

AQA Physics - Space Journey of Knowledge - SEPS only

Context and introduction to the unit: Questions about where we are, and where we came from, have been asked for thousands of years. In the past century, astronomers and astrophysicists have made remarkable progress in understanding the scale and structure of the universe, its evolution and ours. New questions have emerged recently. ‘Dark matter’, which bends light and holds galaxies together but does not emit electromagnetic radiation, is everywhere – what is it? And what is causing the universe to expand ever faster?

KS3: Year 9 - gravity force, weight = mass x gravitational field strength (g), on Earth $g=10 \text{ N/kg}$, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only). Sun as a star, other stars in our galaxy, other galaxies. Seasons and the Earth’s tilt, day length at different times of year, in different hemispheres. Light year as a unit of astronomical distance.

CORE KNOWLEDGE

4.8.1 Solar system; stability of orbital motions; satellites (physics only)

4.8.1.1 Our solar system - Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun. Natural satellites, the moons that orbit planets, are also part of the solar system. Our solar system is a small part of the Milky Way galaxy. The Sun was formed from a cloud of dust and gas (nebula) pulled together by gravitational attraction. Students should be able to explain: • how, at the start of a star's life cycle, the dust and gas drawn together by gravity causes fusion reactions • that fusion reactions lead to an equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy.

4.8.1.2 The life cycle of a star - A star goes through a life cycle. The life cycle is determined by the size of the star.

The life cycle of a star: • the size of the Sun • much more massive than the Sun – see image

Fusion processes in stars produce all of the naturally occurring elements. Elements heavier than iron are produced in a supernova. The explosion of a massive star (supernova) distributes the elements throughout the universe.

Fusion processes lead to the formation of new elements.

4.8.1.3 Orbital motion, natural and artificial satellites - Gravity provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits.

The similarities and distinctions between the planets, their moons, and artificial satellites.

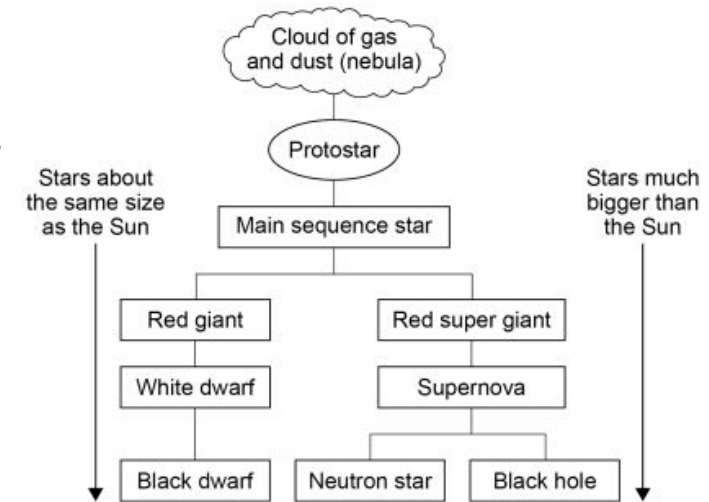
(HT only)

When an object moves in a circle at a constant speed, its direction constantly changes. A change in direction causes a change in velocity. This is because velocity is a vector quantity - it has an associated direction as well as a magnitude. A change in velocity results in acceleration, so an object moving in a circle is accelerating even though its speed may be constant.

The gravitational attraction between two objects decreases with distance. This means that the closer the two objects are to each other, the stronger the force of gravity between them. If the force between them is greater, a greater acceleration will occur. The greater the acceleration, the greater the change in velocity - this causes the object to move faster. This means that objects in small orbits travel faster than objects in large orbits.

4.8.2 Red-shift –

There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift. The observed red-shift provides evidence that space itself (the universe) is expanding and supports the Big Bang theory. The Big Bang theory suggests that the universe began from a very small region that was extremely hot and dense. Since 1998 onwards, observations of supernovae suggest that distant galaxies are receding ever faster. Students should be able to explain: • qualitatively the red-shift of light from galaxies that are receding • that the change of each galaxy’s speed with distance is evidence of an expanding universe • how red-shift provides evidence for the Big Bang model • how scientists are able to use observations to arrive at theories such as the Big Bang theory • that there is still much about the universe that is not understood, for example dark mass and dark energy.



Disciplinary knowledge

WS 1.1, 1.2 and 1.3

Vocabulary

Solar system, dwarf planet, satellite, nebula, fusion, equilibrium, universe, supernova, orbital, red shift, supernovae, Big Bang

Reading is Power

60 second science – Planet formation

Where next?

A Level Astrophysics