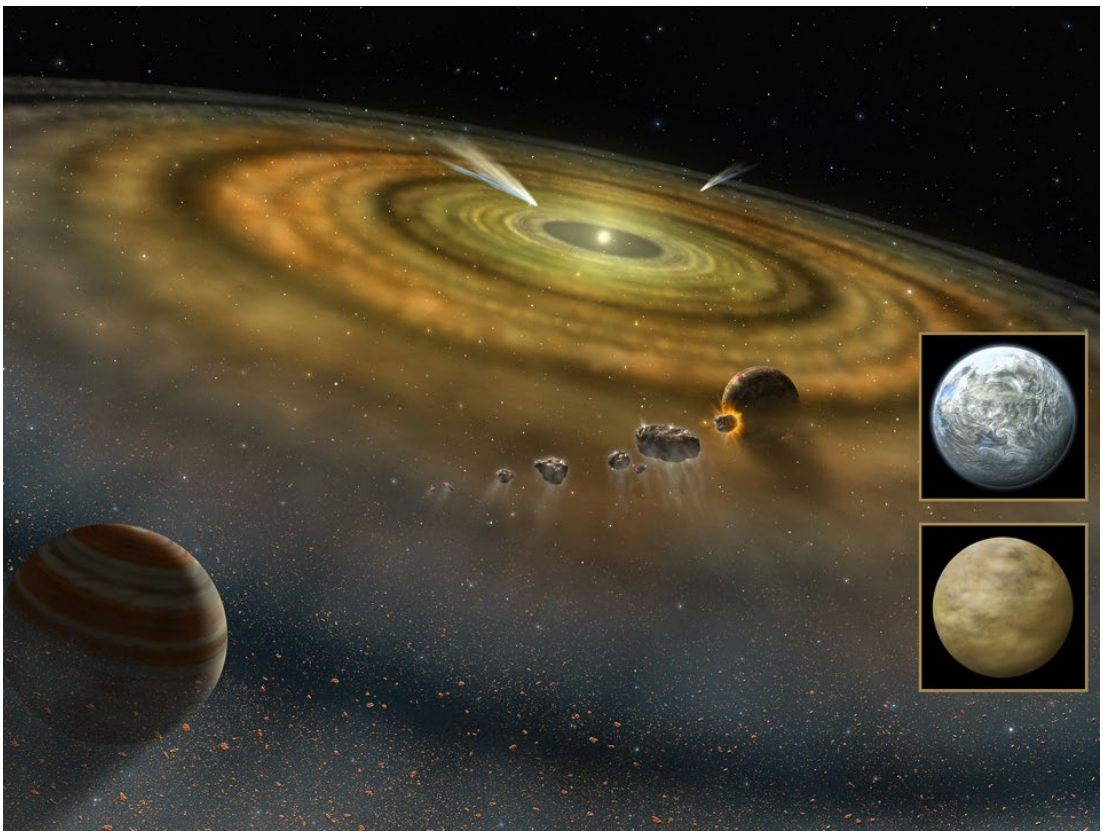
The Big Bang theory states that the universe started as just an extremely concentrated point of energy. This began to expand extremely rapidly in all directions and matter formed out of the energy. All the sub-atomic particles in the universe were made in the first few minutes. As the universe cooled, the sub-atomic particles formed Hydrogen and Helium atoms. This matter formed the raw material for stars and galaxies.

Penzias and Wilson and their evidence for the Big Bang theory

Penzias and Wilson find background radiation in 1964 using a radio telescope, as evidence for **Big Bang** model. The microwaves they discovered are from the left-over EM radiation waves first released from the Big Bang. The Big Bang theory for the origin of the universe now becomes widely accepted.

Making of the Solar System

Around 4.6 billion years ago, our Solar System was formed from a huge cloud of stardust (debris from older exploded stars) contracted under gravity. The mass began to spin as it contracted – much like a figure skater – and formed a disc with a bulge at the center. The bulge developed into the sun, which contains 99% of the Solar System mass. The Sun got hotter as the material compressed together, until finally it was hot enough for a nuclear reaction to start.



