

The Solar System

→ BACKGROUND

The planets

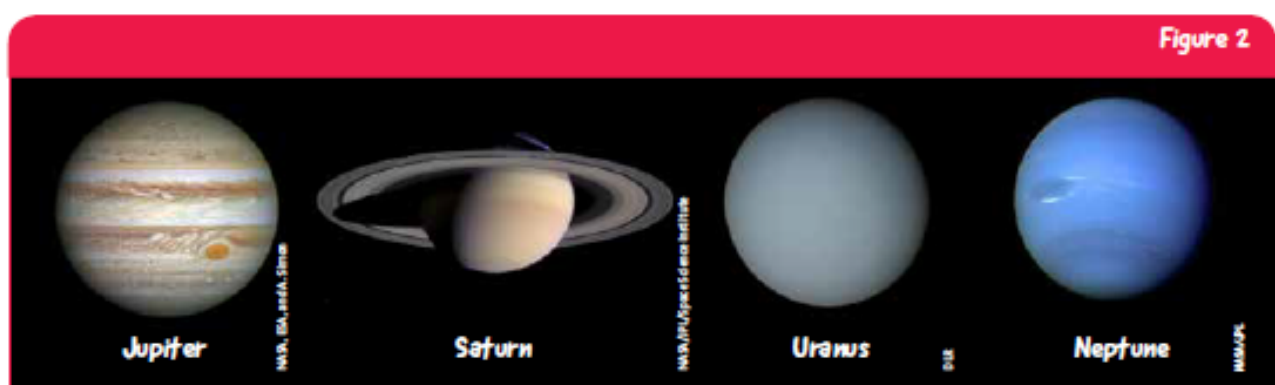
Our Solar System formed about 4.6 billion years ago from a large cloud of gas and dust called a nebula. At the centre is our closest star, the Sun. Orbiting around the Sun are eight planets. In order from the closest to the Sun they are:

Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune

The planets can be placed into two distinct groups. The four planets closest to the Sun are small and rocky and are often referred to as the inner, or terrestrial, planets (Figure 1). The outer four planets are much larger and very cold. These are the giant planets (Figure 2). Jupiter and Saturn are known as the gas giants. Uranus and Neptune are referred to as the ice giants.



↑ The inner (terrestrial) planets. The images shown here are not to scale.



↑ The outer (giant) planets. The images shown here are not to scale.

Rings

All of the giant planets have rings. The most spectacular are Saturn's rings which are the largest in the Solar System (Figure 2). Saturn's rings are made up of billions of small pieces of water ice with traces of rocky material. These pieces range in size from micrometres* to metres across. As the rings are mostly made of ice they reflect the Sun's light and are therefore bright and easy to observe.

* Micrometre: A micrometre, or micron, is a tiny fraction of a metre (1 millionth of a metre). If 1 meter was equal to the length of one football field (~100 metres), 1 micrometre would be about the width of a human hair.

The rings around Jupiter, Uranus and Neptune are much smaller, darker and fainter than the rings around Saturn. They are also made of very different material. The rings of Jupiter and Neptune contain a lot of tiny dust particles. The rings of Uranus consist of larger material, typically around 20 centimetres to 20 metres across. The darkest ring systems are around Uranus and Neptune. The very dark colour of these rings is due to the kind of material they are made of.

Moons

As well as the planets, there are many smaller objects in the Solar System. The most well known group of small objects are moons. A moon is an object that orbits a planet and accompanies the planet on its own orbit around the Sun. Not all planets have a moon. Everyone is familiar with Earth's Moon that is clearly visible in the sky. The other planets with moons are Mars, Jupiter, Saturn, Uranus and Neptune. Some moons are large and spherical like Earth's Moon, such as the four largest moons of Jupiter (the Galilean moons – Io, Europa, Ganymede and Callisto; see Figure 3). These moons are thought to have formed alongside their parent planets. Many other moons, such as the two moons of Mars (Phobos and Deimos), are smaller and have a more irregular shape. Smaller moons, like those of Mars, are thought to be asteroids which were 'captured' by the planet at a later time (Figure 3).



