Astrophysics; Stars

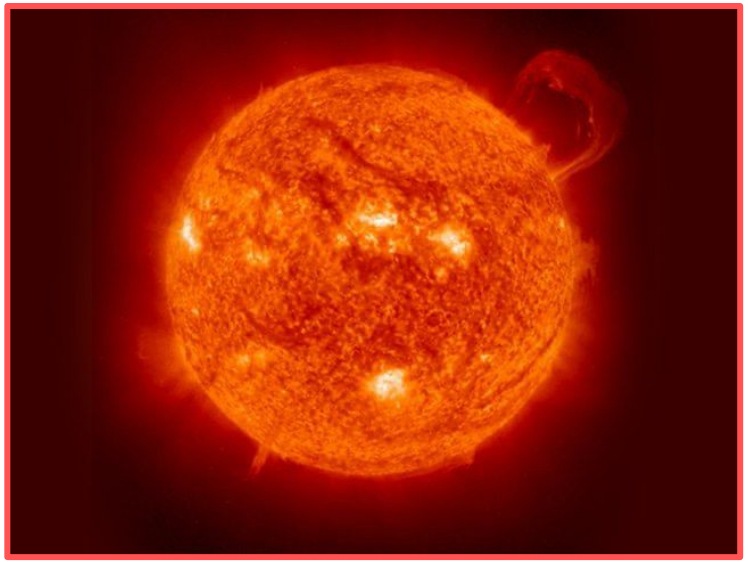
Emily Hatt

The Sun

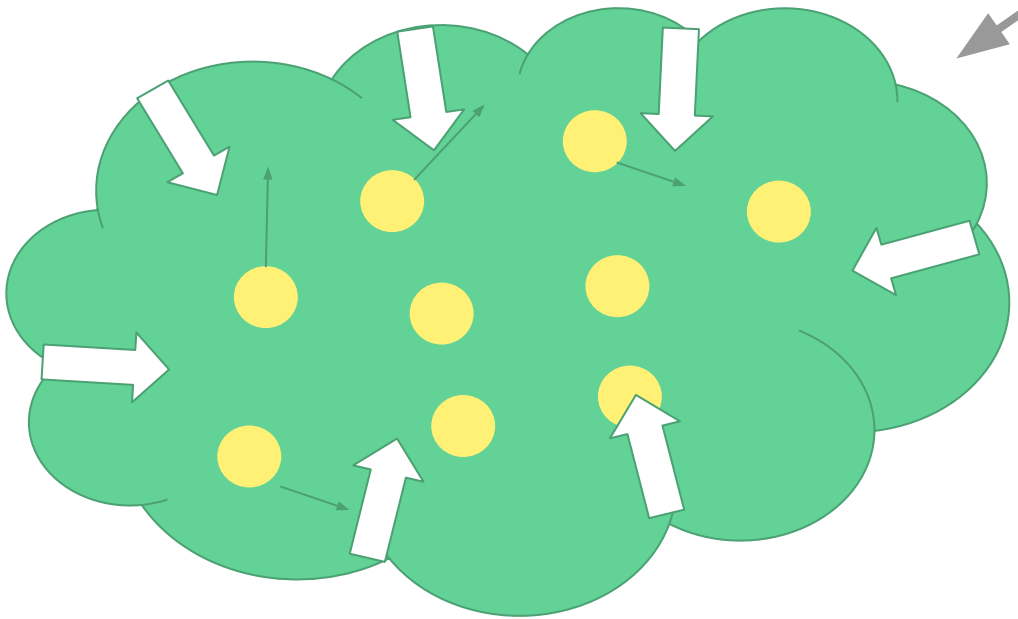
Mass: 330,000x Earth

Radius: 109x Earth

Surface Temperature: ~6000 C

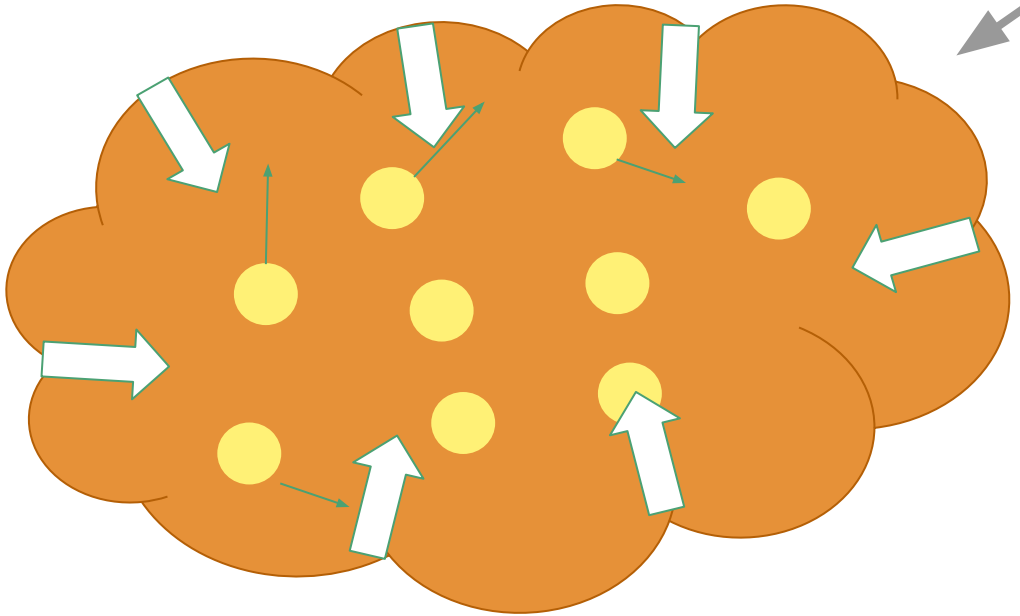


Star Formation



Hydrogen + (small amount) Helium

Star Formation

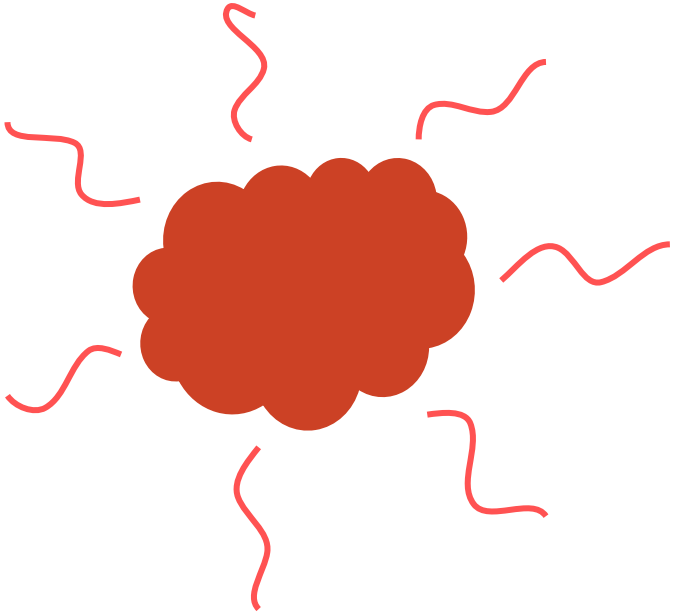


Hydrogen + (small amount) Helium

Gas Pressure

Gravitational attraction

Star Formation



Gas Pressure

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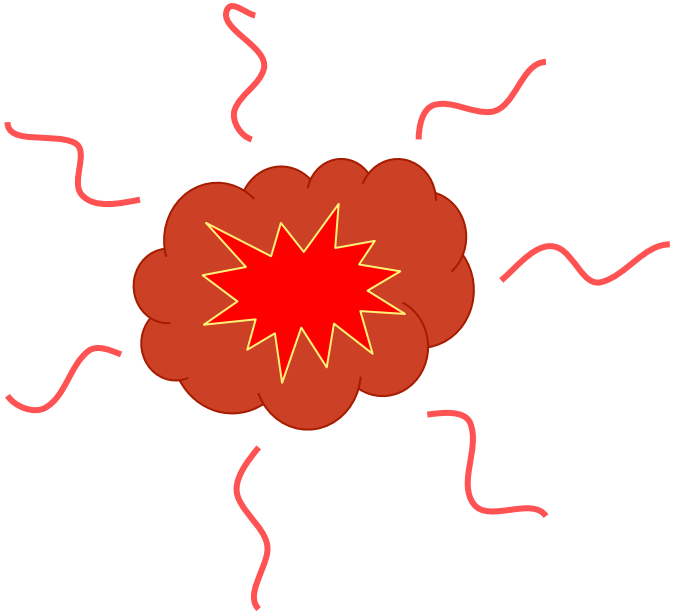
Gravitational attraction

