

# MOTION IN THE UNIVERSE

## The Solar System

Planets and comets travel around the Sun. Moons and satellites travel around the planets. Between any two objects there is always a force of attraction. This attraction is due to the masses of the objects. This is called gravitational force. *The size of the force depends on:*

- masses of the objects
- distance between the masses

Gravitational forces obey an inverse square law — that is, if the distance between the masses is doubled, the forces between them are quartered; if the distance between them is trebled, the forces become one ninth of what they were.

The greater the masses of the two objects the stronger the attractive forces between them. If the distance between the masses is increased the forces between them decrease. The gravitational attraction between two objects with small masses is tiny. Only when one or both of the object has a very large mass - for example, a moon or planet - is the force of attraction obvious. Our Sun contains over 99% of the mass of the Solar System. It is the gravitational attraction between this mass and each of the planets that holds the Solar System together and causes the planets to follow their curved paths.

Those planets that are closest to the Sun feels the greatest attraction and so follow the most curved paths. Planets that are the furthest from the Sun feel the weakest pull and follow the least curved path.

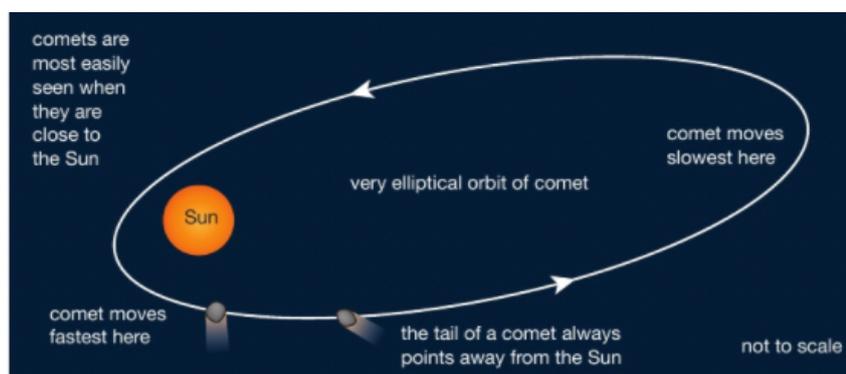
## Satellites & Moons

A satellite is an object that orbits a planet. There are 2 types of satellite: natural and artificial (human-made). Natural satellites are called moons. The Earth has 1 moon which is approximately 340 000 km from Earth and takes just over 27 days to complete one orbit. Many planets have moons and some have more than 1. All moons have circular orbits because of the gravitational forces between them and their planet.

Some artificial satellites are put into a very high orbit above the Earth and are used to help us communicate over large distances (e.g. international phone calls, the internet). Some satellites are put into a much lower orbit and are used to monitor in detail the Earth's surface, such as the temperature of the world's oceans or the progress of forest fires.

## Comets

Comets are large rock-like pieces of ice that orbit the Sun. They have very elliptical (elongated) orbits which at times take them very close to the Sun. At other times they travel close to the very edge of our Solar System.



### **Gravitational Field Strength**

The strength of gravity on a planet or moon is called its gravitational field strength, and given the symbol  $g$ . Different planets have different masses and different radii - both of these will affect their gravitational field strengths.

- The larger the mass of a planet, the greater its gravitational field strength.
- The larger the radius of a planet, the smaller the gravitational field strength at its surface.

### **Orbital Speeds of Planets & Satellites**

The orbital speeds of satellites vary greatly depending on the tasks they are performing.

$$\text{orbital speed, } v = \frac{2 \times \pi \times \text{orbital radius, } r}{\text{time period, } T} \quad (\text{T is the time for one complete orbit})$$

The same equation can be used to calculate the speeds of the planets, where  $r$  is the average distance from the Sun.