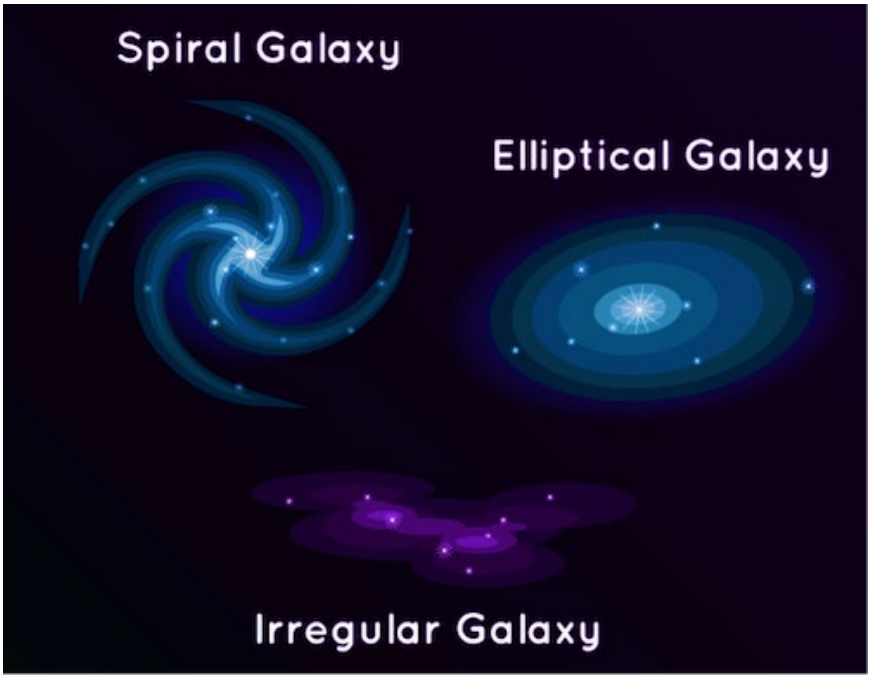
The Earth, Sun, Planets and stars have all formed from matter left over from the Big Bang

The remaining material was flung out along a **single plane** and material lumped together at various distances from the sun to form planets.

The gravity created by the planets mass causes the planets to become spheres.

The gravity of the sun causes the planets to orbit the Sun rather than traveling away. Moons around planets were created in a similar way to the planets around the Sun.

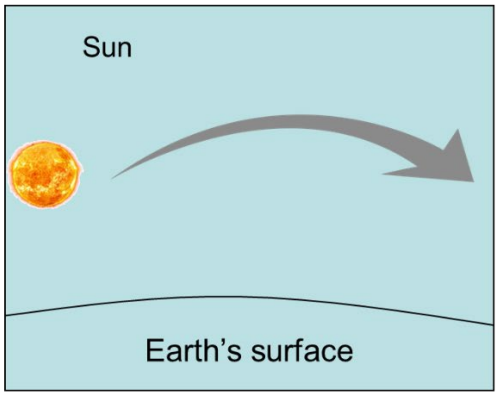
Our Galaxy "The Milky Way"



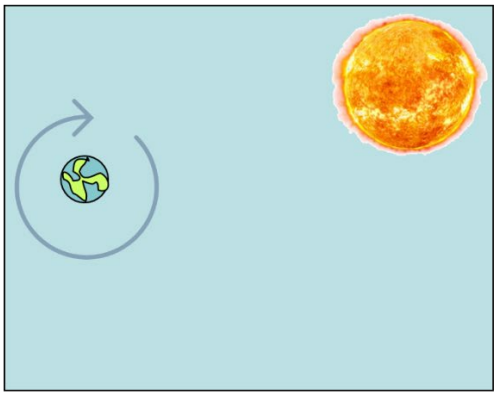
Our Sun, and the planets orbiting around it, is just one of an estimated 100 – 400 billion other stars that make up our Galaxy called the Milky Way, many of them also having planets. A galaxy is made up of billions of stars as well as gas and dust. The components of the galaxy are held together by gravitational attraction and move together. There are estimated to be around one hundred billion galaxies in the Universe. The shape of our galaxy is called a spiral., but galaxies come in many different shapes and sizes.

The daily and annual movements of Earth

Actual movement of heavenly bodies occurs when they are moving from one point to another through space. Apparent movement occurs when stationary objects appear to move across the sky due to the motion of the Earth.



Apparent movement of the sun across the sky during the day.



Actual movement of Earth and Sun

Why do the Stars move across our night sky?

From Earth we can see stars in the sky – it is difficult to see them during the day because the sunlight overpowers the starlight, but they are still there.

