

# INTRODUCTION TO THE SOLAR SYSTEM

## THE SOLAR SYSTEM

The centre of the Solar System is the Sun. The Solar System is made up of the Sun and all the planets, asteroids, and other objects that orbit the Sun.

There are eight planets in our Solar System. Starting with the closest to the sun they are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

The closest four planets (Mercury, Venus, Earth, and Mars) are termed terrestrial planets, meaning they have a hard rocky surface.

The furthest four planets (Jupiter, Saturn, Uranus, and Neptune) are called gas giants.

These planets are much larger and their surface is composed of gas elements (mostly hydrogen).

The Solar System is part of a bigger grouping of stars called a galaxy. Our galaxy is the Milky Way.

The Solar System orbits around the centre of the Milky Way.

Other objects in the Solar System are:-

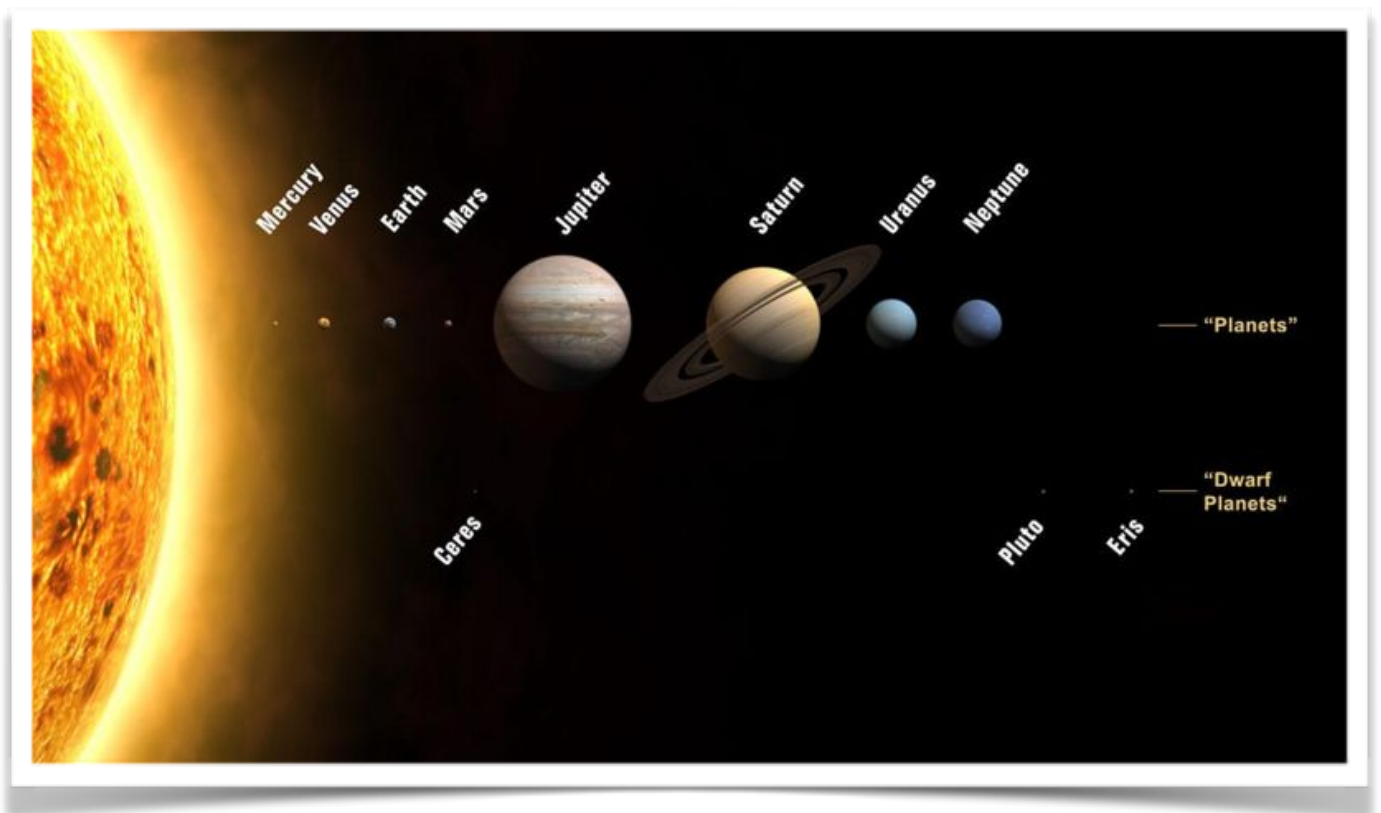
Dwarf Planets

Comets

Asteroid Belt

Kuiper belt

Oort cloud