Star Formation

$$4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He}$$

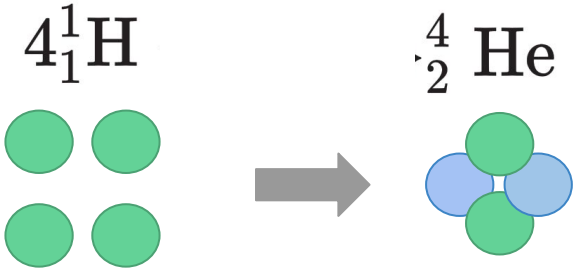


Energy from nuclear reactions

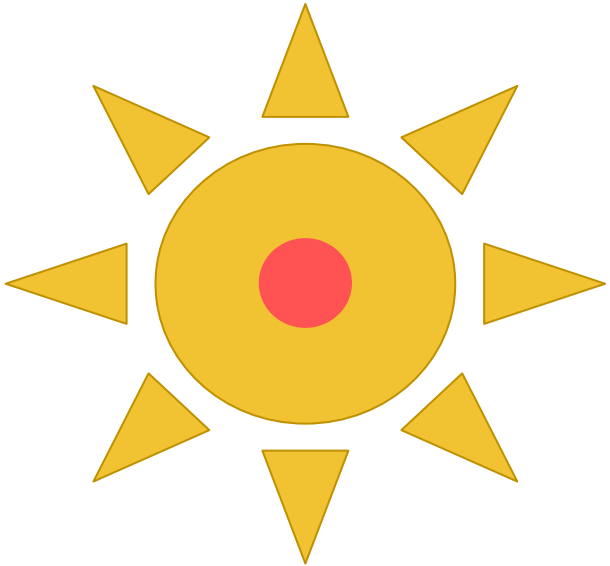
Gas Pressure

>

Gravitational attraction



Star Formation



A star!!!

Energy from nuclear reactions

Gas Pressure

=

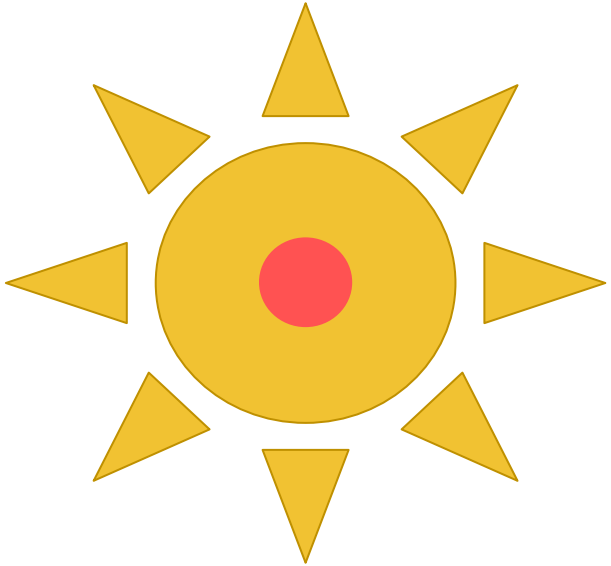
Gravitational attraction

Main sequence - 1st cycle of nuclear burning

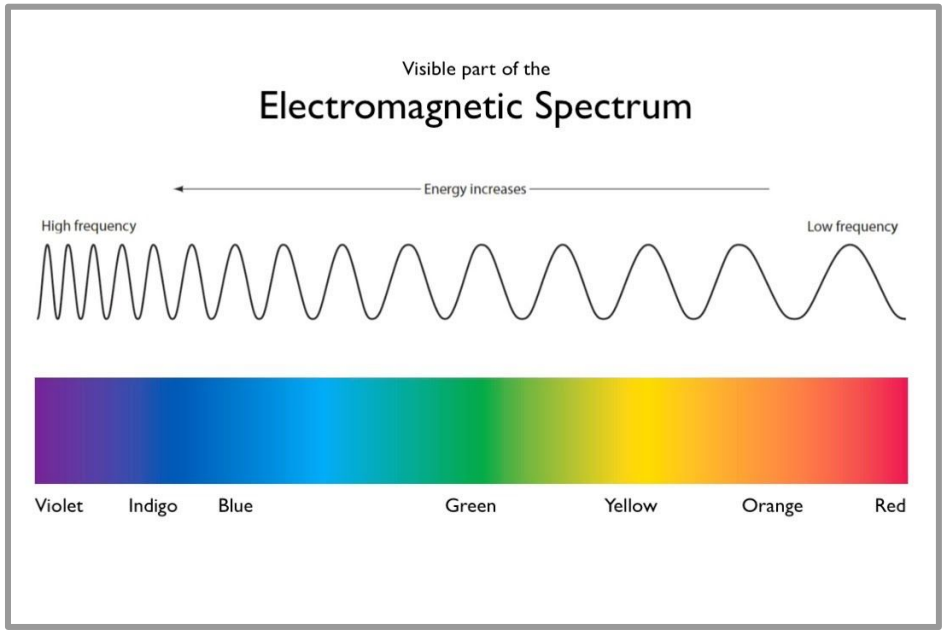
Describing a star

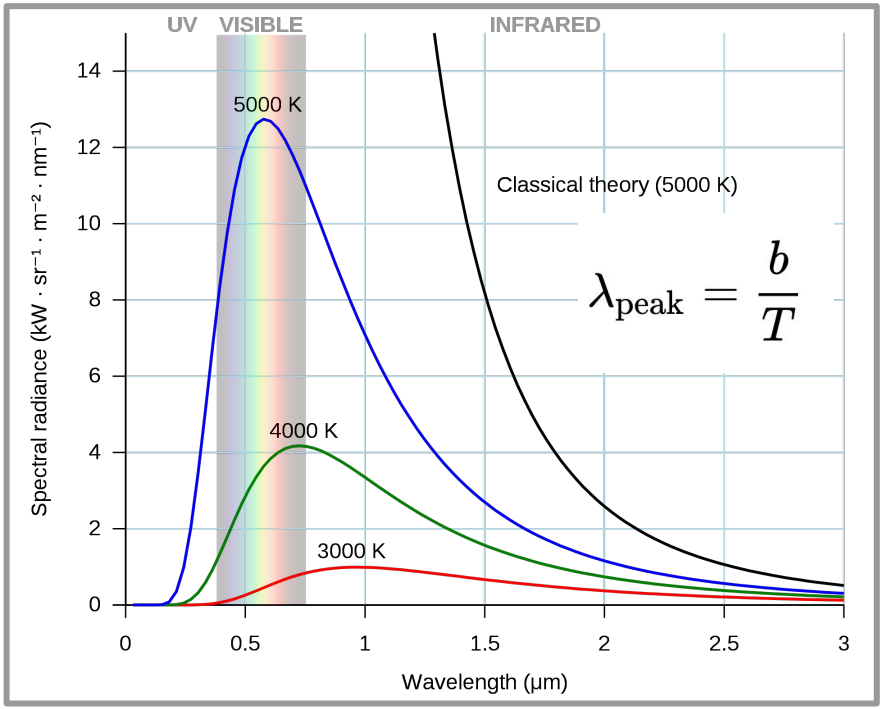
We measure the **light** the star gives off:

1. Brightness
2. Colour



Colour of a star



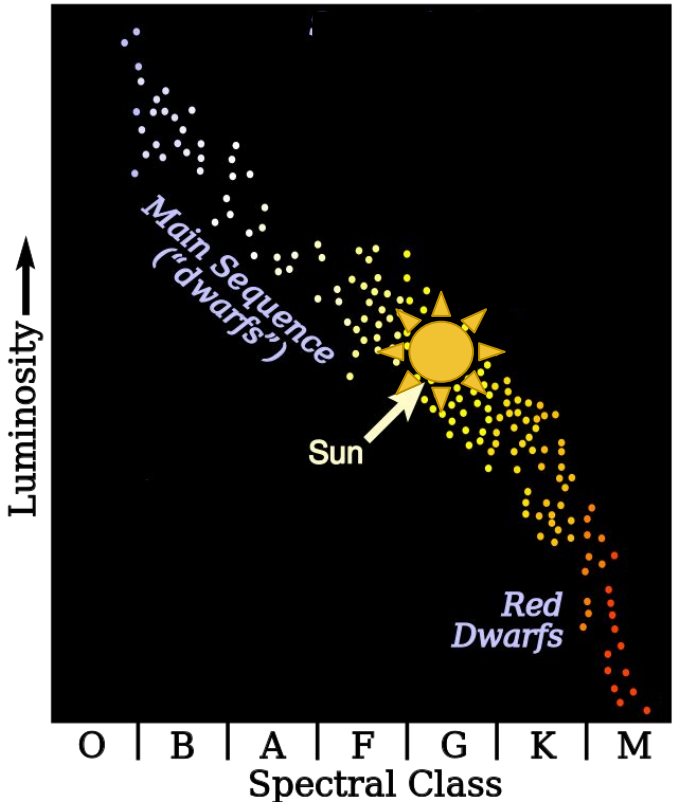


Short wavelength

Long wavelength

HR diagram - Main Sequence

Amount of light

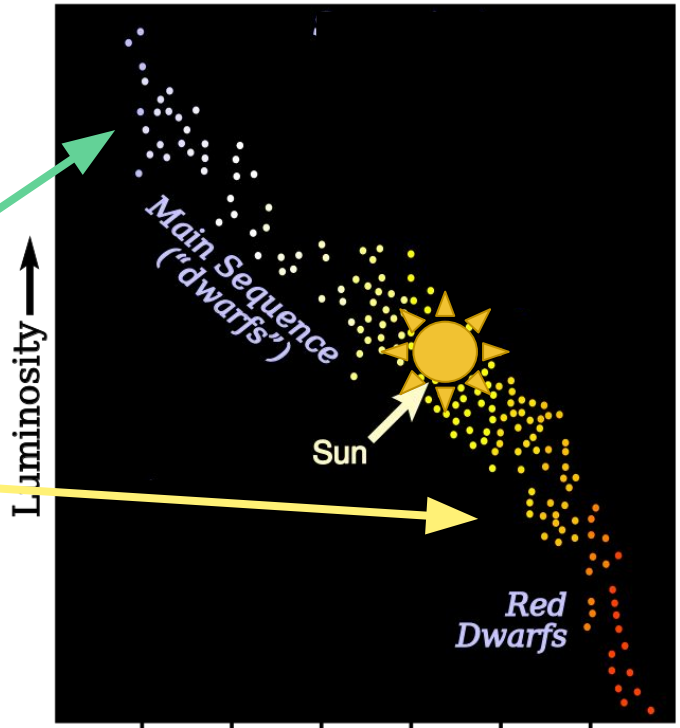


Spectral class ~ surface temperature

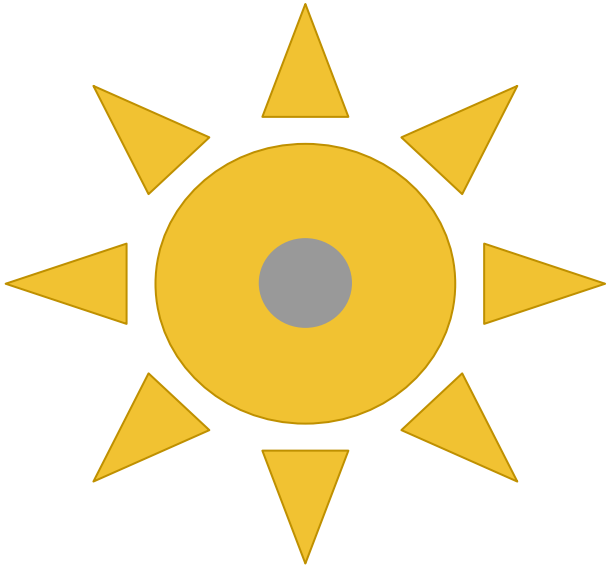
HR diagram - Main Sequence

High mass stars - much more mass than the sun

Low mass stars - similar to the mass of the sun



Low mass: After the main sequence



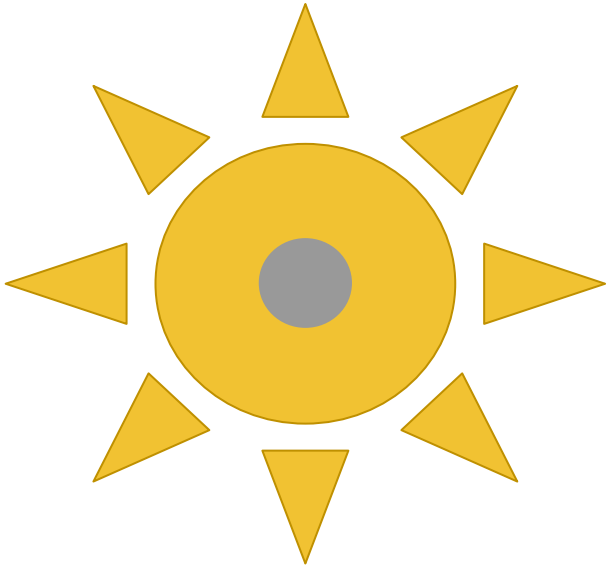
Energy from nuclear reactions

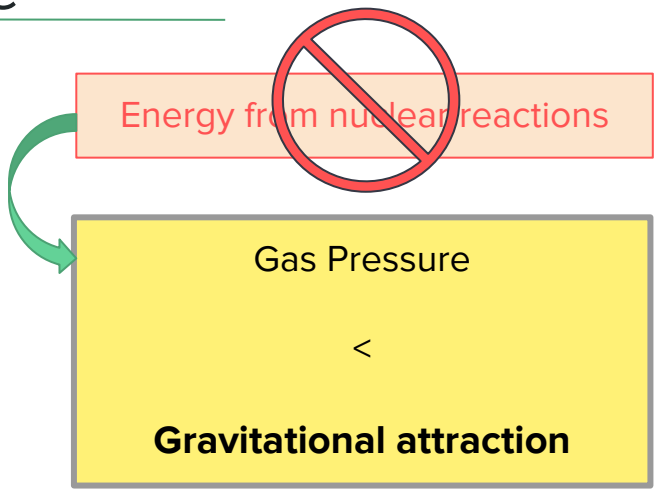
Gas Pressure

=

Gravitational attraction

Low mass: After the main sequence





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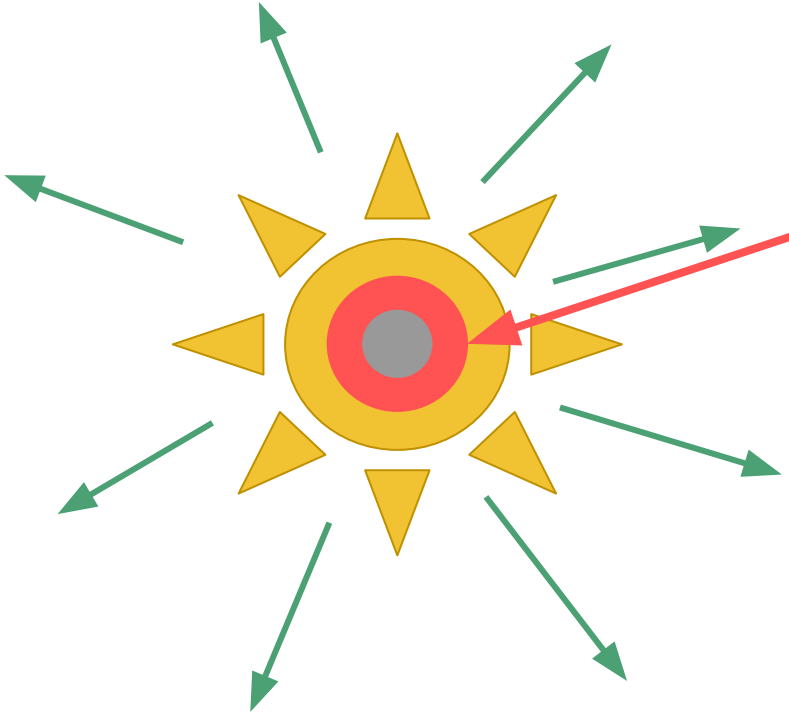
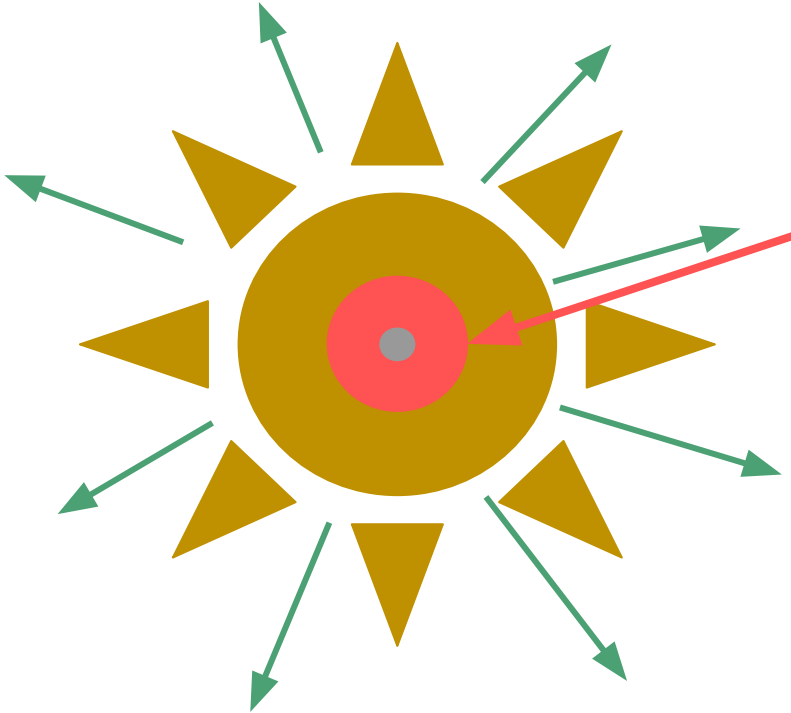