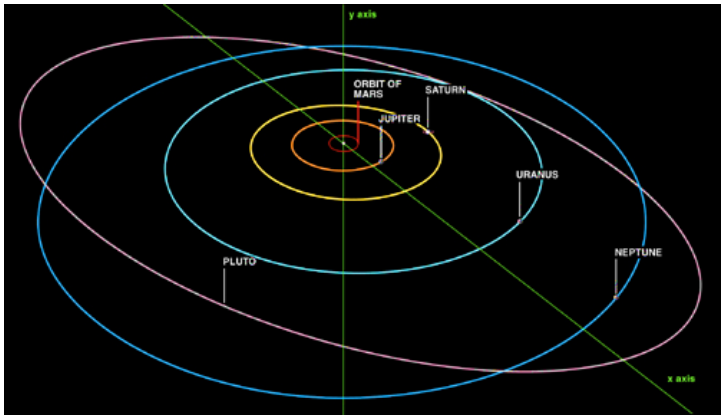
Stars do move but because they are so far away from us, we cannot normally detect this easily. It is because the earth is moving. Earth spins on its axis once every 24hours eastwards. Earth orbits around the sun once every year.

A year is one complete orbit of the Sun

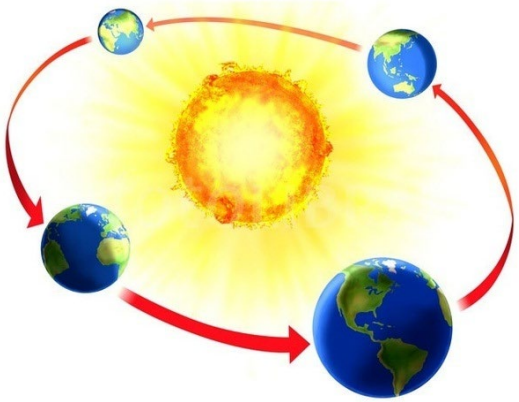
The Earth completes an entire orbit around the sun in 365 days. A year is the period of one revolution of a planet's orbit. Different planets have different lengths of time to complete one orbit or year. All planets in the solar system orbit around the Sun.

The year length of planets differ

The planets orbit around the Sun in the same direction - counter-clockwise. They also orbit around on the same plane (except for the dwarf planet Pluto which appears to have been "knocked off course" by another object in the past. The closer to the Sun, the shorter a Planet's year is.



The Earth orbits around the Sun, like the other planets, and the Moon orbits around the Earth



Planets orbit stars. Planets do not give off their own light, but they reflect light from stars. Earth **orbits** the Sun once every 365.25 days. (1 year). Earth **spins** anti-clockwise on an axis at 23.5° to the plane it orbits around the sun. Earth takes 24 hours to complete one rotation, only one-half of Earth is exposed to light from the sun at any given time; creating periods of **day and night**.

The Sun is the closest star to the Earth

A star is a mass of extremely hot gas. It gives off heat and light energy produced by nuclear reactions.

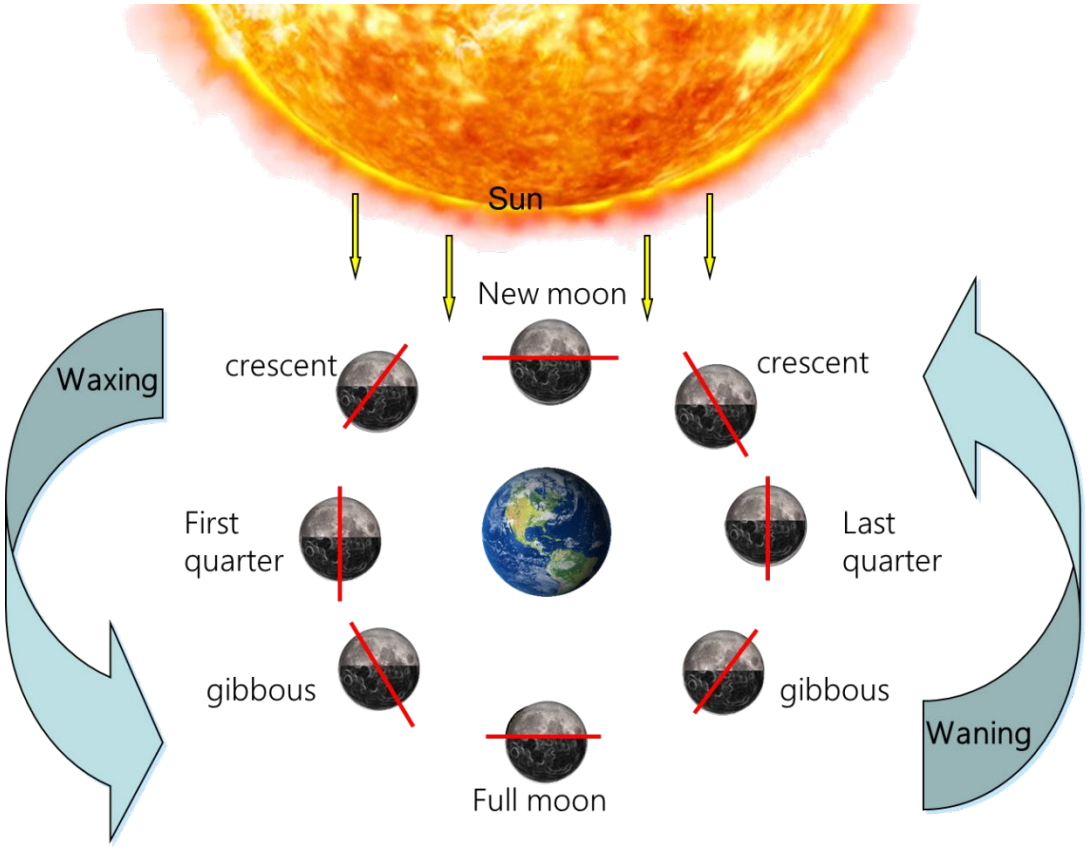
- ❑ The sun consists of extremely hot gases held together in a sphere by gravity.
- ❑ Nuclear reactions occur inside the sun
- ❑ Hydrogen is changed into helium
- ❑ Huge amounts of energy are released
- ❑ The interior temperature is 14 million °C
- ❑ The surface temperature is 5,800 °C
- ❑ The sun emits radiant energy (light/heat)

