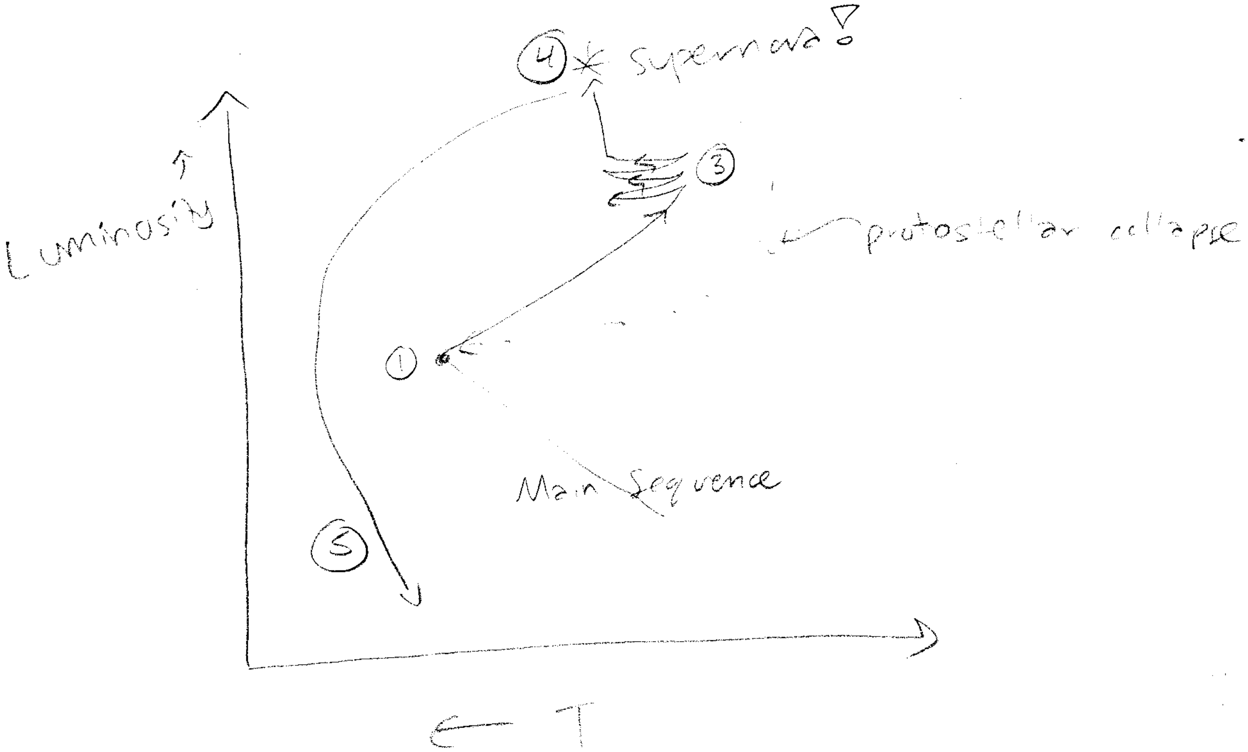
Life of a High Mass ☆



① <u>Main Sequence</u>: lives a much shorter lifetime than low mass stars:

recall: $\cdot\ L \propto \frac{E}{t_{life}}$

$\cdot\ E \propto Mc^2$

for ☆'s on the main seq. → $\cdot\ L \propto M^{3.5}$

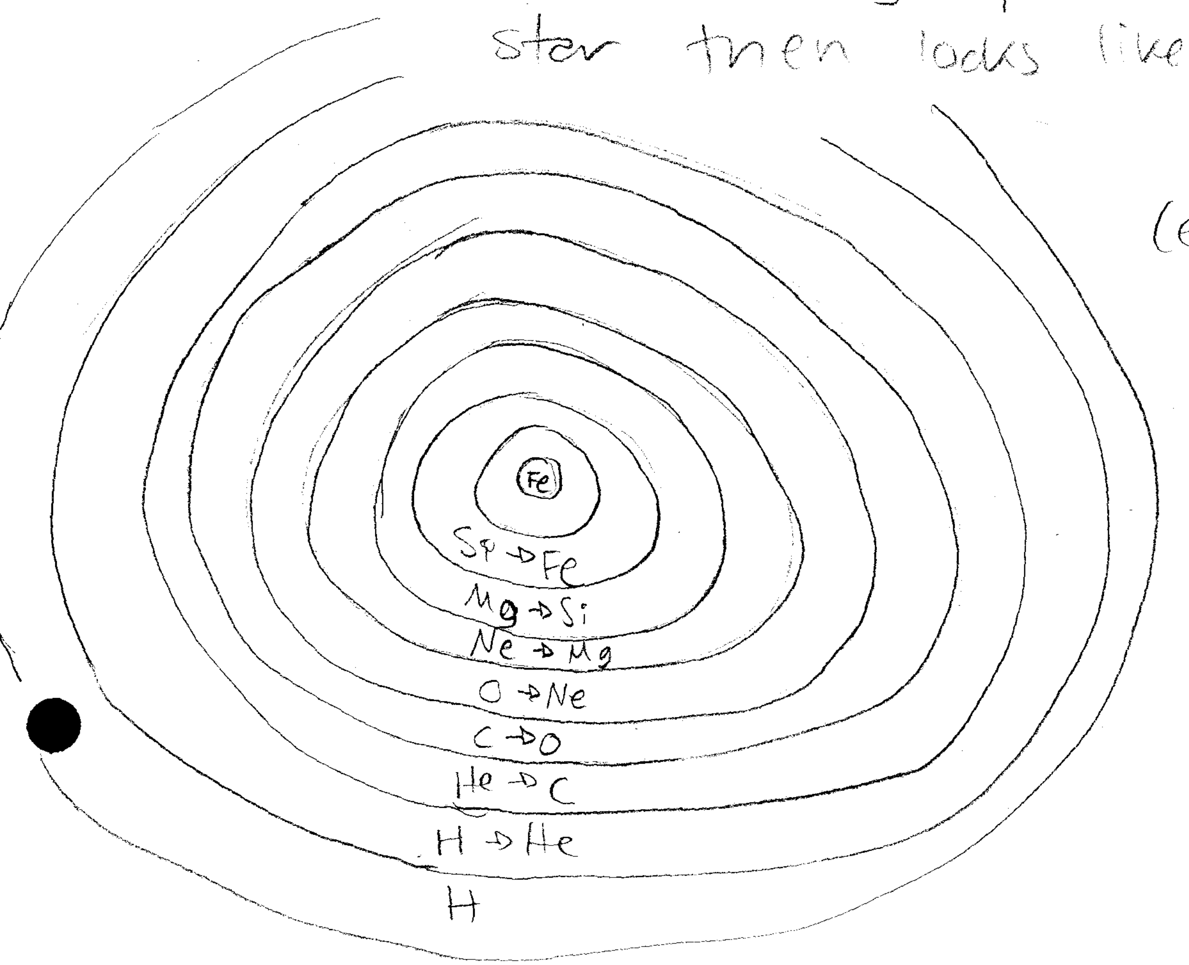
$$\left.\begin{array}{l} L \propto \frac{E}{t_{life}} \\ E \propto Mc^2 \\ L \propto M^{3.5} \end{array}\right\} M^{3.5} \propto \frac{M}{t_{life}} \Rightarrow t_{life} \propto M^{-2.5}$$

- fuse H → He via the <u>CNO cycle</u>
  ⇒ a more complicated reaction sequence involving carbon, nitrogen & oxygen which is more effecient @ higher temps. (in high mass ☆'s

③ Post-M.S. & Pre-S.N.

- Because the H→He core of high mass ☆'s is hotter than low-mass stars, the core is <u>not</u> degenerate
  - ⇒ there is <u>not</u> a He-flash for He→C fusion

- Because the core is hotter, it can fuse elements past C
  - ⇒ depending on how massive (i.e. hot) the ☆ is, it may fuse elements all the way up to Iron. The star then looks like:



(except more spherical)

④ any further nuclear reactions beyond Fe <u>require</u> energy

$\Rightarrow$ nothing to hold up very massive ($M \gtrsim 10 M_\odot$) ☆'s against gravity.

$\Rightarrow$ SUPERNOVAE?

⑤ if $M \lesssim 20 M_\odot$ $\Rightarrow$ End stage is <u>Neutron</u> <u>Star</u>

if $M \gtrsim 20 M_\odot$ $\Rightarrow$ even neutron degeneracy pressure cannot support the ☆ against gravitational collapse

$\Rightarrow$ <u>Black</u> <u>Hole</u>