Shell hydrogen fusion

$$4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He}$$

Low mass: After the main sequence



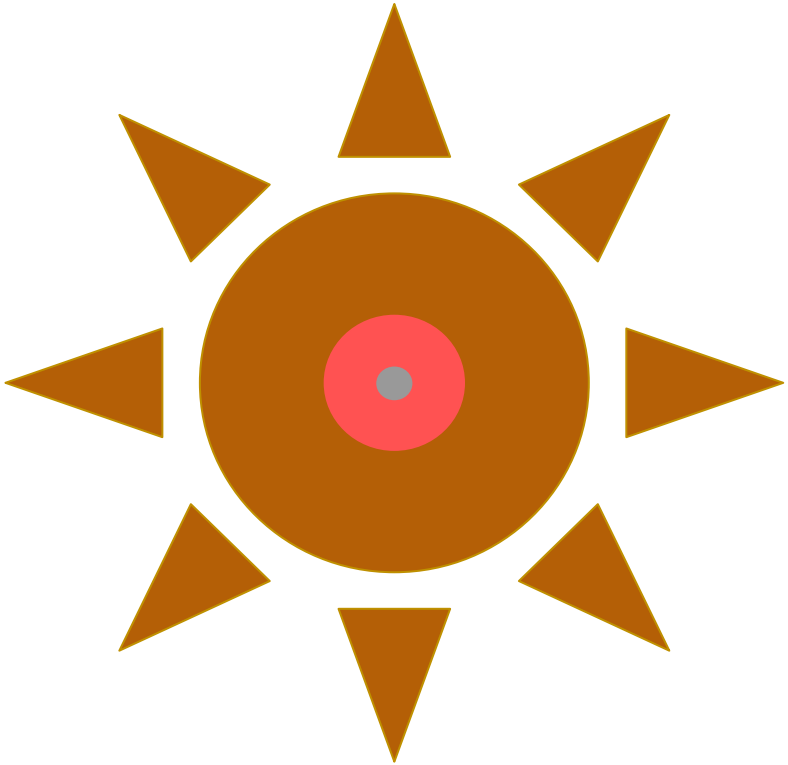
Shell hydrogen fusion

$$4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He}$$

Core contracts

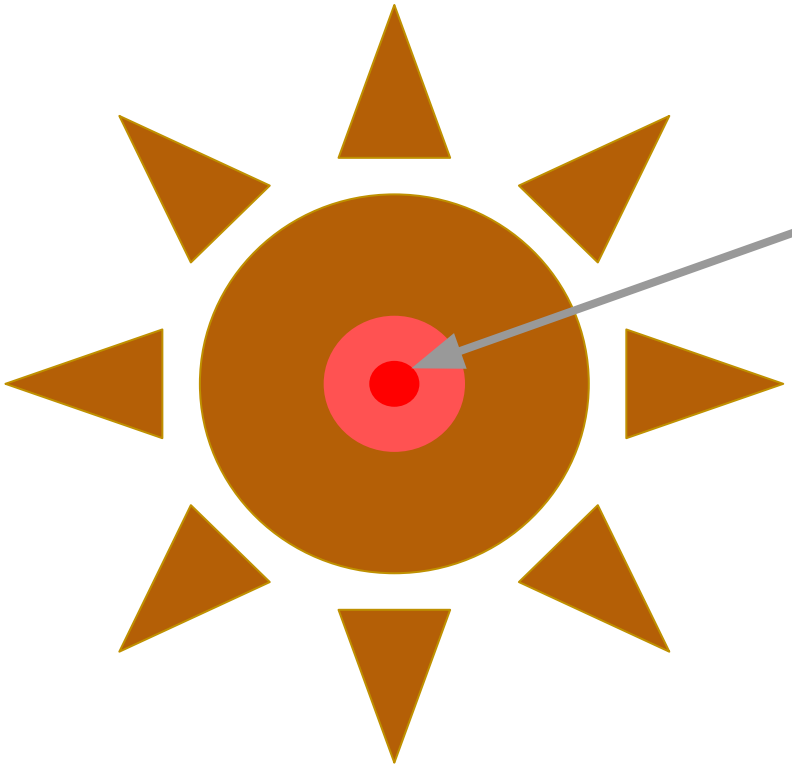
Outer layers expand

Low mass: After the main sequence



Red Giant - its big and its red

Low mass: After the main sequence

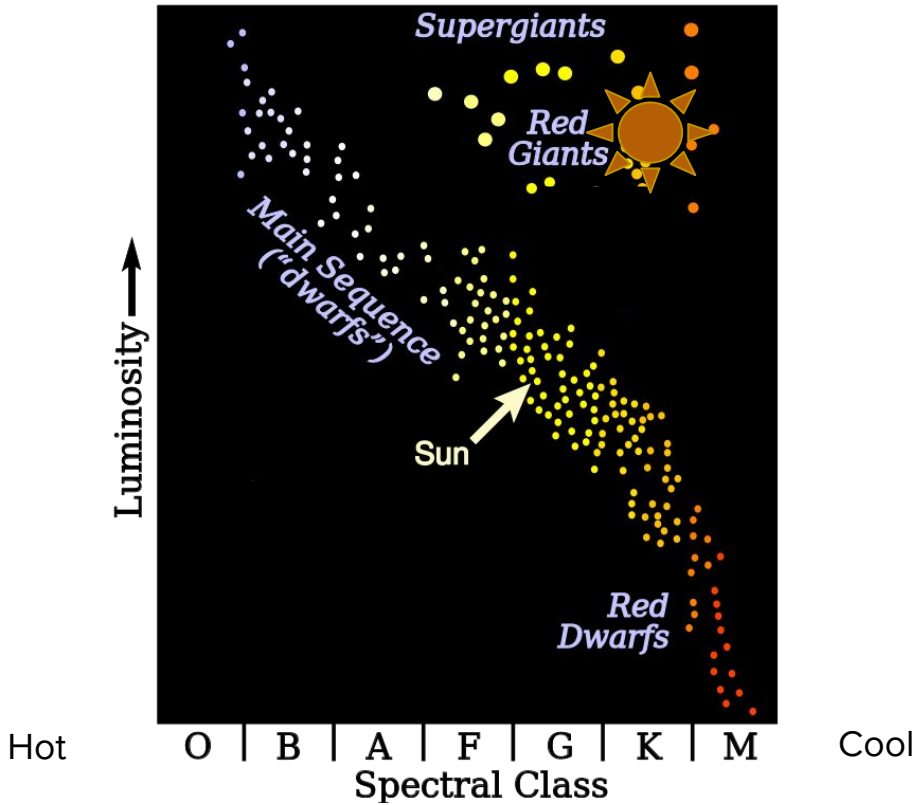


Core helium burning

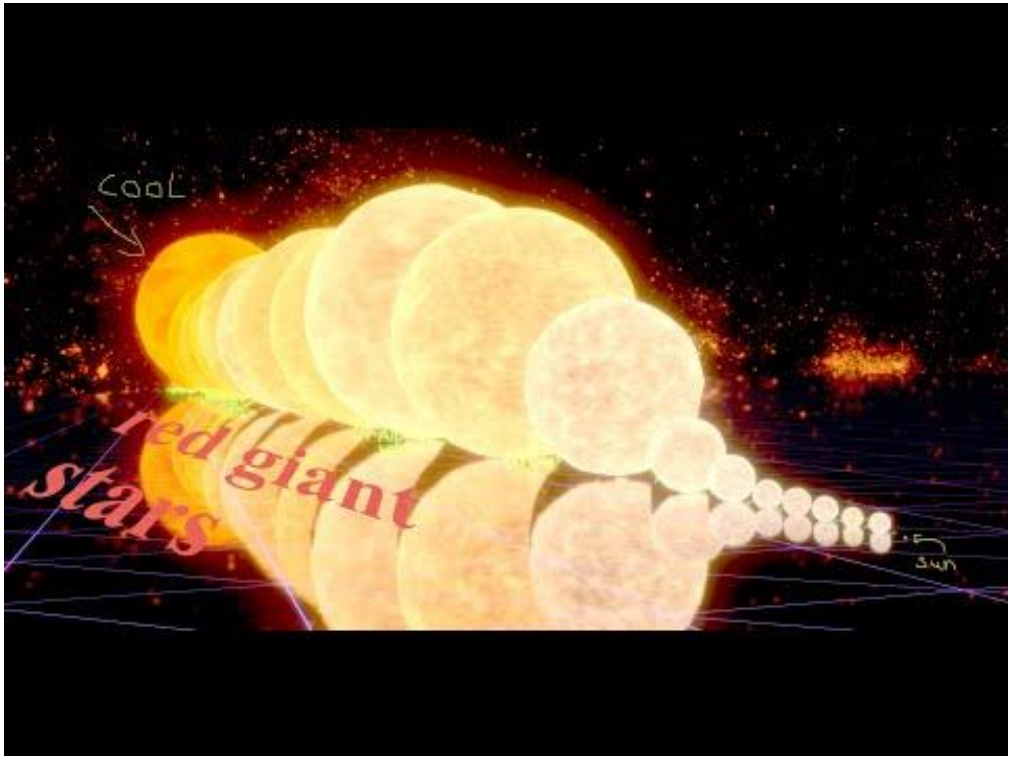
$$^{4}_{2}\mathrm{He} + ^{4}_{2}\mathrm{He} \rightarrow ^{8}_{4}\mathrm{Be}$$