## THE SUN

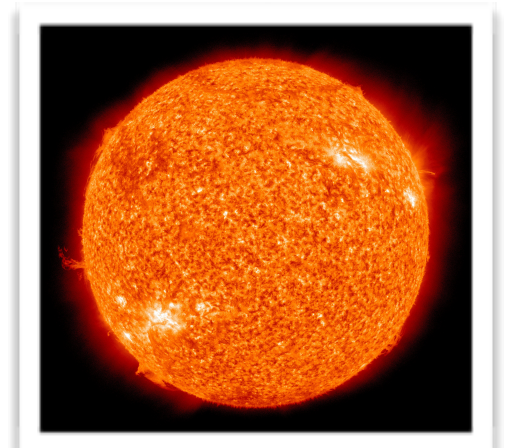
**Mass:** 333 thousand times the mass of Earth

**Diameter:** 109 times the diameter of Earth

**Temperature:** 5,500 degrees C (10,000 degrees F) on the surface

**Distance from Earth:** 93 million miles

**Age:** 4.5 billion years



## PLANET MERCURY

**Moons:** 0

**Mass:** 5.5% of Earth

**Diameter:** 3031 miles

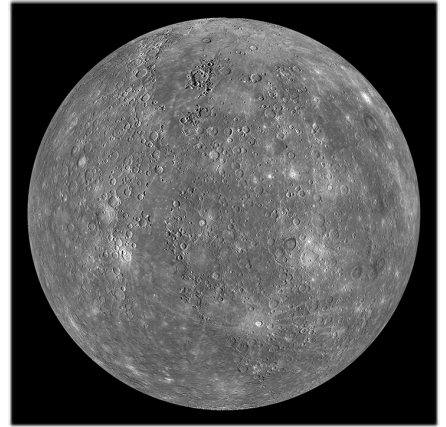
**Year:** 88 Earth days

**Day:** 58.7 Earth days

**Temperature:** -300 to +800 degrees F

**Distance from the Sun:** 1st planet from the sun, 36 million miles

**Type of Planet:** Terrestrial (has a hard rocky surface)



## PLANET VENUS

**Moons:** 0

**Mass:** 82% of Earth

**Diameter:** 7520 miles

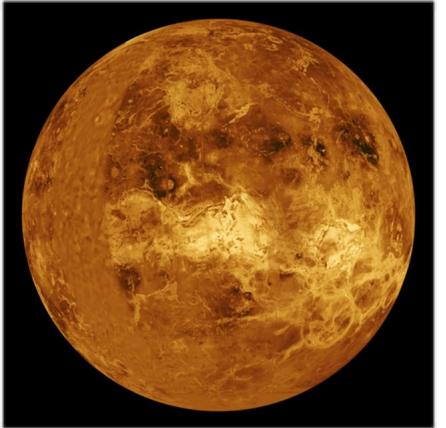
**Year:** 225 Earth days

**Day:** 243 Earth days

**Temperature:** 850 degrees F

**Distance from the Sun:** 2nd planet from the sun, 67 million miles - Venus spins in the opposite direction to all other planets.

