Stellar Evolution

Further Evolution of Low mass Stars:

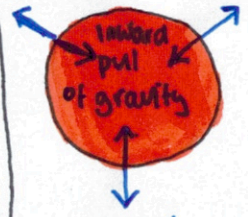
↳ core mass below Chandrasekhar limit

1. Generation of energy stops, radiation pressure becomes zero and gravitational collapse of core occurs
2. The temperature is raised again and hydrogen fuses again but this time in a shell around the core
3. Core of helium contracts further, temperature raises, increases rate at which energy is generated in hydrogen shell and star expands and cools, forming a red giant
4. If core becomes hot enough, helium will fuse to form carbon
5. Outer layers of star continue to expand and are visible in expanding sphere of gas called planetary nebula
6. Core eventually stops collapsing due to electron pressure: electrons cannot be squeezed together any further and this stops collapse
7. The star is a very hot and small white dwarf
8. Over times, it cools to ~~for~~ become a black dwarf

Further Evolution of massive stars:

↳ core mass greater than Chandrasekhar limit

1. Continues to collapse and temperature is so high that carbon fuses into neon
2. Cycle of fuel exhaustion – core collapse – new fusion continues until iron formed in core. During this time, star will expand to red supergiant
3. Can't fuse iron into other elements and release energy so run out of fuel and collapse under own gravity but nuclear reactions unable to occur
4. If star's core is less than 3x mass of Sun's core, collapse halted by neutron pressure: electrons forced into protons forming neutrons and they resist being squeezed together. Becomes 20km in diameter neutron star. Sudden halt in core contraction causes shockwave that blows the star apart in a supernova explosion, forming newer heavier elements
5. If core greater than 3 solar masses, even neutron pressure insufficient to halt ~~neutron pressure~~ gravitational collapse by neutron pressure following supernova, and core collapses, forming a blackhole.



Star cycle Beginning:

1. All stars start in cool, dense molecular clouds of gas and dust in spiral arms of galaxies
2. Cloud collapses and fragments because it is unstable, forming smaller clumps: protostars
3. As each protostar collapses, GPE is converted into KE and the temperature increases
4. Eventually, it becomes hot enough for nuclear fusion of hydrogen and helium. It becomes main sequence
5. The energy radiated by core (radiation pressure) quickly balances and ceases further collapse and continues 90% of its lifetime as main sequence

Chandrasekhar Limit

1.4 times the mass of the Sun dictates how star will evolve next

Neutron stars

rotate very rapidly, and emit pulses of radio waves from polar hotspots

Blackhole detection:

- neighbouring star falls into it and accelerating matter generates x-rays that are detected

in 1781, Charles Messier published his Catalogue of Nebulae and star Clusters containing 103 astronomical objects (there are now 110)

↓

Messier was only interested in discovering comets

Patrick Moor's Caldwell Catalogue is an extension of Messier's catalogue

Open Clusters of young stars mostly within the spiral arms of our Galaxy e.g. the Pleiades

Nebulae are large interstellar clouds of gas and dust e.g. Orion Nebula

Globular Cluster of old stars surrounding centre of galaxy

Galaxies are distant e.g. Andromeda

The New General Catalogue published in 1888 contains over 8000 extended objects, most of which only visible with large telescope