The Earth has one natural satellite, The Moon.

A satellite is the name given to a small object that orbits a planet. Planets have their own natural satellites called moons. The Mass of the planets results in gravity, causing the moons to orbit. Earth has just one moon – called the Moon. The Moon is made of solid rock and is covered in craters. The Moon's gravity pulls at the earth (the water moves towards it, but solid earth cannot) and creates tides twice a day. The Moon spins on its axis at exactly the same rate as it orbits around the Earth, so we only ever see the same side facing us. There is no dark side of the Moon because all parts of it eventually receive sunlight.

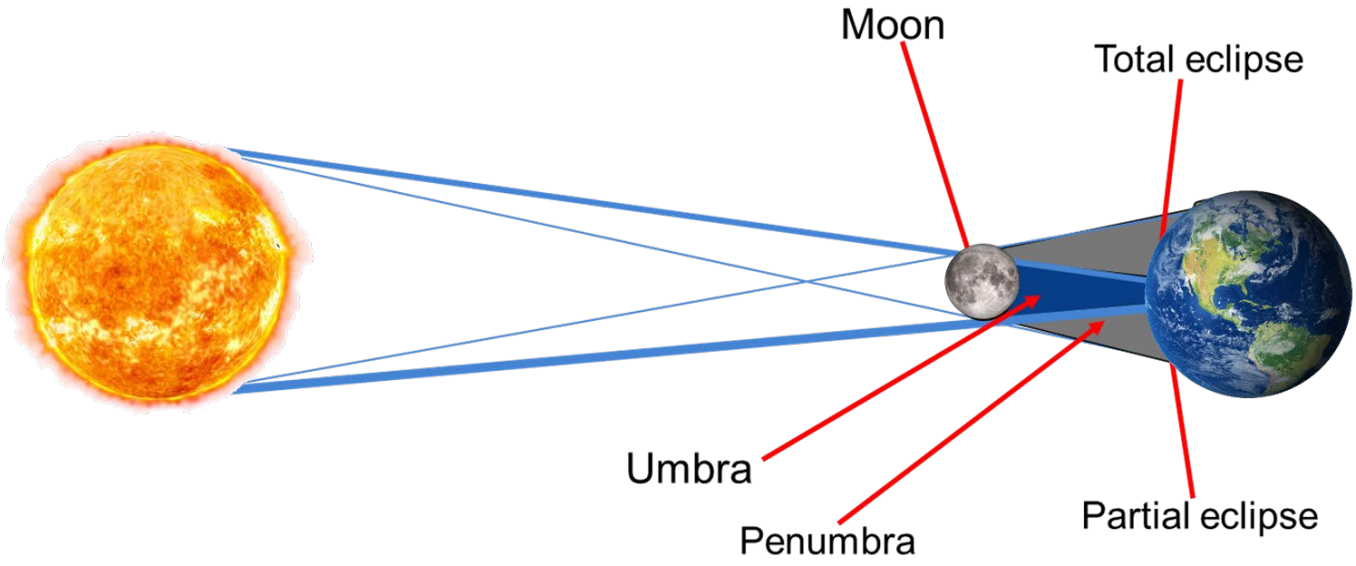
The Lunar cycle and the phases of the moon

As the Moon moves, it appears to change shape. One half is always lit by the Sun, but we can see varying lit portions from Earth's surface. These different shapes are called the **phases of the Moon**, and one cycle takes 28 days.



