Physics Knowledge Organiser
Space

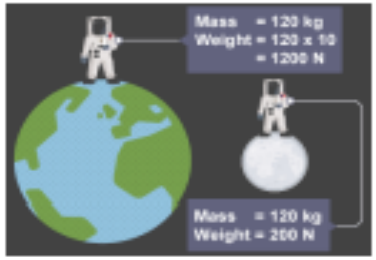
KPI 9.1: Describe the properties that affect the sizes of gravitational forces between different objects in the Solar system
KPI 9.2: Calculate the weight of an object on different planets

Gravitational forces
There is a gravitational force of attraction between all objects. However this force only becomes important when the objects are very large. For example planets, stars and moons.
The size of the gravitational force between objects depend on two things:
1. **How large the objects are**
2. **How far away the objects are from each other**

For example all the planets are attracted to the Sun by a force of gravitational attraction, this keeps them in orbit and prevents them from flying off into space.
The Moon is also kept in orbit with the Earth due to gravitational attraction. As the Earth is much smaller than the Sun it can only keep the Moon in orbit as it is very close to the Earth.

Mass and Weight
Mass measures how much material there is (in kg), whereas weight measures the **force** acting on an object due to a **gravitational field**. Therefore the mass of an object **never changes.**

The weight of an object depends on **the gravitational force** that is acting on it and can therefore change. The diagram below shows the difference between mass and weight, not how the astronauts mass remains constant but their weight is much lower on the Moon.



Key Terms	Definitions
Mass	Mass measures the amount of material in an object, and is measured in kilograms (kg).
Weight	Weight is a **force**, caused by gravity acting on a mass. Since it is a force, it is measured in Newtons.
Gravitational Field Strength	The measure of how strong the gravitational field of a large object is. For instance, the gravitational field strength on Earth is about 10 N/kg. This means that a weight of 10 N acts on each kg of mass on Earth.

Equation	Meanings of terms in equation
$W = m\,g$	*W = weight (Newtons, N)* *m = mass (kilograms, kg)* *g = gravitational field strength (Newtons per kilogram, N/kg) – on Earth, this is about 10 N/kg)*

Weight on different planets
All planets have a gravitational field strength. This is a measure of how much force another object will experience.
To calculate an objects weight you **multiply the mass of the object by the gravitational field strength of the planet** (see the equation in the box above).
Below is an example of how much a 50kg mass would weigh in different parts of the solar system.
When an object is in Space we say it is **weightless** as the force of gravity felt by the object is very small.

Planet	Weight of the 50 kg crate
Mercury	190 N
Venus	440 N
Earth	500 N
Mars	190 N
Jupiter	1245 N
Saturn	520 N
Uranus	520 N
Neptune	690 N
Pluto	14.5 N

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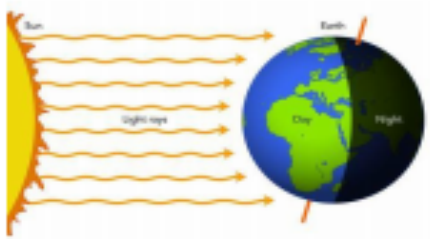
KPI 9.3: Explain why we experience seasons

Key Terms	Definitions
Axis	The imaginary line in the Earth between North and South pole
Day	The time taken for a planet to rotate once on its axis. On Earth this is 24 hours.
Year	The time taken for a planet to completely orbit the Sun. It takes Earth 365.25 days.

Day and Night and Years

The Earth takes 365 ¼ days to orbit the Sun, we call this **a year**. The length of a year is different on other planets. If the planet is further from the Sun the length of a year is longer, for example Jupiter takes 12 Earth years to orbit the Sun. This is because Jupiter has to travel much further in its orbit.

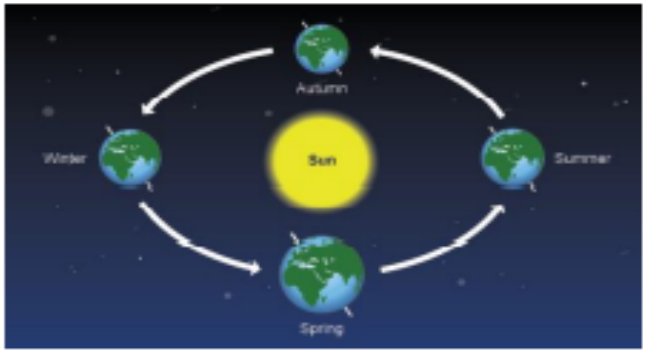
The Earth is constantly rotating on its axis (the imaginary line between the North and South pole). It rotates once every 24 hours, we call this **a day.** During this time, half of the Earth will be facing the Sun, this half of the Earth will be in daylight, the side not facing the Earth will be in night.