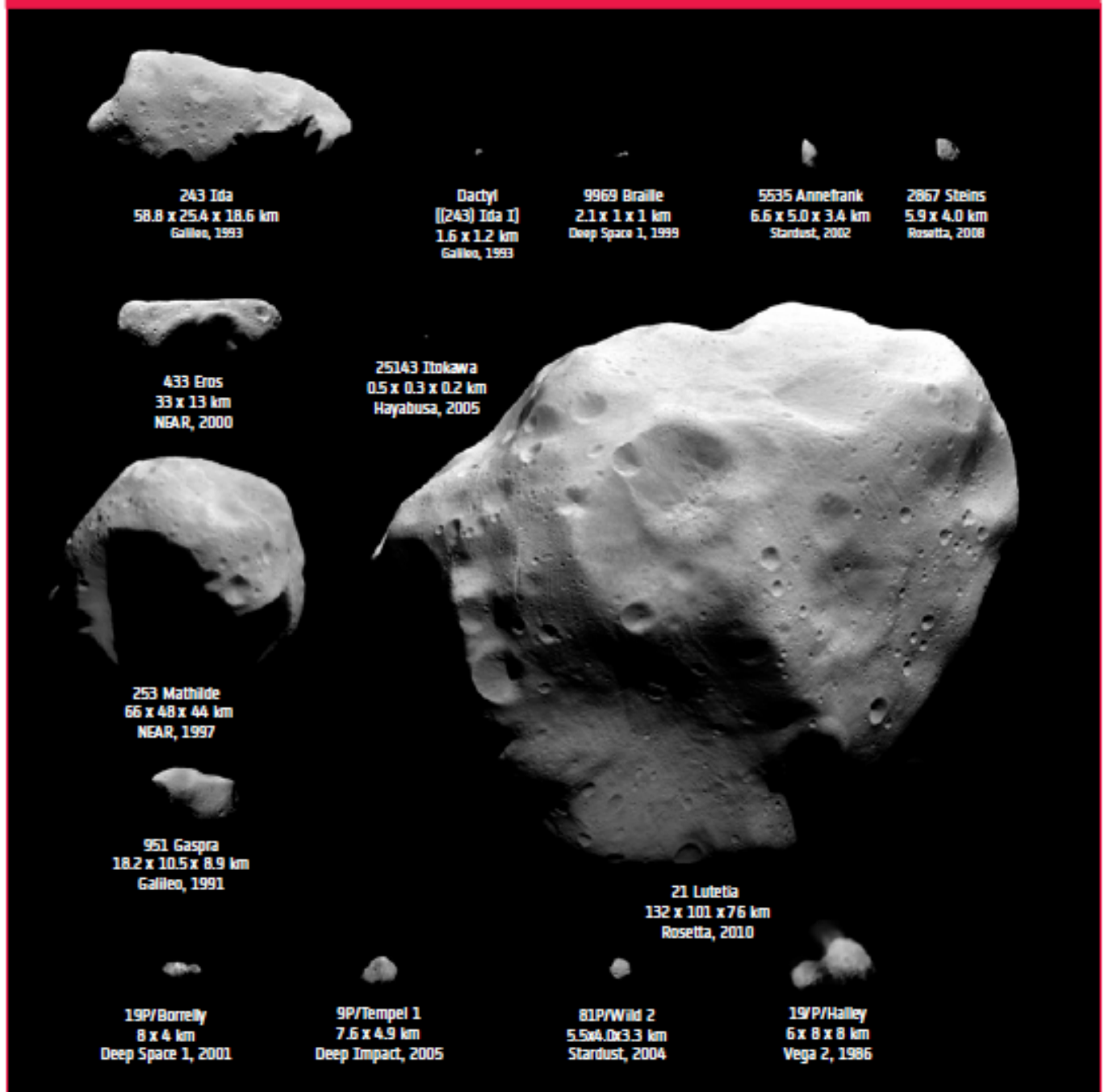
↑ Examples of moons in the Solar System. The images shown here are not to scale.