**Type of Planet:** Terrestrial (has a hard rocky surface)



## PLANET EARTH

**Moons:** 1

**Mass:**  $5.97 \times 10^{24}$  kg

**Diameter:** 7926 miles

**Year:** 365.3 Days

**Day:** 23 hours and 56 minutes

**Temperature:** -125 to +130 degrees F

**Distance from the Sun:** 3rd planet from the sun, 93 million miles

**Type of Planet:** Terrestrial (has a hard rocky surface)



## PLANET MARS

**Moons:** 2 (Phobos and Deimos).

**Mass:** 11% of Earth

**Diameter:** 4217 miles

**Year:** 1.9 Earth years

**Day:** 24.6 hours

**Temperature:** -190 to +60 degrees F

**Distance from the Sun:** 4th planet from the sun, 142 million miles

**Type of Planet:** Terrestrial (has a hard rocky surface)



## PLANET JUPITER

**Moons:** 79 (and growing)

**Mass:** 318 times the mass of Earth

**Diameter:** 88,846 miles

**Year:** 11.9 Earth years

**Day:** 9.8 hours

**Temperature:** -170 degrees F

**Distance from the Sun:** 5th planet from the sun,  
484 million miles

**Type of Planet:** Gas Giant (composed mostly of  
hydrogen and helium)



## PLANET SATURN

**Moons:** 82 (and growing)

**Mass:** 95 times the mass of Earth

**Diameter:** 74,900 miles

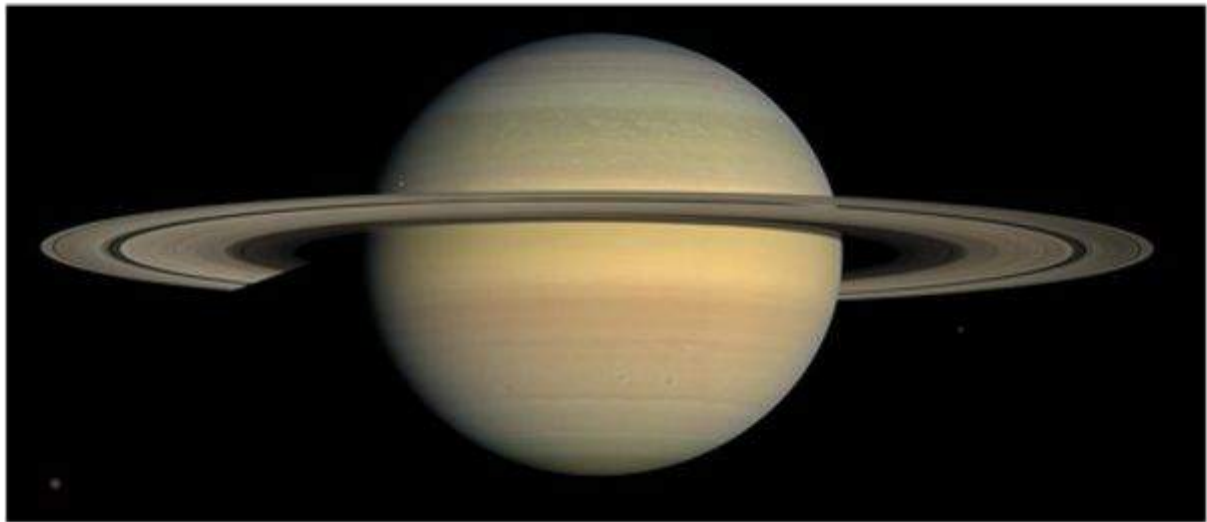
**Year:** 29.4 Earth years

**Day:** 10.7 hours

**Temperature:** -215 degrees F

**Distance from the Sun:** 6th planet from the sun, 887 million miles

**Type of Planet:** Gas Giant (composed mostly of hydrogen and helium)



## PLANET URANUS

**Moons:** 27 (and growing)

**Mass:** 14.5 times the mass of Earth

**Diameter:** 31,763 miles

**Year:** 83.8 Earth years

**Day:** 17.2 hours

**Temperature:** -280 degrees F

**Distance from the Sun:** 7th planet from the sun,  
1.8 billion miles

**Type of Planet:** Ice Giant (gas surface with an  
interior composed of ices and rock)



## PLANET NEPTUNE

**Moons:** 14 (and growing)

**Mass:** 17 times the mass of Earth

**Diameter:** 30,775 miles

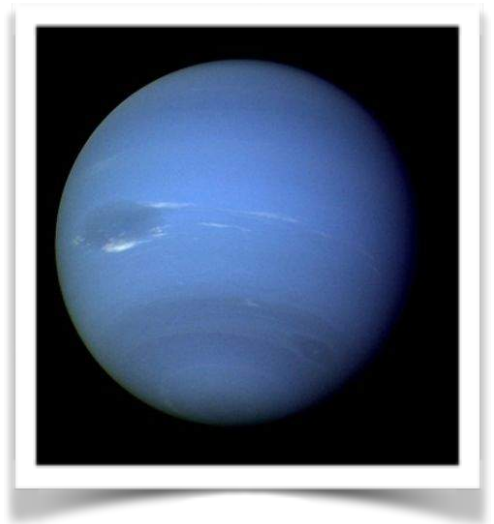
**Year:** 164 Earth years

**Day:** 16.1 hours

**Temperature:** -235 degrees F

**Distance from the Sun:** 8th planet from the sun,  
2.8 billion miles

**Type of Planet:** Ice Giant (gas surface with an  
interior composed of ices and rock)



## DWARF PLANET PLUTO

**Moons:** 5 known

**Mass:** .2% of Earth's mass

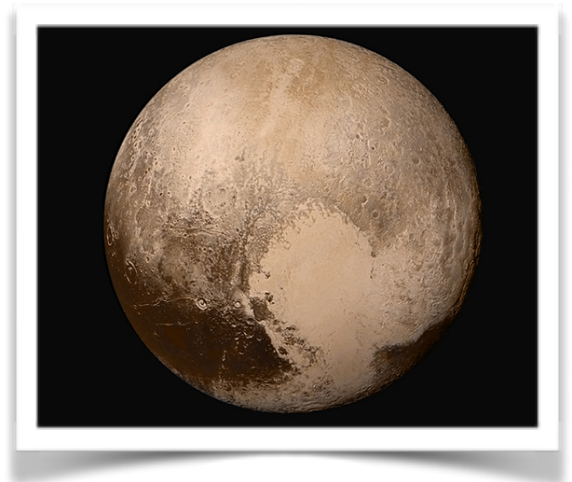