$$^{4}_{2}\mathrm{He} + ^{8}_{4}\mathrm{Be} \rightarrow ^{12}_{6}\mathrm{C}$$

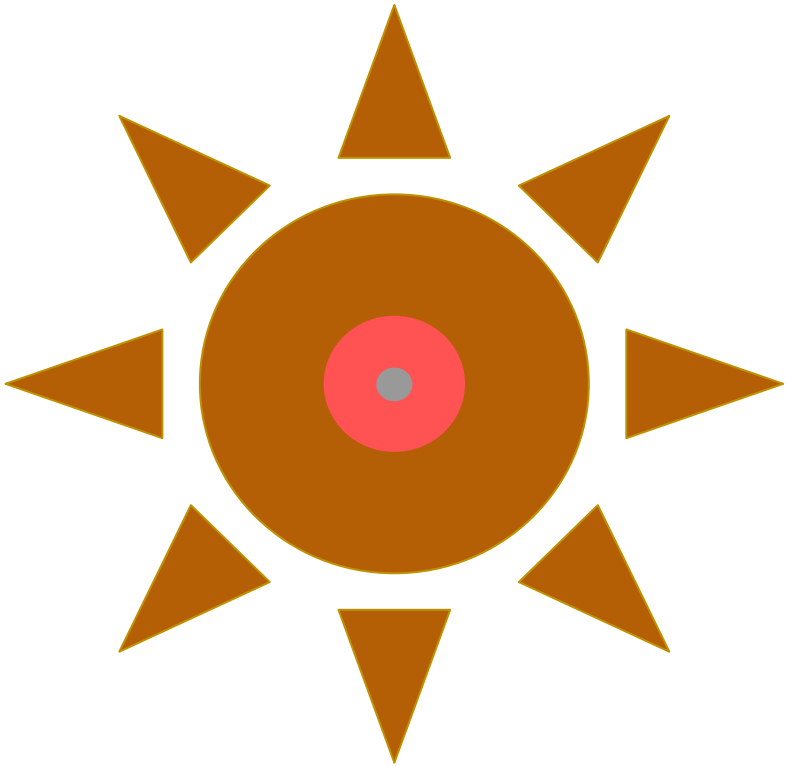
HR diagram - Red Giants



Red Giants



Post RGB: Low mass



Energy from nuclear reactions

Gas Pressure

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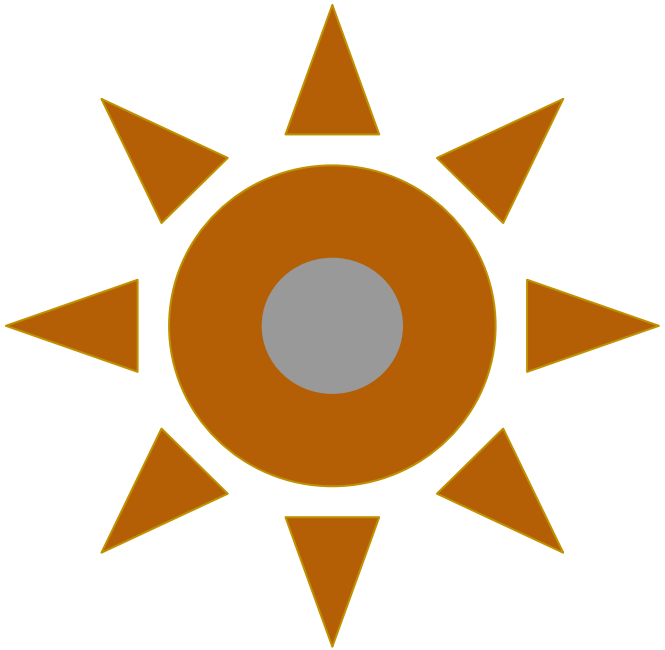
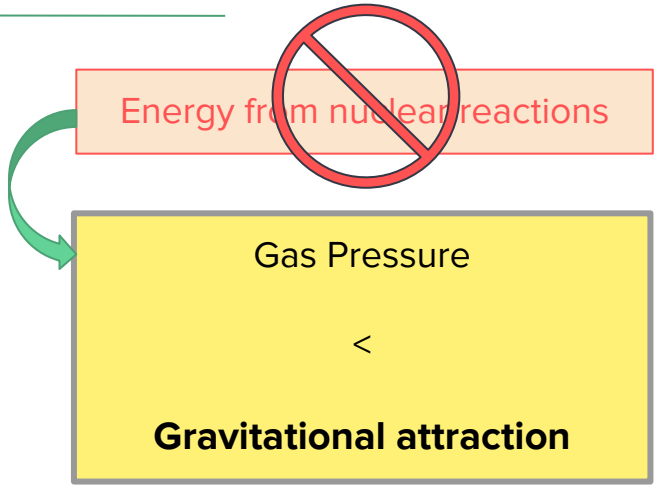
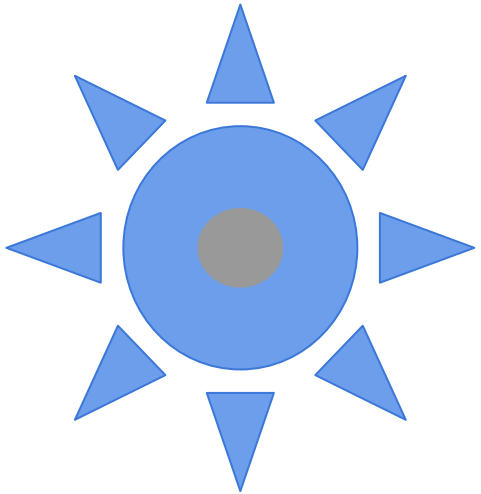
Gravitational attraction

Post RGB: Low mass





Post RGB: Low mass



White Dwarf

Electron Degeneracy Pressure

Gas Pressure

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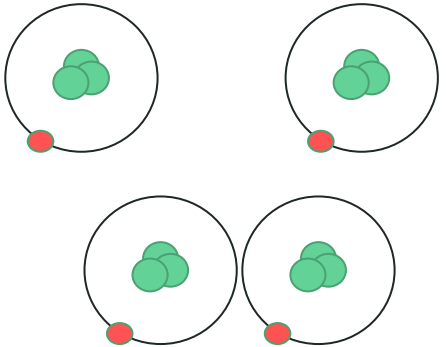
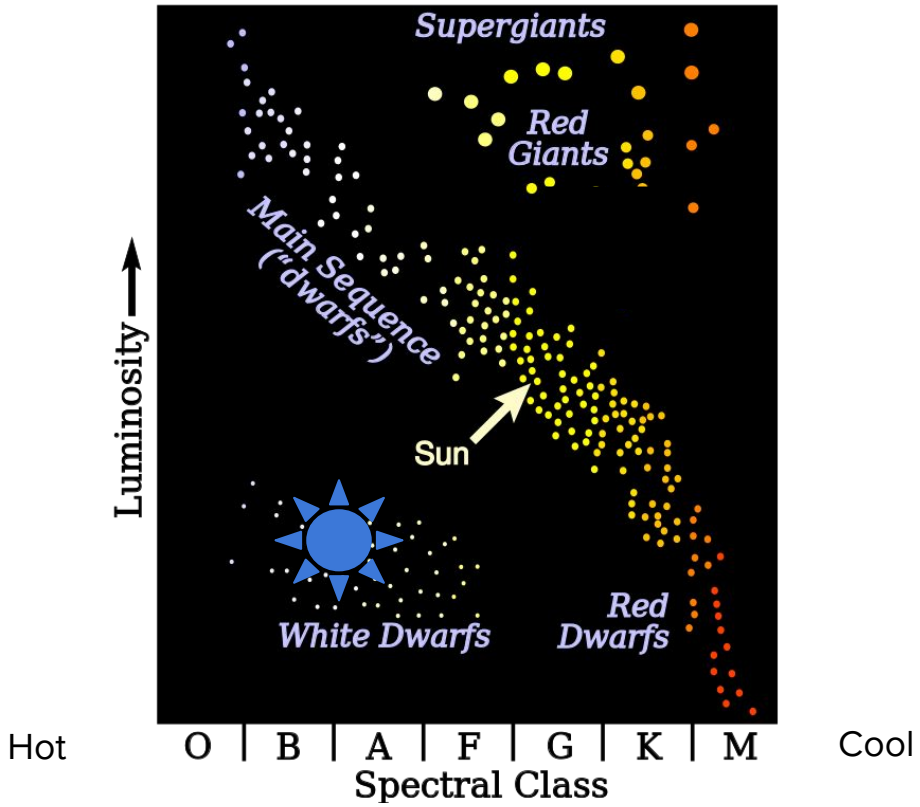
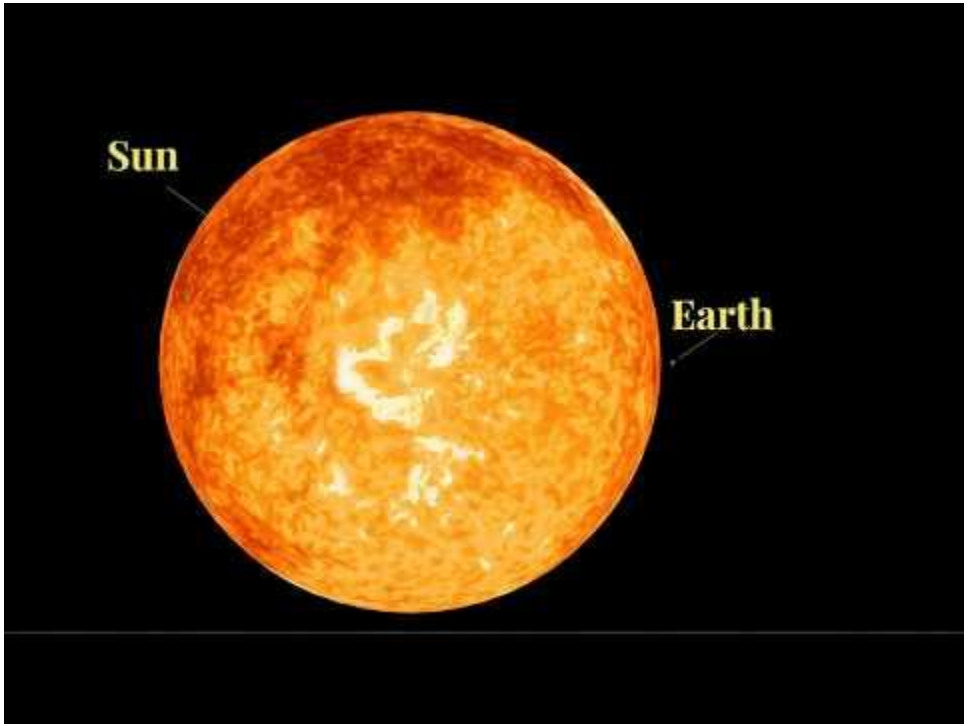
Gravitational attraction