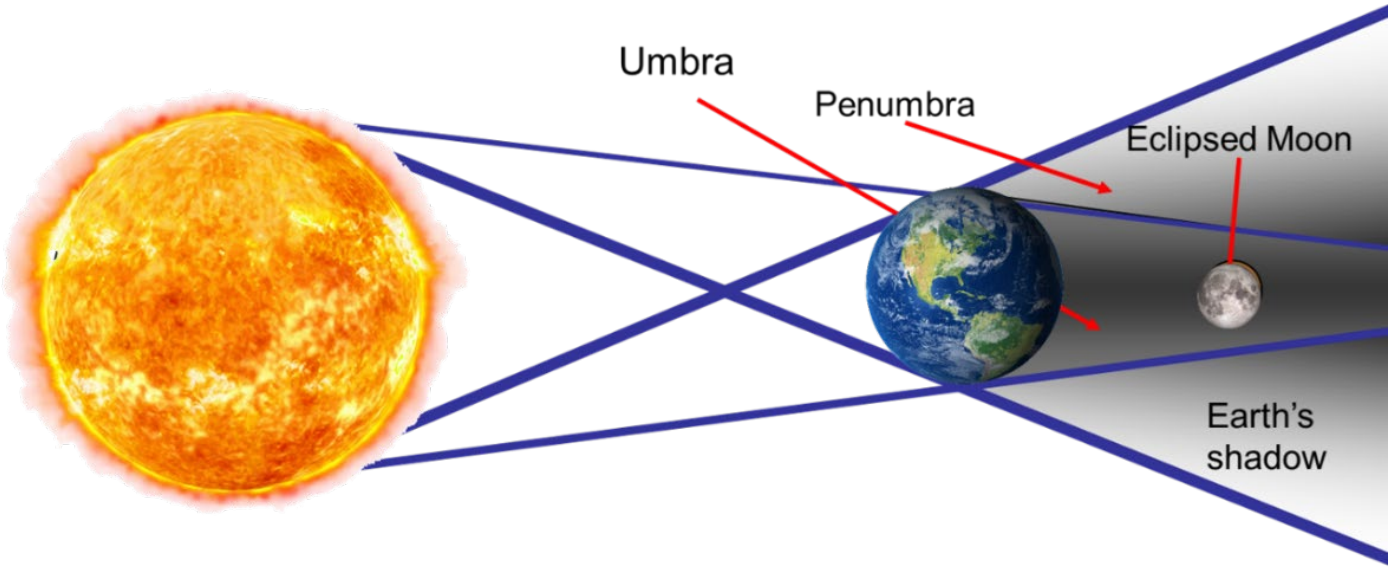
Eclipses occur when one body in space moves into the shadow of another body

Solar eclipses occur when the new Moon passes between the Sun and Earth. Total solar eclipses are very rare events as the Moon is so small in comparison to the distance to the Sun. A total eclipse allows us to see the corona (outside layer) of the Sun and Stars behind the Sun, whose light is bent by gravity. Einstein used this observation during a total eclipse as evidence for his theory of general relativity.



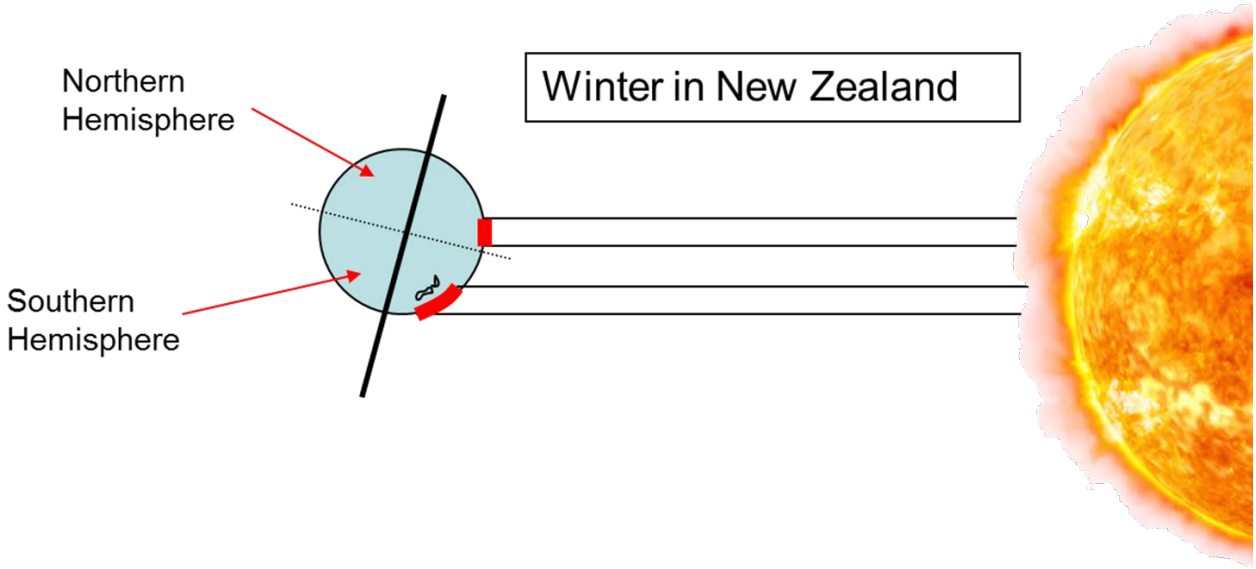
Lunar eclipses occur when a full Moon moves into the shadow of the Earth