**Diameter:** 1450 miles

**Year:** 248 Earth years

**Day:** 6.4 Earth days

**Temperature:** -385 degrees F

**Distance from the Sun:** 3 - 5 billion miles from  
the sun.



There are a lot of mnemonics available on the internet giving the order of the planets

However I have found that Young People enjoy making their own up.

Remember that Pluto is now classed as a minor planet and is not included in “official” lists. But I still include it.

A couple of examples are given below:-

Mercury	- My	- My
Venus	- Very	- Vicious
Earth - Elderly	- Earthworm	
Mars	- Mother	- Might
Jupiter	- Just	- Just
Saturn	- Served	- Swallow
Uranus	- Us	- Us
Neptune	- Noodle(s)	- Now
(Pluto	- Pies	- Panic)

etc, etc.



## MOONS OF THE SOLAR SYSTEM

As a follow on from the Planets, you could talk about the moons orbiting some of the planets. A good website for details of planets, moons and solar system is - <https://solarsystem.nasa.gov>

Earth	- 1 moon	Mars	- 2 moons
Jupiter	- 79 moons	Saturn	- 82 moons
Uranus	- 27 moons	Neptune	- 14 moons
Pluto	- 5 moons		

## Constellations

Constellations are groups of stars that appear from our Earthly point of view to form patterns. The groups of stars are also called an asterism.

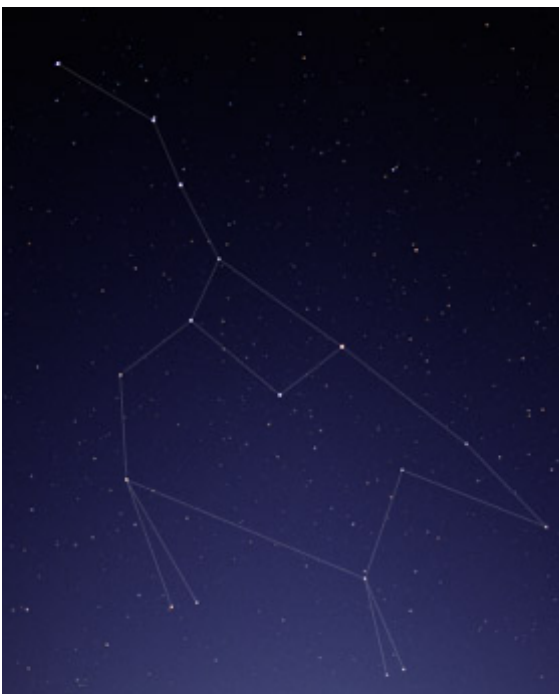
There are 88 officially recognised constellations. 48 are known as original or ancient, this means they were documented and created by the Greeks, in particular Ptolemy (a 2nd century AD astronomer), and probably by the Babylonians and still earlier civilisations.

The older names are mainly based around Greek mythology, hence the names Cassiopeia, Orion, etc.

Please try to avoid the confusion between Astronomy and Astrology...!

There are several “constellations” visible during various times of the year which are easy to recognise and pick out from their starry background. It is sometimes easier to see the brighter stars when there is some light pollution. If the skies are very dark it can get very difficult to pick them out with so many background stars.

The easily visible ones are usually part of a larger grouping of stars. It is just that these stars are brighter against our light polluted skies and therefore easier to pick out.



### URSA MAJOR

The first one we call The Plough, (Americans call it The Big Dipper), it is actually part of a larger constellation the Great Bear (Ursa Major).