HR diagram - White Dwarves



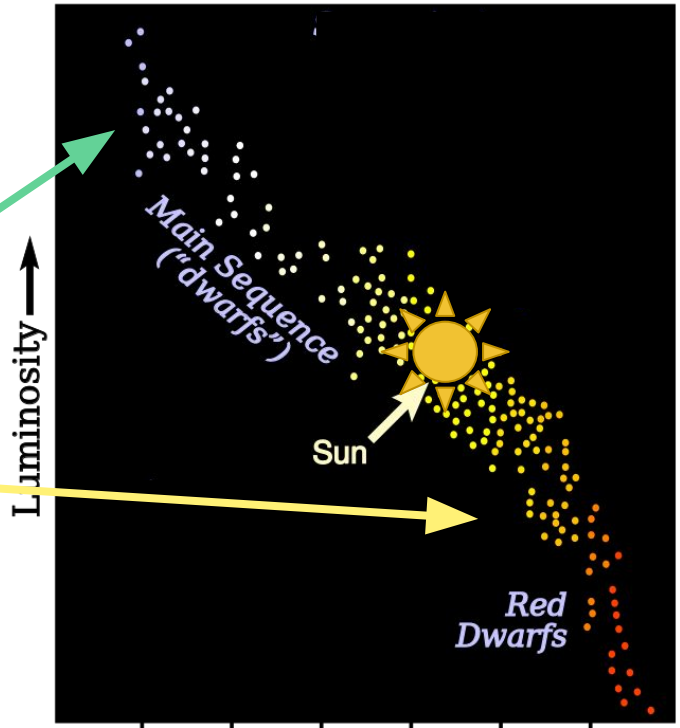
White dwarf size



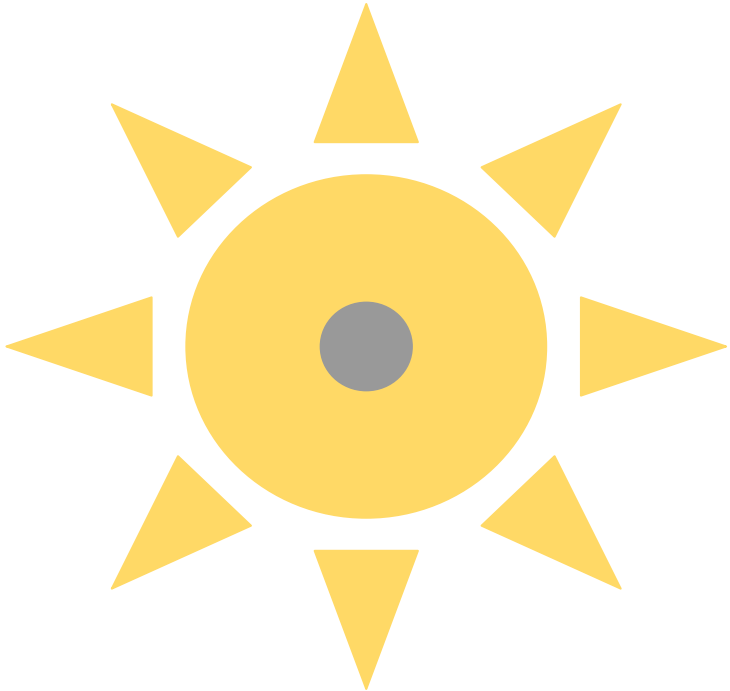
HR diagram - Main Sequence

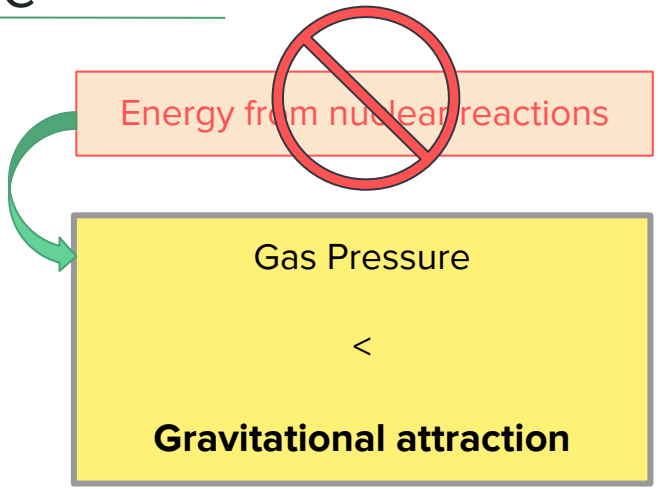
High mass stars - much more mass than the sun

