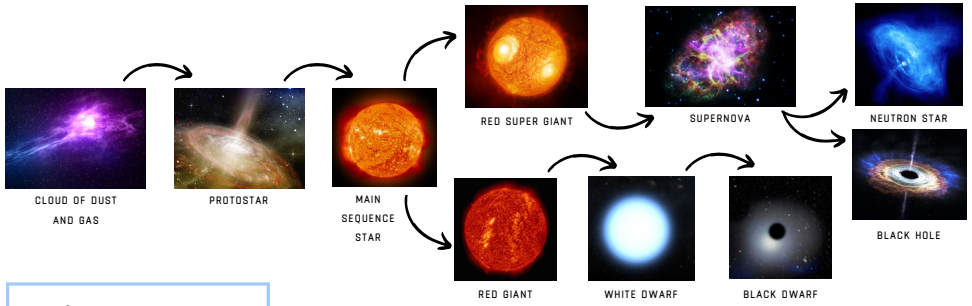
SPACE PHYSICS

life cycle of stars



CLOUD OF DUST AND GAS

- Stars are initially a cloud of dust and gas called a nebula

PROTOSTAR

- Force of gravity pulls dust and gas together to form a protostar
- Temperature rises as star gets denser and more particles collide
- When temperature is high enough, hydrogen nuclei undergo nuclear fusion, forming helium nuclei
- Huge amounts of energy is released, keeping core of star hot

MAIN SEQUENCE STAR

- Star enters long stable period
- Outward pressure caused by nuclear fusion trying to expand star is balanced with force of gravity pulling everything inwards
- Eventually hydrogen begins to run out
- Star swells into red super giant/red giant
- Becomes red as surface cools
- Fusion of helium occurs
- Heavier elements (up to iron) created in core

RED SUPER GIANT

- Stars bigger than Sun start to glow brightly again as they undergo more fusion
- Expand and contract several times forming elements as heavy as iron in various nuclear reactions

SUPERNOVA

- Eventually red super giant explodes in a supernova
- Forms elements heavier than iron and ejects them into universe to form new planets and stars
- Stars and their life cycles produce and distribute all naturally occurring elements

NEUTRON STAR

- Exploding supernova throws outer layers of dust and gas into space, leaving a very dense core behind called a neutron star

BLACK HOLE

- If the star is massive enough, a black hole will be formed
- Super dense point in space that light cannot escape from

RED GIANT

- Stars same size as Sun (or smaller) become unstable and eject their outer layer of dust and gas

WHITE DWARF

- Hot, dense, solid core

BLACK DWARF

- As white dwarf cools down, less energy is emitted
- When sufficient amount of energy is no longer emitted, it is a black dwarf

the big bang

RED SHIFT

- The universe appears to be expanding
- When we look at light from distant galaxies, we find that the wavelength has increased
- The wavelengths are longer than they should be (they are shifted towards the red end of the visible light spectrum) - this is red shift
- This suggests that the source of the light is moving away from us
- Measurements of the red shift indicate that the distant galaxies are moving away from us very quickly
- More distant galaxies have greater red shifts than nearer ones -> they are moving away faster

THE BIG BANG

- If all the galaxies are moving away from each other at great speed, there must have been a great explosion to make them move - the Big Bang
- Initially all matter in the universe occupied a very small space which was very dense and very hot
- Then it exploded, and space started expanding
- This expansion is still going on

NEW EVIDENCE

- Whenever scientists discover new evidence, they have to either make a new theory or change a current one to explain what they have observed
- There is still lots we don't know about the universe
- Observations of supernovae from 1998 to the present day suggest that distant galaxies are moving away from us faster and faster
- Currently scientists believe the universe is mostly made up of dark matter (unknown substance holding galaxies together but does not emit electromagnetic radiation) and dark energy (thought to be responsible for the accelerated expansion of the universe)

the solar system

OUR SOLAR SYSTEM

Solar system is all the objects that orbit the Sun, including:

- Planets (large objects that orbit a star, their gravity is strong enough to pull in nearby objects apart from their natural satellites)
- Dwarf planets (planet-like objects that orbit stars)
- Moons (orbit planets, natural satellites)
- Artificial satellites (orbit the Earth, man-made satellites)

Artificial satellites have two orbits:

- Polar orbits – move around the poles (vertically), used for monitoring weather, military spying
- Geostationary orbits – take 24 hours to orbit the earth so appear to stay in the same place above Earth, used for telecommunication, broadcasting

ROCK GIANTS

GAS GIANTS

MY VERY EASY METHOD JUST SPEEDS UP NAMING

MERCURY
VENUS
EARTH
MARS
JUPITER
SATURN
URANUS
NEPTUNE

ORBITS

- Planets move around the Sun in elliptical orbits
- If an object is moving in a circle, it is constantly changing direction, meaning it is constantly accelerating
- This also means it has a constantly changing velocity
- To accelerate, there must be a force acting on the object (gravitational force between planet and Sun or planet and satellites)
- This force is directed towards the centre of the circle
- This would cause the object to fall towards whatever it is orbiting, but as it is already moving, this just causes it to change direction
- The object keeps accelerating towards what it's orbiting, but the instantaneous velocity (90 degrees to acceleration) keeps it travelling in a circle

- Closer to star/planet = stronger gravitational force
- The stronger the force, the faster the orbiting object needs to travel to remain in orbit
- For an object in a stable orbit, if the speed of the object changes, the size (radius) of its orbit must change, too
- Faster moving objects will move in a stable orbit with a smaller radius than slower moving ones