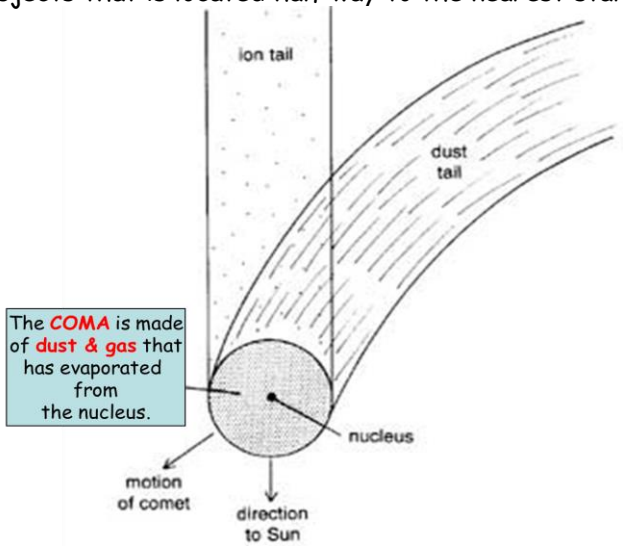
Astronomy **Summary Knowledge Organiser** – Ch. 5 (Topic 11) **Exploring the Solar System (I) Planets, comets & meteors**

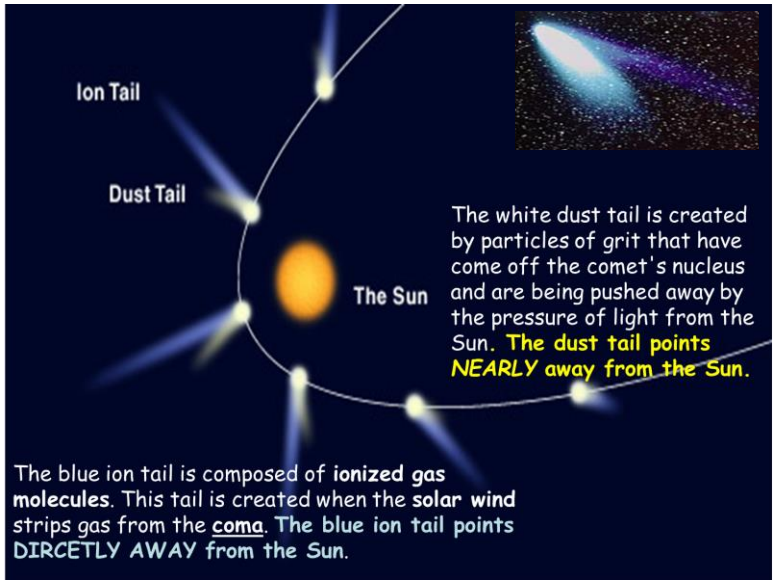
Name	Type of body	Mean distance from Sun/AU	Sidereal period/ Earth year	Mean temperature /°C	Diameter /1000 km	Mass/ Earth mass	Ring systems	Moons
Mercury	planet	0.38	0.24	170	4.9	0.55	no	none
Venus	planet	0.72	0.62	470	12.1	0.82	no	none
Earth	planet	1.0	1.0	15	12.8	1.00	no	1: the Moon
Mars	planet	1.5	1.9	−50	6.9	0.11	no	2 small moons: Deimos and Phobos
Ceres	dwarf planet	2.8	4.6	−105	0.95	1.5×10^{-4}	no	none
Jupiter	planet	5.2	11.9	−150	143	318	yes	4 major moons: Ganymede, Callisto, Europa, Io >60 others
Saturn	planet	9.5	29.5	−180	121	95	yes	5 major moons: including Titan, Iapetus >55 others
Uranus	planet	19.1	84.0	−210	51	15	yes	5 major moons: including Titania, Oberon >20 others
Neptune	planet	30.0	165	−220	50	17	yes	1 major: Triton >12 others
Pluto	dwarf planet	39.5	248	−230	2.4	2.2×10^{-3}	no	1 major: Charon >4 other moons
Haumea	dwarf planet	43.1	283	−241	1.4	6.7×10^{-4}	no	2
Eris	dwarf planet	67.8	557	−230	2.3	2.8×10^{-3}	no	at least 1

