I. The Solar System

a. What is a solar system? Name components of a solar system.
    i. Our solar system was originally one molecular cloud that condensed into the about 4.6 billion years ago

b. Inner planets
    i. Relatively small
    ii. Mostly composed of rocks and minerals and are therefore sometimes called terrestrial planets
    iii. Core is composed of iron surrounded by silicate
    iv. Further reading: http://en.wikipedia.org/wiki/Terrestrial_planet

c. Asteroid belt
    i. Between mars and Jupiter
    ii. Most asteroids are located here, although there are other smaller asteroid belts in other places in the solar system
    iii. Asteroids in the asteroid belt are actually very spread out and are not densely packed like they are usually portrayed in illustrations

d. Outer planets
    i. Jupiter, Saturn, Uranus and Neptune are the outer planets and are also called the gas giants (pluto used to be an outer planet but has since been demoted to a dwarf planet rather than a planet)
    ii. Composed mostly of gas rather than solids
    iii. Jupiter and Saturn are mostly composed of hydrogen and helium
    iv. Uranus and Neptune have hydrogen atmospheres with icy water, ammonia and methane centers
    v. More info: http://en.wikipedia.org/wiki/Gas_giant

e. Gravity/Kepler's laws of planetary motion
    i. Discuss formula for gravity – what happens when you increase the mass of one of the bodies, what happens when you increase the separation of the bodies?
    ii. Do sample calculation – which gravitational forces are the strongest, the force between earth and the sun, the force between the earth and the moon, or the force between the sun and the moon? (see work sheet)
    iii. Keplers three laws:
        1. The orbit of every planet is an ellipse with the sun at one foci
        2. A line joining the planet and the sun sweeps out equal areas in equal times
        3. The square of the orbital period (the time it takes for the planet to complete one orbit) is directly proportional to the cube of the semi major axis of the orbit
    iv. Read more about keplers laws - http://en.wikipedia.org/wiki/Kepler%27s_laws_of_planetary_motion

f. Ellipse activity (see handout)

i. Define these parts of an ellipse – foci, major and minor axes, semi-major and semi-minor axes, eccentricity
ii. Major axis is the longer straight line (see picture in power point), the semi-major axis is half that distance and is usually written as a
iii. Minor axis is the shorter straight line the semi-minor is half that and is written as b
iv. Explain what eccentricity is and ask them to reason out what the eccentricity of a circle is using the formula
v. Do activity and have students compare the ellipses they drew – did putting the foci closer together result in something with higher or lower eccentricity (less or more like a circle)
vi. Have them compare the eccentricity of the ellipses they drew to the eccentricities of various planets (see handout)

II. Galaxies
a. Our galaxy is the milky way, which is a spiral galaxy (looks like a spiral)
b. The closest spiral galaxy is Andromeda (2.5 million light years away – a light year is the distance light travels in a year, it is a measure of distance - NOT time!)

III. Stars
a. Are made up of plasma (super-heated matter) and is held together by gravity
b. The light and heat produced by a star occurs due to thermonuclear fusion – the fusion of atoms
c. A star starts out mostly as hydrogen (H) gas which undergoes a several step fusion reaction that results in four H nuclei and two electrons being fused into an He nucleus, 2 neutrinos (elementary particles with neutral charge) , and 6 photons (light energy) – this is the reaction the "powers" the sun
d. Several other fusion reactions can happen, especially when the H starts to be used up and more He is left over – fusion reactions in suns can form heavier elements
e. More info: http://zebu.uoregon.edu/~soper/Sun/fusionsteps.htmlm
f. Stars start out as nebulas which are gaseous clouds, gravity causes them to clump together and it becomes a protostar
g. In order for a true star to form equilibrium much be reached – the reactions in the stars cause pressure to build up, pushing the gas molecules of the star apart, but gravity holds them together. Pressure must be equal to gravity for a star to form (if pressure is greater the star can't stay together but if gravity is greater the star collapses), it needs to reach a critical temperature in order for this equilibrium to be reached (if not it becomes a brown dwarf rather than a star)
h. If stars run out of H to fuse they will die – smaller stars have longer lifespans because they require less H to maintain their size (less gas pressure is required to maintain equilibrium)
i. As star starts to run out of H, it fuses He instead (the change in composition causes the star to become red so it's called a red giant) – the core of the star contracts but the outside expands – which is why it's a giant

j. After that stars start to collapse because the force of gravity is stronger than the gas pressure – small stars become earth-sized white dwarfs but medium sized stars become super nova (an explosion caused by rapid the shrinking of the star)
k. If the star is large enough it can cause a black hole which has such a strong gravitational field that not even light can escape
l. More info: http://sunshine.chpc.utah.edu/labs/star_life/starlife_main.html

IV. If there is extra time do a discussion on the future of space travel
    i. Discuss possibility of going to mars – watch this - http://www.youtube.com/watch?v=mircaavvZtQ
    ii. Privatization of space travel/exploration – read this article out loud: http://www.cbc.ca/news/technology/story/2010/04/15/obama-space-changes.html
    iii. Discuss possibilities of space tourism