Earth's axis is tilted some 23.5 degrees against the Earth–Sun plane (which causes the seasons); and the Earth–Moon plane is tilted about 5 degrees against the Earth-Sun plane (without a tilt, there would be an eclipse every two weeks, alternating between lunar eclipses and solar eclipses).



The tilt of the Earth's axis causes seasons

Earth's distance from the sun has little to do with the seasons. The seasons are caused by the tilt of the earth on its axis as it revolves around the sun. The earth is tilted at a 23.5 degree angle from a vertical axis drawn perpendicular to the plane of the earth's orbit around the sun. This tilt causes some parts of the earth to get slanting rays of sunlight some of the year and vertical rays of sunlight at other times.



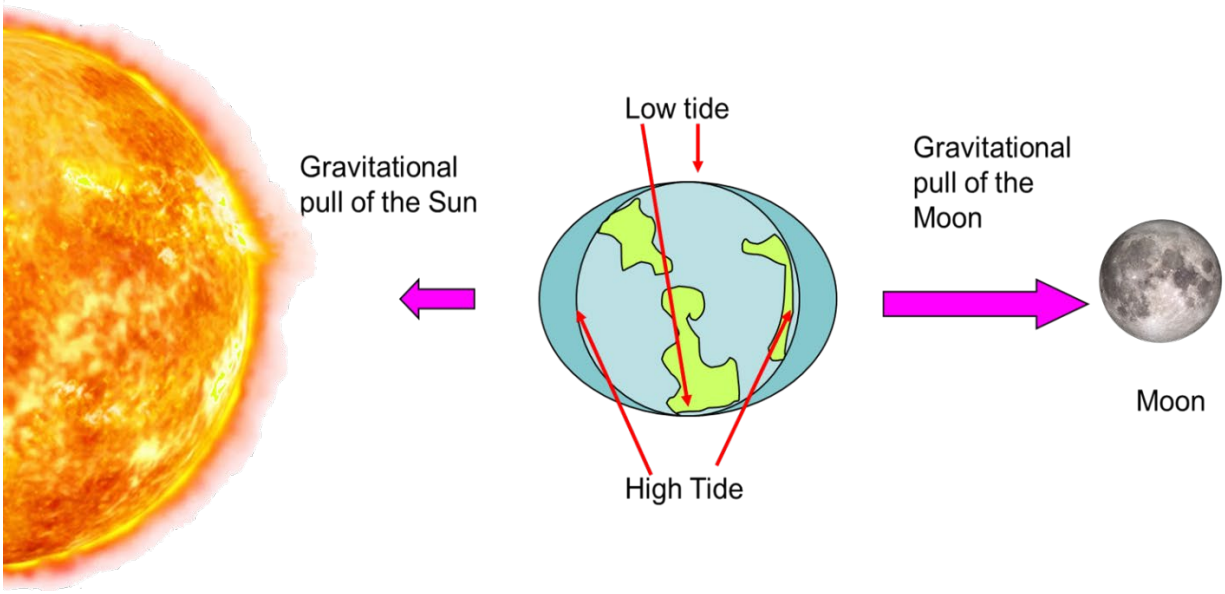
When a hemisphere of the earth is tilted toward the sun, it is summer in that hemisphere. When it is tilted away from the sun, it is winter. Energy from the sun, in the form of radiant energy, is spread over a larger area of the earth that is tilted away from it – this makes the energy less concentrated – therefore we feel less warmth and light (winter).

Tides on Earth are caused by the gravitational pull of the Moon (and to a lesser extent, the Sun.)