Asteroids

Asteroids are a group of small, irregular-shaped bodies located in the inner Solar System. Asteroids are made of rocky and metallic material, such as iron. There are millions of asteroids in the Solar System. The majority of asteroids orbit the Sun in the Asteroid Belt between the orbits of Mars and Jupiter. Asteroids are thought to be material left over from the formation of the Solar System. The biggest asteroid, called Ceres, is around 950 km across. It is so big that it is almost spherical and is believed to be an embryonic planet that, billions of years ago, couldn't form fully due to the large size, and hence large gravitational pull, of nearby Jupiter.

The European Space Agency's Rosetta mission passed by and studied two asteroids, 21 Lutetia and 2867 Steins, on its long journey to a comet. Figure 4 is a montage of images of asteroids and comets to show the large variation in size and shape.

Figure 4



↑ A composite showing the different shapes and sizes of asteroids and comets. The comets are the four objects at the bottom of the figure. The text accompanying each image is:

- Line 1 - number and name of the object,
- Line 2 - dimensions in kilometres,
- Line 3 - name of the spacecraft that studied the object and the year in which the image was taken.

Created from a montage by Emily Lakdawalla. Ida, Dactyl, Braille, Annetrank, Gaspra, Borrelly: NASA / JPL / Ted Stryk. Steins: ESA/ OSIRIS team. Eros: NASA / JHUAPL. Itokawa: ISAS / JAXA / Emily Lakdawalla. Mathilde: NASA / JHUAPL / Ted Stryk. Lutetia: ESA / OSIRIS team / Emily Lakdawalla. Halley: Russian Academy of Sciences / Ted Stryk. Tempel 1: NASA / JPL / UMD. Wild 2: NASA / JPL.

Comets

Comets are small, icy worlds that originate from regions of the outer Solar System, beyond the planet Neptune, known as the Kuiper Belt and the Oort Cloud. Comets are mostly made out of ice but also contain dust and rocky material. Just like asteroids, they are material left over from the formation of the Solar System and have an irregular shape (Figure 4). The majority of comets take hundreds or thousands of years to orbit the Sun - compare that to just one year for the Earth! Occasionally, the orbit of a comet can be changed sending it racing towards the inner Solar System. As comets approach the Sun, they begin to heat up and sometimes produce spectacular tails of gas and dust (Figure 5). Many comets have very elongated orbits, which means that they are close to the Sun, and therefore visible, for only a short period of time. The orbits of some comets have changed so significantly that they now orbit the Sun on much shorter timescales. Comet 1P/Halley orbits the Sun about every 75 years and has been recorded to be observed from Earth (with the naked eye) on a regular basis over the last thousand years or so. One famous record of comet 1P/Halley's visibility from Earth was made on the Bayeux Tapestry that depicts the Battle of Hastings in 1066 (Figure 6).



Figure 5

↑ Photo of the comet Hale-Bopp taken in Croatia.