## THE PLOUGH

The two bottom stars in the Plough are also pointer stars, moving from left to right the next brightest star seen in the sky is Polaris or The Pole star or North Star. Used for centuries as a navigation aid as it appears to be stationary in the sky with all other stars revolving around it.

This progression of the stars through the night sky means that the exact location of a constellation changes, so it is a matter of looking up and identifying the constellation shapes.

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The next constellation is Cassiopeia (W Cassiopeia).

The stars we see are the five brightest stars of Cassiopeia – Alpha, Beta, Gamma, Delta, and Epsilon Cassiopeiae.

Cassiopeia is located opposite The Plough with the Pole star in-between them.

Cassiopeia was a queen in Greek mythology. (A very potted version) -

The legend is Cassiopeia boasted that she was more beautiful than the sea nymphs. This angered Poseidon (sea god), he sent a monster to ravage the kingdom. Cassiopeia's daughter Andromeda was tied to a rock to appease

the monster. Perseus saw Andromeda from his flying horse Pegasus, rescued her and everyone lived happily ever after.

The gods were happy and put everyone in the heavens as stars, except Cassiopeia had upset the gods with her boasting so was placed in the sky to revolve around the North star, this means for about 6 months of the year she is upside down



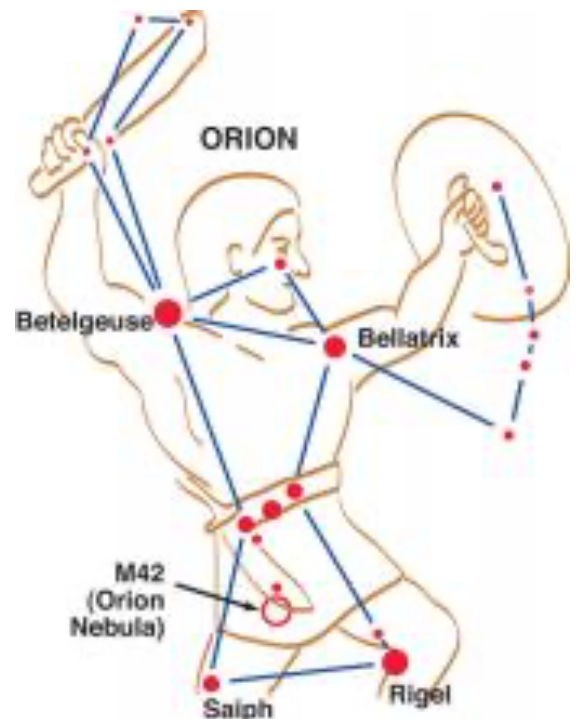
The next constellation is Orion (The Hunter).

This is a winter southern sky constellation, where as the Plough and Cassiopeia can be viewed all year round.

The name Orion is taken from another Greek mythological figure, he is depicted as fighting Taurus (The Bull) to his right and to his left are his two hunting dogs Canis Major and Canis Minor. Orion is the son of the sea god Poseidon and a Cretan princess Euryale.

However the shape of the constellation was recorded on a mammoth ivory as early as 32,000 to 38,000 years old. It is also recorded in Chinese, Polynesian, Asian, Middle Eastern and American history.

As we view the constellation Orion is facing to the right with his shield held up.



The three bright stars in a horizontal line in the middle are called Orion's belt. The group of stars below that are called Orion's sword.

There are lots of interesting stars in Orion, detailing them would take too much room here. Google can bring up a lot more information.



As an example of the different distances from Earth that the various stars are, below is list of the main stars in Orion.

The smaller the magnitude number the brighter the star...!

Bright stars of Orion

<b>Proper name</b>	<b>Light years from Earth</b>	<b>Apparent magnitude (or brightness)</b>
<u>Betelgeuse</u>	624	0.42
<u>Rigel</u>	772	0.18
<u>Bellatrix</u>	245	1.64
<u>Mintaka</u>	916	2.20
<u>Alnilam</u>	1,342	1.69
<u>Alnitak</u>	800	1.88
<u>Saiph</u>	650	2.07
<u>Meissa</u>	1,042	3.47

This ties in nicely with talking about distances from the Earth or Sun to other stars or galaxies.

Because we are talking about such vast distances, as you will see from the above table, astronomers talk about distances in Light Years.

What is a Light Year I hear you ask. This could get quite technical sounding if you let it, but it is ok to talk in approximate distances. So here we go..

Light travels at a speed of 186,000 miles (300,000 Km) per second.

So - One light-year is about 6 trillion miles (9 trillion Km).

(In case anyone asks that would read as a 6 with 12 zeros).