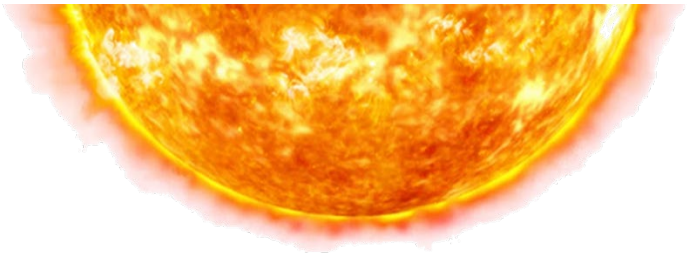
The Mass of both the Earth and Moon create gravity which pulls the two together. As the water on the Earth is much freer to move then we see this bulge slightly towards the Moon creating tides. Due to a number of factors including the spin of the Earth the water on the opposite side of the Earth also bulges out.

Because the bulge of water remains in the same position relative to the Moon and the Earth spins once every 24hours then we experience two high tides each 24hours as we move past the position of the two bulges of water.

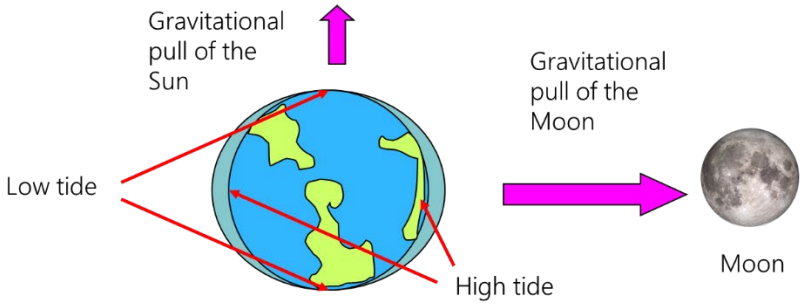
Spring or Neap tides are created due to the positions of the Moon and the Sun in relation to Earth



A **spring** (or King) tide is created when the gravitational pull of the Moon and the Sun, due to their positions, work together to produce an extra-large tidal difference. This occurs at full Moon as above and New Moon when the Moon and Sun are on the same side as earth.

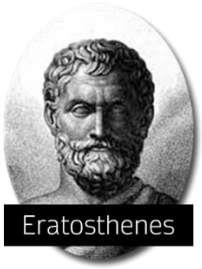


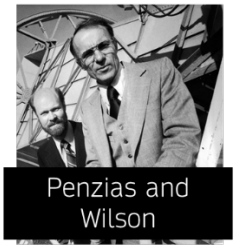
A **Neap** tide is created when the gravitational pull of the Moon and the Sun, due to their positions, cancel each other out to some extent, to produce an extra small tidal difference. This occurs at first quarter and third quarter positions when we only see half the lit Moon in the sky.

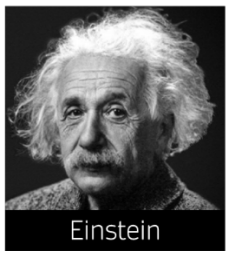


1. Match the names of the famous philosophers and scientists to the approximate dates of their major Astronomy discoveries.

