

# The Fate of Stars

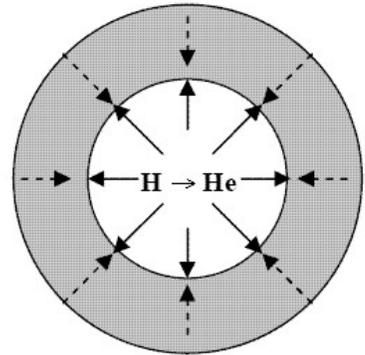
Just like people, stars have a lifetime that they live through.

- Our sun is about 4.5 billion years old, and should continue to “burn” for about another 7 billion years... it’s middle aged, which makes it a “Main Sequence Star”.
- This process goes faster for stars with more mass, since they have more gravitation making them crush in at higher temperatures and pressures.

## Main Sequence Stars

About one million years after the star forms, it becomes a main sequence star.

- It will be going through proton-proton chain reactions.
- The force of gravity inward = the force of fusion outward from the core.
- This will continue for about 10 billion years.
- Over this time it will slowly run out of hydrogen and fill up its core with helium.

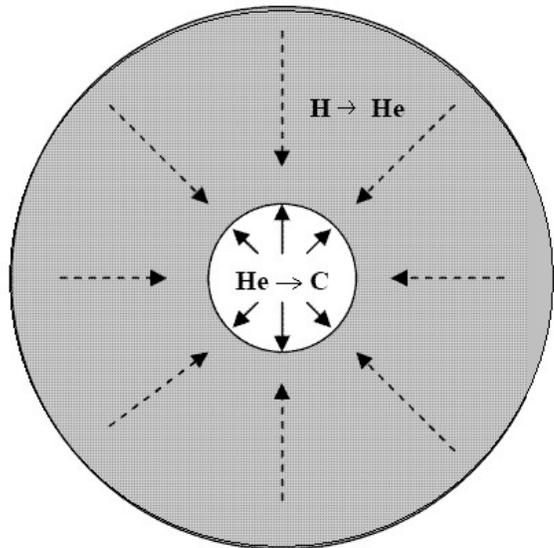


## Red Giants & Supergiants

The hydrogen is starting to be used up in the core, although the proton-proton chain might continue in the outer layers of the star.

As the hydrogen is used up in the core of the star, it will start to have less outward force.

- If the outward force drops low enough, the core will start to collapse from gravity pushing inward.
  - This causes the core to heat up and start the carbon cycle, while the heat radiates outward to the outer layers.
  - The heated outer layer expands and cools.
- The star is now a red giant, which can be up to 1000 times bigger than our own sun right now.
- It will continue to collapse and expand in a cycle for only about a billion years, slowly losing some of its outer layers.
- What happens next depends on how much mass it has left... either a *white dwarf* or a *neutron star* will form.



## White Dwarf

If the mass left is small to medium, the star will eventually collapse into a white dwarf.

It will be about the size of the Earth, but almost 70% as heavy as a sun

Although it is not as bright, it can continue to release heat for a few billion years from heat in its core.

As it cools, it will eventually become a *black dwarf*... a dead, burned-out star core.

## Neutron Stars

If the mass of the red giant is big enough, it will eventually collapse under the intense gravity of its own weight down to a neutron star.

All of the atoms of the star have been scrunched together to form neutrons.

It can have more mass than our sun compressed into a sphere 20 km in diameter!

The outer layers of the red giant probably exploded outwards as a *supernova*.

This releases elements from hydrogen to iron into space.

It is possible that the neutron star might collapse even further and form a *black hole*.