Low mass stars - similar to the mass of the sun

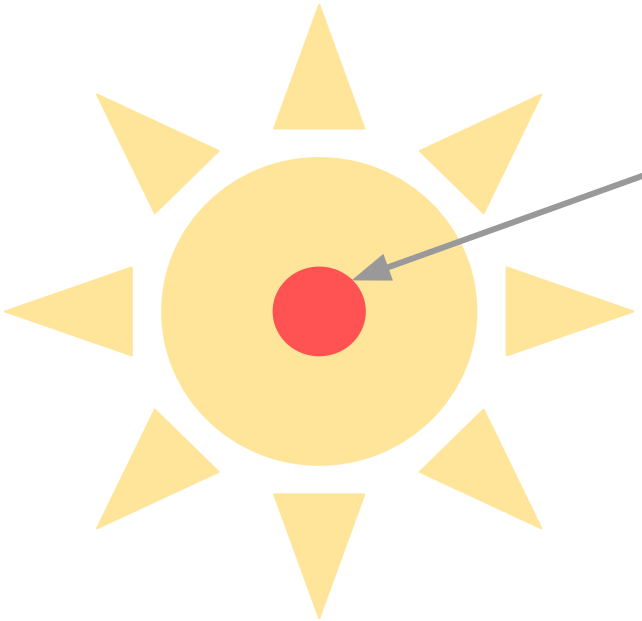


High mass: After the main sequence





High mass star

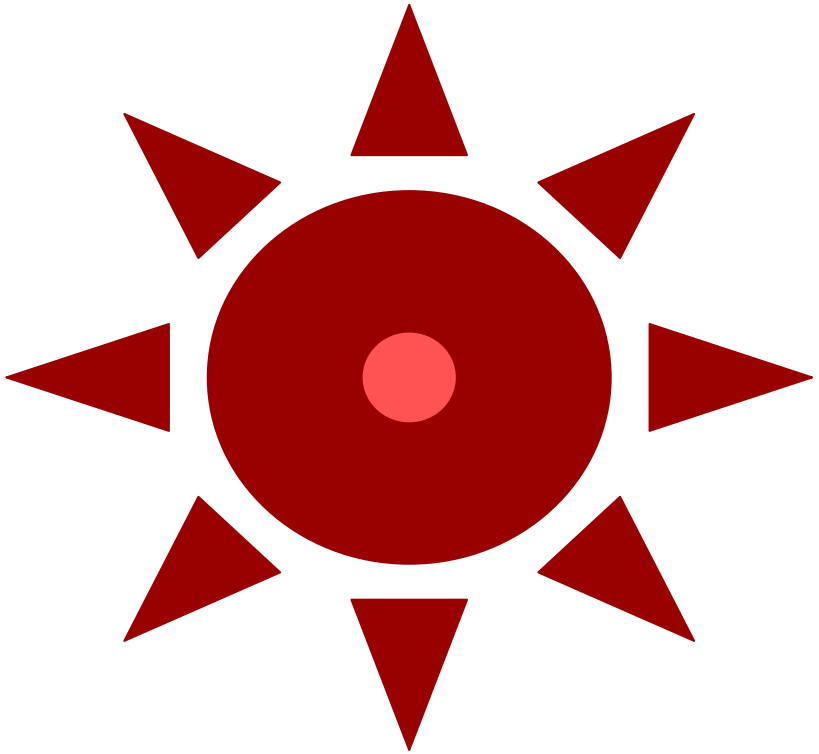


Core helium burning

$$^{4}_{2}\mathrm{He} + ^{4}_{2}\mathrm{He} \rightarrow ^{8}_{4}\mathrm{Be}$$

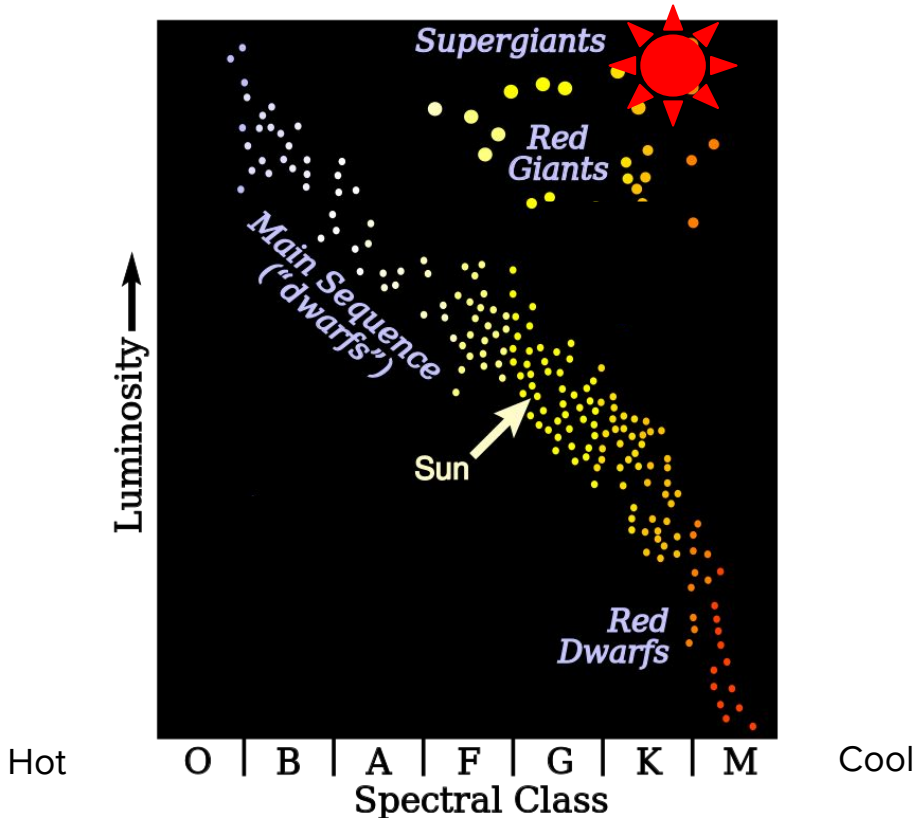
$$^{4}_{2}\mathrm{He} + ^{8}_{4}\mathrm{Be} \rightarrow ^{12}_{6}\mathrm{C}$$