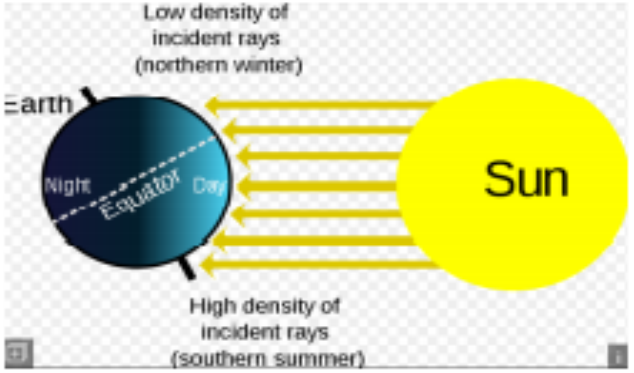


The seasons

The Earth's axis (the imaginary line between the North and South pole) is tilted slightly, the angle of the tilt is approximately 23°.This means that different parts of the Earth are tilted towards or away from the Sun at different times of year.

- When the northern hemisphere is tilted towards the sun we get summer in the UK (longer days and warmer temperatures). It will be Winter in the southern hemisphere.
- When the northern hemisphere is tilted away from the sun we get winter in the UK (shorter days and colder temperatures) It will be Summer in the southern hemisphere.
- During the Summer the Sun appears higher in the sky and the day is longer. During the Winter, the Sun appears lower in the sky and the day is shorter.





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KPI 9.4: Compare the relative sizes of different astronomical structures within the universe using astronomical distances

Our solar system

Our solar system consists of:

- One star: the Sun (the Sun is about 100 times larger than Earth);
- Eight planets, which orbit the Sun;
- Dwarf planets, such as Pluto, which also orbit the Sun;
- Natural satellites: the moons that orbit some of the planets;
- Other objects like asteroids and comets.

Our solar system is a very small part of the Milky Way galaxy. Galaxies consist of millions of stars, held together by their gravitational attraction to one another.

The order of the objects in terms of size is:

asteroid → moon → planet → star → solar system → galaxy

Theories on the formation of the Solar System

Human's understanding of the Solar System has developed. The Greek astronomer Ptolemy proposed the **geocentric model**, which placed the Earth at the centre of the Solar System, with other stars and planets orbiting the Earth, while the Earth remained stationary.

In the 17th century Galileo invented the refracting telescope, with this he observed Jupiter and observed that Jupiter had Moons. This showed that not everything orbited the Earth. This led to the development of the **heliocentric** model of the Solar System, this time the Sun was stationary and at the centre, whilst the planets orbited the Sun. This was proposed by the scientist Copernicus

The heliocentric model was an improvement but using modern telescopes we now know much more about the Universe and have discovered that our Solar System is also rotating as part of the Milky Way Galaxy.

Key Terms	Definitions
Star	A huge (compared to Earth) sphere of superhot gas (plasma).
Planet	A spherical object much smaller than a star, made of rocky or gaseous material , which orbits a star.
Dwarf planet	Small planets that have not cleared their orbit of other material. Like planets, they orbit a star.
Galaxy	A huge number of stars held together by their gravitational attraction to one another. Our galaxy is called the Milky Way.
Astronomical Unit	Distance between the Earth and the Sun
The Universe	Is all of space and time
Light year	The distance travelled by light in one year.

Light Years

The distances between objects in the Universe are so large that we do not use units like kilometres instead we use **the light year**.

A light year is a measure of distance equal to the distance light travels in one year (9400000000000km).

The distance between the Sun and our nearest other star Alpha Centuri is 4.22 light years.

The distance between the Milky and our nearest other galaxy Andromeda is 2.5 million light years.

In our Solar System, **the Astronomical Unit (AU)** is often used as a unit of measurement. 1 AU is the distance from the Earth to the Sun or 149597870 km. . The distance between Mars and the Sun is approximately 1.52 astronomical units.