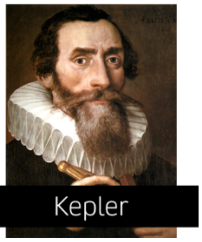

Copernicus

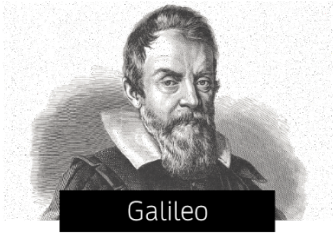

Eratosthenes

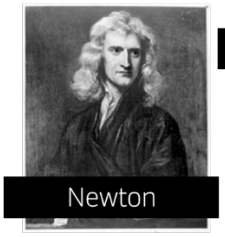

Penzias and Wilson

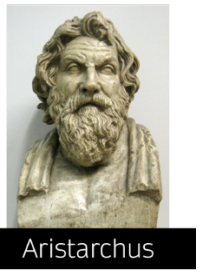

Einstein


Ptolemy


Kepler


Galileo


Newton


Aristarchus

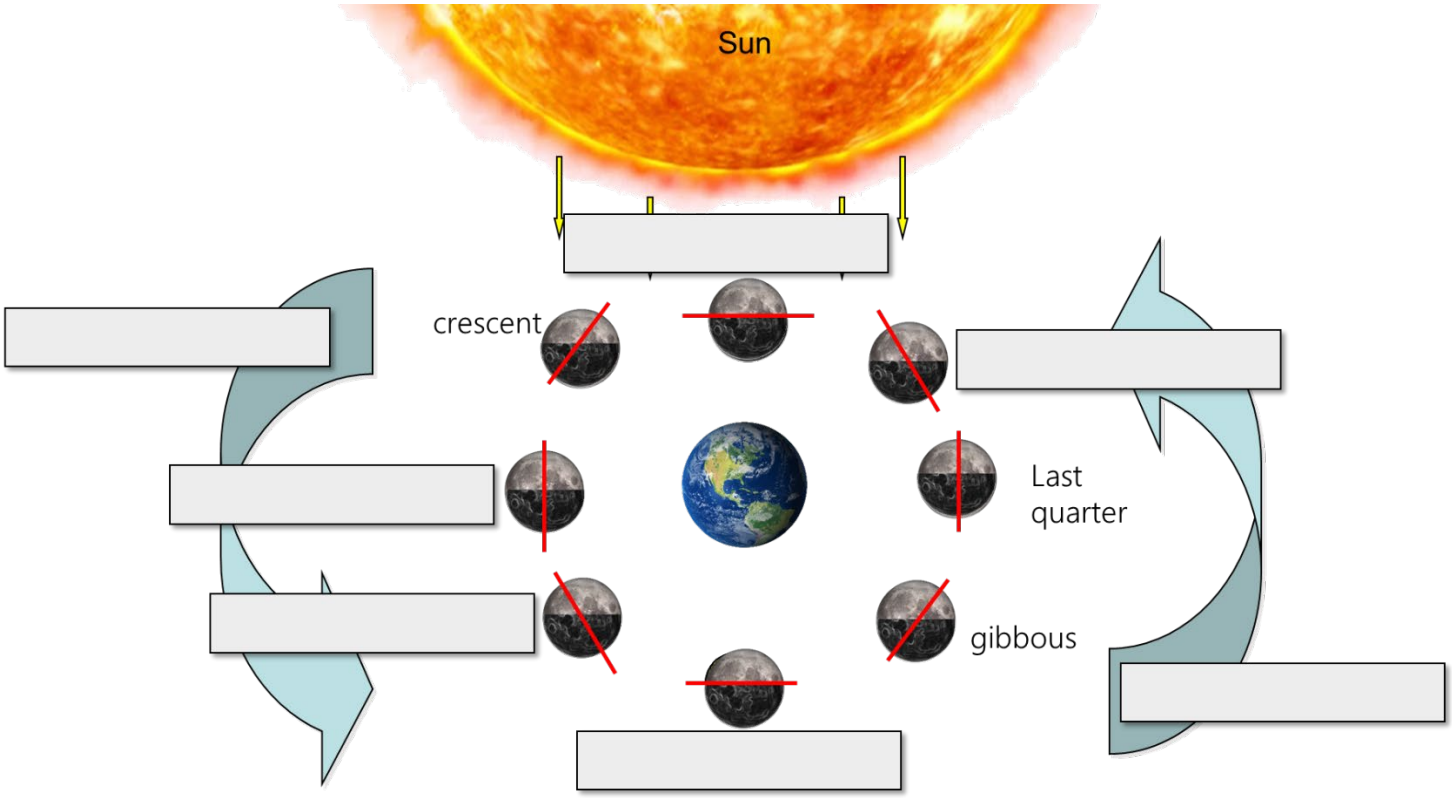
Date	250BCE	200BCE	150AD
Name			
Date	1500	1590	1610
Name			
Date	1687	1911	1964
Name			

2. Rule a line to connect each astronomy term to the correct definition.

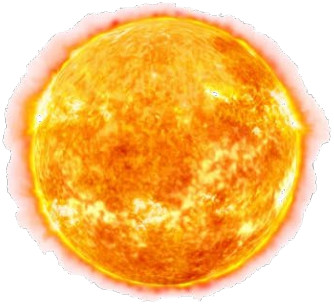
Term	Definition
Milky Way	Stationary objects appear to move across the sky due to the motion of the Earth.
A day	An entire orbit around the sun
A month	The star at the centre of our solar system
A year	The natural satellite of Earth
Apparent movement	One complete rotation of a planet on its axis
The Sun	Occurs when one body in space moves into the shadow of another body
The Moon	Our home galaxy made up of billions of stars as well as gas and dust.
Earth's tides	Approximately one complete orbit of the Moon around the Earth
An eclipse	Caused by the gravitational pull of the Moon (and to a lesser extent, the Sun.)

3. Complete the labelled diagram showing phases of the Moon

full moon	new moon	gibbous	crescent	first quarter	waxing	waning



4. Draw the lines from the Sun to show the area on the earth that has a **total eclipse** and the area that is a **partial eclipse** – shade these areas



5. In your own words complete the explanation for why we have **seasons** on Earth. Use the notes above to help.

Include the terms: tilt, direct rays, slanted rays, in your explanation.

The seasons are caused by _____ as it revolves around the sun.

In Summer, New Zealand has _____

In Winter, New Zealand has _____