High mass star

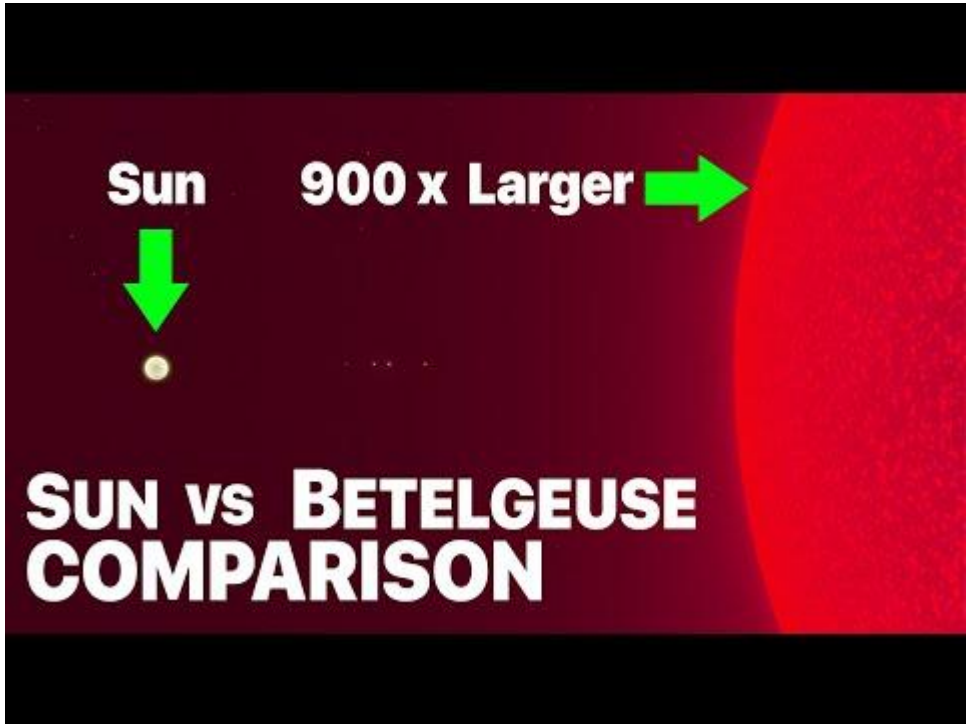


Red supergiant - its very big and red

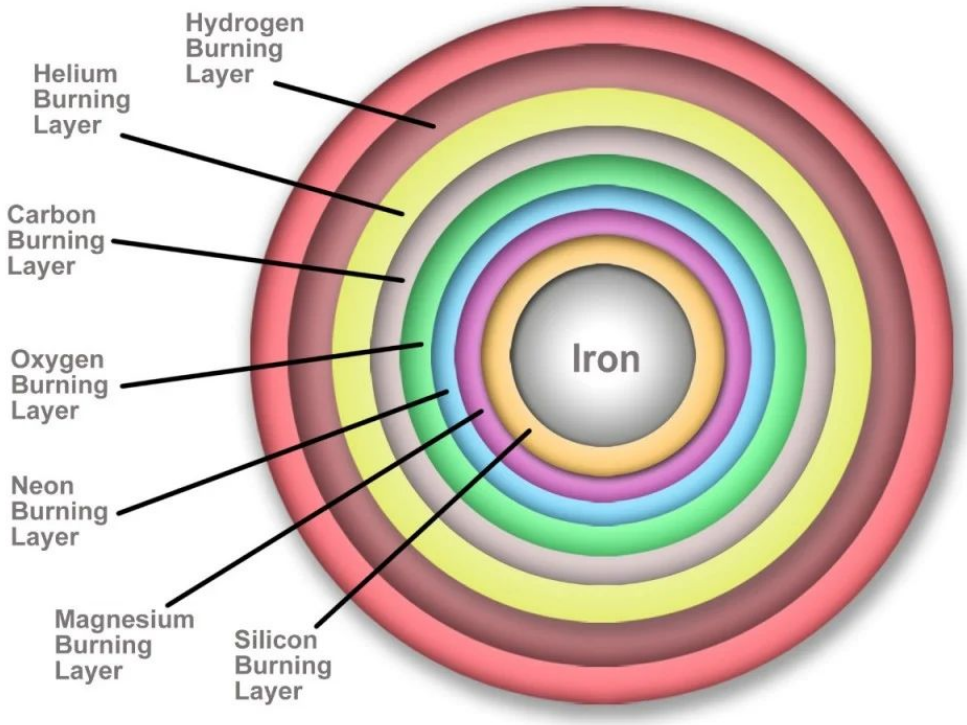
HR diagram - Red Supergiants



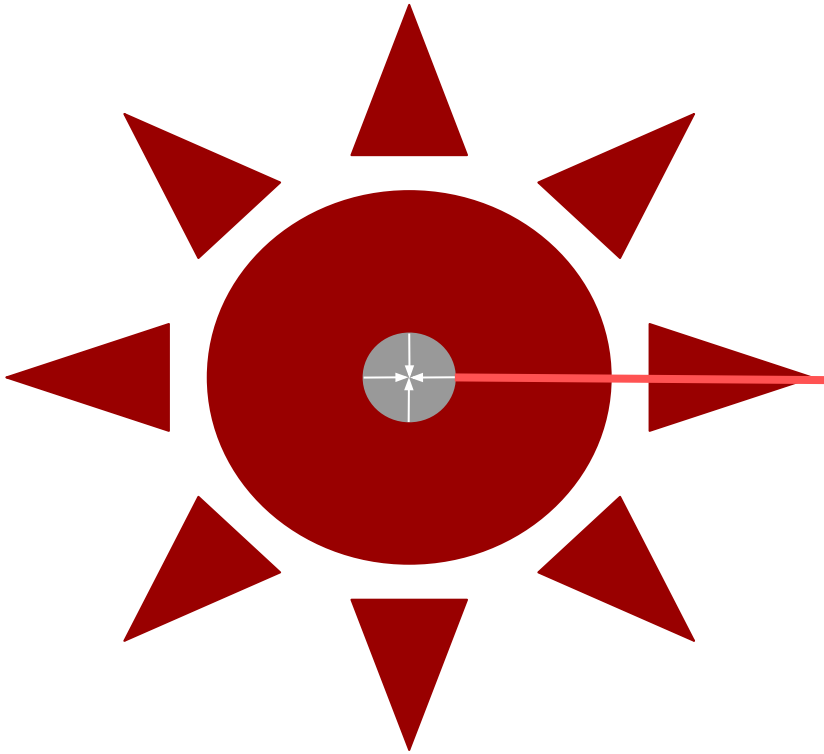
Red Supergiant



The high mass onion



Collapse

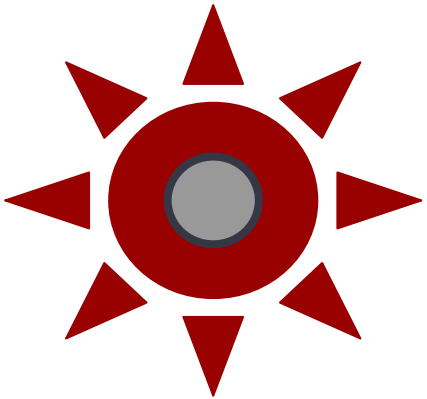


Iron burning **absorbs** energy

Contraction accelerates!

Massive collapse

Collapse

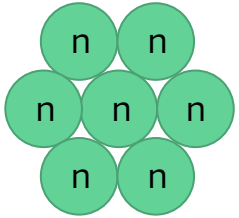


Neutron Degeneracy Pressure

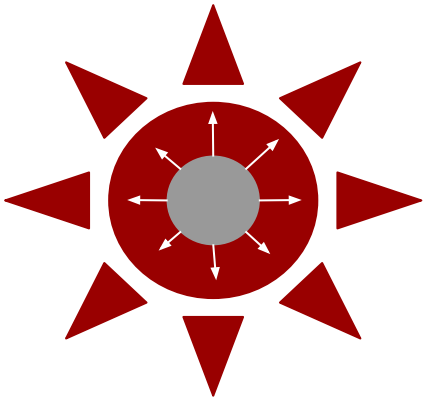
Gas Pressure

=

Gravitational attraction



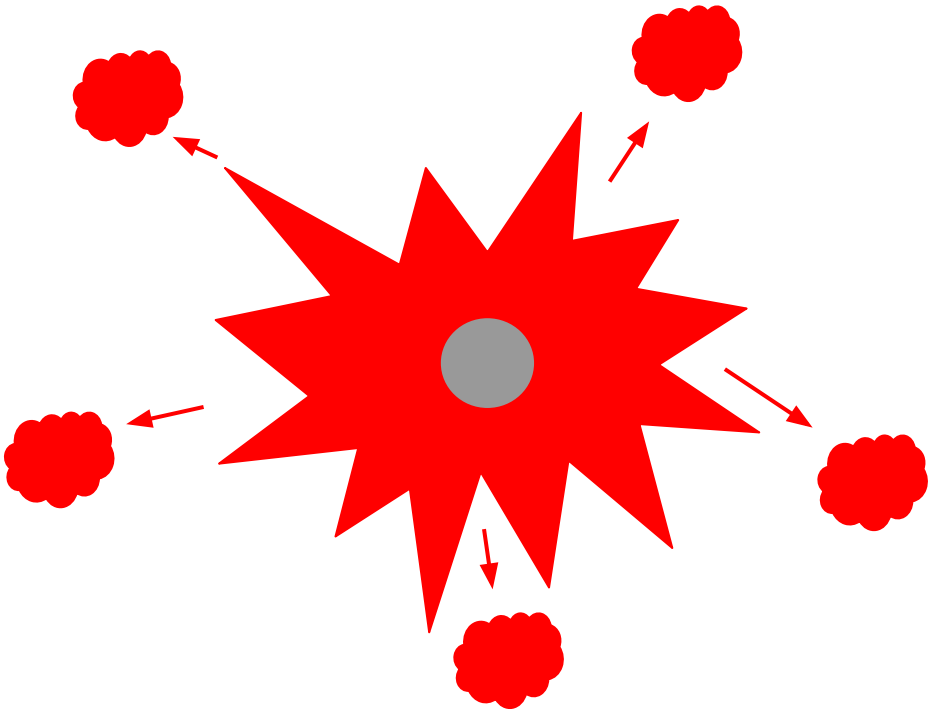
Collapse



Core releases **neutrino** particles that blast outward

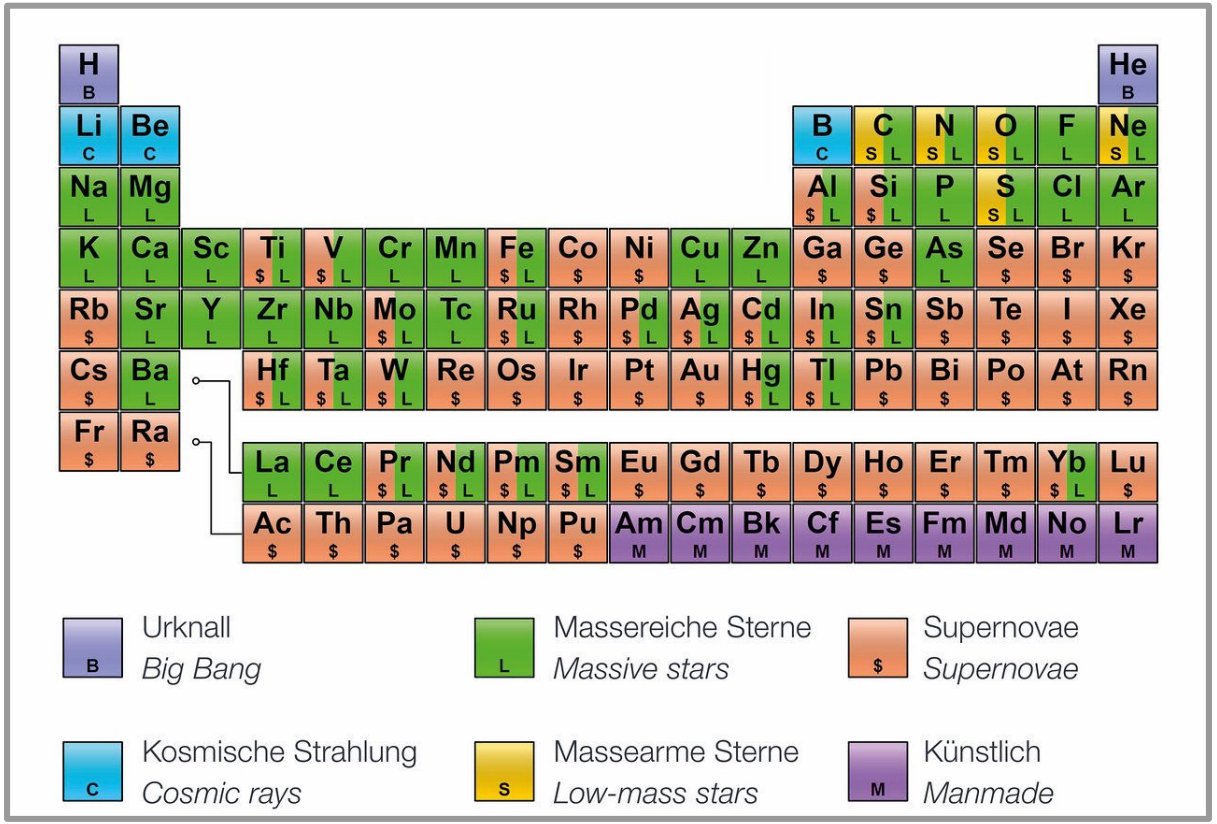
Explosion

High mass star: Supernova



100 x the energy the sun will radiate over its entire life!

Supernova and the periodic table



High mass star: Neutron star or Black hole

Neutron star

Neutron degeneracy pressure wins

Black hole

Gravitational potential wins

Overview