The **4 inferior terrestrial planets** are **relatively small** and have **iron cores**. *Inferior*- they orbit the Sun closer than Earth.
The **4 superior gaseous giant planets** have **liquid interiors** and huge **atmospheres** made of mainly **Hydrogen (H_2)** and **Helium (He),** along with traces of Methane (CH_4) and Ammonia (NH_3).
All 4 gas giants **have ring systems** and a **large number of moons**! *Superior* - orbit the Sun further away than Earth.
Dwarf planets – have **enough mass** that their own gravity is strong enough to make them **spherical** BUT have not managed to clear their orbit of debris.
Small Solar System Objects (SSSOs) include **asteroids** (irregular shaped rocky objects of diameter 10m to 1000km, they are mainly found in the doughnut-shaped asteroid belt between Mars & Jupiter), **meteoroids** (range from particles of dust to boulder sized (<10m) chunks of stone, ice & metal) and **comets** (dirty snowballs made of dust, rock and ICE).

There are **2 types of comets** –
SHORT PERIOD comets
take **less than 200 years** to orbit the Sun
orbit the Sun on a similar plane to the planets
originate from the **Kuiper belt**
LONG PERIOD comets
take **more than 200 years** to orbit the Sun
orbit the Sun on many different orbital planes that are highly inclined to those of the planets
originate from the **Oort cloud**(a spherical body of icy objects that is located half way to the nearest star!)



As comets approach the Sun a ***COMA*** of **gases & dust** forms and this shrouds the **NUCLEUS** (a small (approx. 10km diameter) body of **rack & ice**).
Tails also form that can be several **millions of km long**!



As comets approach the Sun, first a coma forms as gases evaporate from the icy nucleus and then closer to the Sun the 2 tails form. As the comet moves away from the Sun the tails will diminish and eventually fade from view.
The **ION tail – longer, straight & blue** – created when charged atoms(ions) become **excited** by collisions with particles in the **solar wind**, when the ions **de-excite** they emit light by fluorescence.
The **DUST tail – thicker but shorter, curved & white** – created when **solar radiation pressure** pushes particles out of the comets nucleus, these then **reflect sunlight** so the tail is visible. The dust tail is curved because the now 'free' grains of dust can follow their own independent solar orbit.

Meteor Showers These occur when the Earth (whilst orbiting the Sun) passes through a **meteoroid stream** left behind by a comet. As individual meteoroids enter the Earth's atmosphere at speeds ranging from **20-70km/sec**, air resistance converts the kinetic energy into thermal energy and they reach such a high temperature that they begin to **emit light**! The **streak of light** that they create in the sky is called a **meteor** (or shooting star). When we see a meteor shower the streaks of light **appear to diverge from the same single point in the sky**, this is called the **radiant**. The name of a meteor shower is given depending on in which constellation the radiant is located, eg. Perseus - Perseids meteor shower, Orion – Orionids meteor shower.
Large meteoroids originating from the asteroid belt, the Moon or Mars can sometimes create **very bright meteors** are called **fireballs.**
Meteoroids that **reach the surface** of Earth are called **meteorites,** they can be **stony** or **metallic** in nature..

Astronomy **Summary Knowledge Organiser** – Ch. 5 (Topic 11) **Exploring the Solar System (ii) Size, telescopes & probes**

Mean diameter of Earth	13 000 km
Mean diameter of Moon	3500 km
Mean diameter of Sun	1.4×10^6 km
One Astronomical Unit (AU)	1.5×10^8 km

1 A.U.is the <u>mean</u> distance from the Earth to the Sun.
It is **150 million km!**

Mean Earth to Moon distance	380 000 km
One light year (l.y.)	9.5×10^{12} km

One light year is the <u>distance</u> travelled by light in one year.

