THE LIFE CYCLES OF STARS

HIGH MASS STARS

MAIN SEQUENCE

Composition is > 98% hydrogen and helium. 1/3 of the hydrogen is converted to helium.

- 10–150 solar masses
- 90% of lifespan
- Spica, Theta Orionis C

GIANT/SUPERGIANT

Massive stars are capable of producing heavier elements, like iron, through fusion.

- significant loss of mass
- 10% of lifespan
- Betelgeuse, Rigel

SUPERNOVA

Outer layers of hydrogen and helium are ejected along with some heavier elements.

- All but 10% of the original mass is ejected
- seconds
- Cassiopeia A, Kepler's Supernova

BLACK HOLE

A star's core collapses into extremely dense matter. Even light cannot escape the gravitational pull.

- 3 solar masses or larger
- 10^{70} years
- Cygnus X-1, Sagittarius A

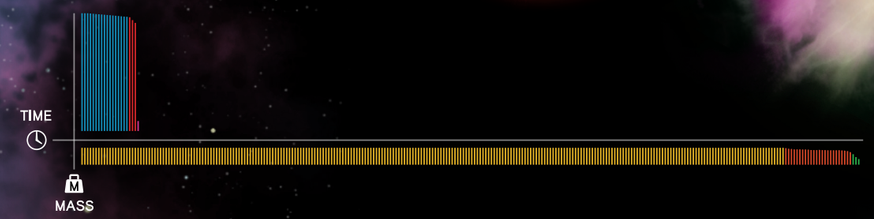
OR

NEUTRON STAR

A star's core collapses into a dense mass of neutrons.

- 1.4–3 solar masses
- 10^{33}–10^{45} years
- Circinus X-1, The Mouse

BORN IN NEBULAE
Gas clouds collapse and matter accumulates on a protostar.



High-mass stars live for one million to tens of millions of years while low-mass stars, like our Sun, live for tens of millions to trillions of years.

RETURN TO NEBULAE
Matter expelled from stars can eventually accumulate into new star-forming nebulae.

LOW MASS STARS

MAIN SEQUENCE

Composition is > 98% hydrogen and helium. 1/3 of the hydrogen is converted to helium.

- .08–10 solar masses
- 90% of lifespan
- Sun, Altair

RED GIANT

Expending hydrogen in their cores, these stars extend their outer layers and can grow to > 100 times their main sequence size.

- 99% of original mass
- 10% of lifespan
- Aldebaran, Arcturus

PLANETARY NEBULA

The outer layers of gas are ejected while the star's core contracts into a white dwarf.

- All but 5-15% of the original mass is ejected
- tens of thousands of years
- M27, NGC 40

WHITE DWARF

This star core is typically composed of carbon and oxygen. Neon, magnesium, and helium are possible.

- 5–15% of original mass
- 10^{15}–10^{25} years
- Mira B, Sirius B

BLACK DWARF

A hypothetical remnant of a cooled white dwarf, the Universe's existence is too short to prove its existence.

- < 1.4 solar masses
- 10^{33}–10^{45} years