Our Sun is the closest star to us and is about 93 million miles away. This means the sun light we see has taken 8.3 minutes to reach us.

Our next closest star is Proxima Centauri which is 4.3 light years away.

This means that the light we see from it, started out on it's galactic journey 4.3 years ago.

As you will see from the chart below some distances become so large that they start to become difficult to understand/comprehend.



# How many light-years away?

Earth is approximately...



8.3 light-minutes  
from the Sun



4.3 light-years away  
from Proxima Centauri,  
our closest neighboring  
star



320 light-years  
from the North  
Star, Polaris



26,000 light-years  
away from the center  
of our galaxy, the Milky  
Way



2.5 million light-years  
from Andromeda, our  
closest neighboring  
galaxy



13.4 billion light-years  
away from one of the  
oldest galaxies ever  
found, called GN-z11

(Image courtesy of NASA Science Space Place website)

## Programme Ideas

Using large sized thick paper, preferably black, make pin holes in the positions of the stars in a constellation and then shine a torch through from one side and ask the young people to guess the constellation.

For younger age groups a little dot of white on the card can help.

This can be done as bases with each group creating a different constellation and then asking the rest of them to guess the constellation.

I designed a Solar System travel passport for our Cubs and using bases the Cubs visited the various planets, where leaders gave the cubs facts about a particular planet. This was done over a couple of weeks.

At the end of each evening their passports were stamped with moon and star shaped stamps from a craft shop. At the end of the journey they returned to earth for a small welcome home party. Added bonus the most easily obtainable freeze dried "Astronaut" food is ice cream.

Make models of the planets or print off photos and get the young people to position themselves in the planetary order. Depending on numbers you could include some moons. If space permits then get the young people to circle the sun with the moons circling the appropriate planet.

Ask a local Astronomical Society if they can attend an evening with telescopes to allow the young people a chance to view the stars.

Most societies will have an outreach section to assist you.

I have found 6 societies in Surrey they are:-

Ewell AS - Farnham AS - Farnham Night sky (Mainly astrophotography)

Guildford AS - The Croydon AS and Walton AG.

For a list of clubs outside Surrey please go to [astronomyclubs.co.uk](http://astronomyclubs.co.uk) for a county by county list.

Most societies occasionally advertise public viewing events.

The craters on the moon are well documented and again a quick search on the internet will bring up the names of the larger more distinctive ones.

Ask the young people to bring binoculars and spend an evening observing the moon. This could be done on any clear evening, it does not have to be a full moon, in fact it is better viewing either side of a full moon as the reflection of light can obscure some details, where as the oblique light, highlights craters and their features.

Something that may need a bit of research is to put together a "Top Trumps" type game based on facts about planets, galaxies etc. ie Size, distance from earth, magnitude, number of moons.

Meteor showers are a good chance to go outside and view meteorites, although viewing is best quite late in the evening.

Sadly we will have just missed the Perseid shower as they peaked on 12th August.

The next ones are the Draconids visible 8th and 9th October and The Orionids who's peak is expected to be 21st October.

There are 3 more meteor showers due in November and December.

For further details of this years meteor showers please go to [timeanddate.com](http://timeanddate.com).

The meteor showers are named after the constellation they appear to originate from.

So The Perseids appear to come from the top of the constellation Perseus in the NE sky.

The Draconids appear to originate from the constellation Draco (The Dragon) in the WNW sky.

The Orionids appear to originate from just above the top left side of the constellation Orion in the southern skies.

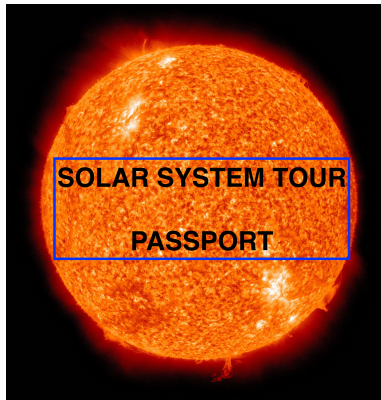
Meteor showers are very predictable and are caused by Earth passing through the debris left by a comet.

The Orionids are from debris from Comet Halley.

The Draconids are from debris from Comet Giacobini-Zinner.

The Perseids are from debris from Comet Swift-Tuttle.

For other programme ideas have a look at the NASA website - <https://spaceplace.nasa.gov>



Going back to the Solar System tour, I was able to fit three of these on an A4 sheet. Then added the pictures of the planets and their details on separate sheets, to form the passport.