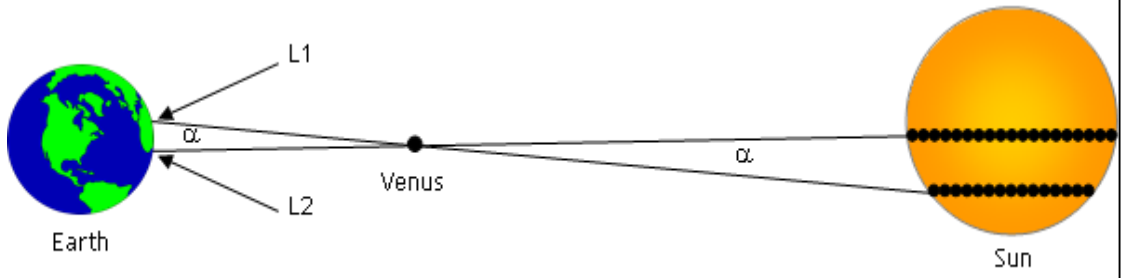
Light is very fast – it travels 300,000km in one second, that is the same as 300,000,000m/s.

Speed of light in vacuum	3.0×10^8 m/s

There are four major types of **space probe**:
- **fly-by**, the probe literally **flies past a target** and in most cases allows studies of many targets to be made;
- **orbiter**, such as NASA's *Magellan* probe that **orbited the planet** Venus and mapped its surface using radar;
- **impactors**, involving a **deliberate crash-landing** onto the target body;
- '**soft' landers** – these involve a **controlled descent** and a **safe landing** on the surface of the target body.

All probes have to be **launched** from Earth by **ROCKETS** which are the only machines powerful enough to overcome Earth's gravitational force and reach the required **ESCAPE VELOCITY** of **11.2 km/s** (when **on the Earth's surface**/launch pad). The escape velocity decreases as altitude increases. **More mass** in the rocket = **more fuel** burned!

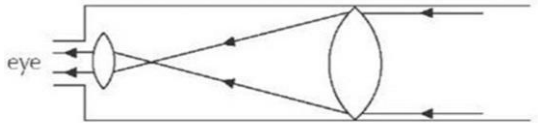
Although we knew the **<u>relative</u> scale of the solar System** astronomers did not know its **<u>absolute</u> scale,** until Edmond Halley demonstrated that if astronomers were viewing from different latitudes on Earth they would observe a **transit of Venus** moving across the Sun's disc on slightly different paths - Halley called the paths '**chords**'. This observed effect is known as **parallax** and it arises because different astronomers are viewing the Sun at slightly different angles from each other.



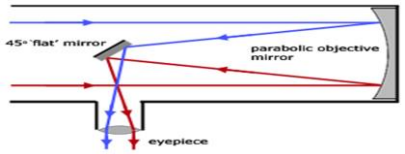
Because the Sun is a sphere, the chords would have different lengths from each other, depending on the latitudes from which the observations took place.
Halley showed that by applying **geometry**, the **angular difference between any two chords** could be calculated from the **difference in their lengths**; this in turn could be determined by the **difference between the two times taken to cross the solar disc**.

<u>Optical telescopes</u> – there are 2 types - **REFRACTORS** (have an **objective lens** and an **eyepiece lens**) and **REFLECTORS** (have an **objective <u>mirror</u>** and an **eyepiece lens**).

Keplerian refractor



Newtonian reflector



<u>Disadvantages of refractors</u>
The **objective lens cannot be made very large** (because they lose their shape due to gravity) so they cannot capture as much light as reflectors.
Some of the **light** that passes through the glass lenses **is absorbed**(dimmer image formed).
Lenses focus different wavelengths (colours) of light at different points which makes the images formed blurred and unclear, this is called **chromatic aberration**.

Aperture – the telescopes size – it is the **diameter of its objective lens or mirror**. Its role is to **capture as much light as possible** & to **focus it into a small bright image.**
Light grasp – a measurement of how much light is captured by a telescopes objective lens or mirror. It depends on the cross-sectional area of the objective. To <u>calculate light grasp</u> you simply **square the diameter of the objective**.
Eyepiece – **magnifies** the image created by the objective so objects can be seen in more detail and at an **higher resolution**. The **magnification** of a telescope depends upon the **<u>ratio</u>** of the **focal lengths of the objective and eyepiece.**

Remember, <u>both</u> focal lengths must be given in the **SAME UNITS!*

$$\text{magnification} = \frac{\text{focal length of objective element}}{\text{focal length of eyepiece}}$$