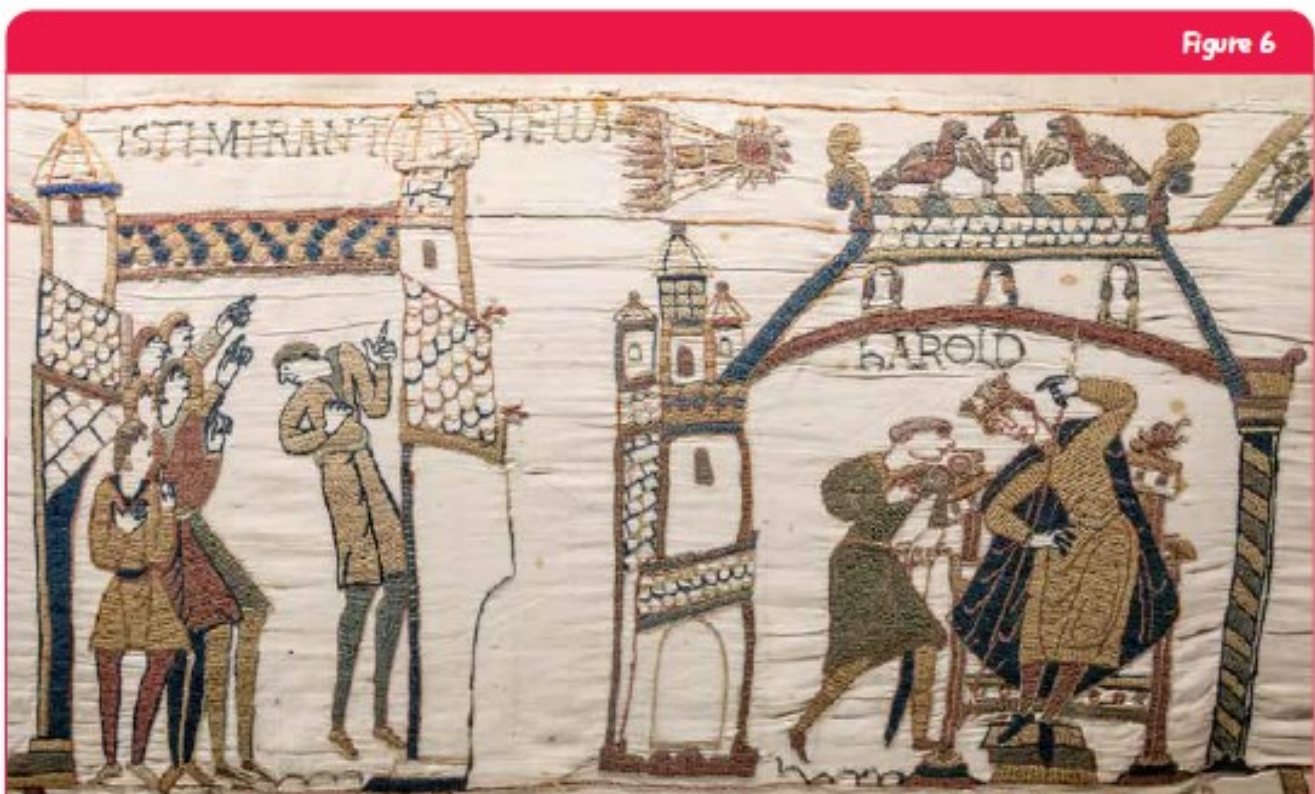







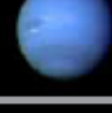



Figure 6

↑ Comet 1P/Halley depicted on the Bayeux tapestry (top centre).

The following table (Table 1) gives a summary of the planets and smaller bodies in the Solar System including the number of moons, whether they have rings, their main colours and features and their shapes.

Table 1						
planet	rings?	number of moons	colour	shape	distinctive features	image
Mercury	no	0	dark grey	sphere/circle	craters	
Venus	no	0	white (clouds), yellow/orange	sphere/circle	cloudy	
Earth	no	1	blue, green, yellow, brown, white (clouds)	sphere/circle	water	
Mars	no	2	reddish brown, ochre	sphere/circle	snow caps	
Asteroids	-	- *	dark grey	irregular-shape	craters	
Jupiter	yes	67	brown, red, white	sphere/circle	red spot, dark and light bands	
Saturn	yes	62	yellow, greener towards the poles	sphere/circle	rings	
Uranus	yes	27	cyan (turquoise)	sphere/circle	uniform colour, no clear features	
Neptune	yes	14	blue/green	sphere/circle	big storms	
Comets	-	-	black/dark grey	irregular-shape	tails when near the Sun	

* Some of the larger asteroids have moons such as asteroid 243 Ida but as a group, the majority of asteroids are not known to have a moon. The moons around asteroids are most likely captured small asteroids like the other small moons in the Solar System (e.g. the moons of Mars).

a) Which planet has the most moons? _____

b) Which planet has the fewest moons? _____

c) The planets with rings are: _____

d) The planets without rings are: _____

e) Where in the Solar System are asteroids found? _____

f) Where in the Solar System are comets found? _____

g) Do any planets or Solar System objects have special features? _____
