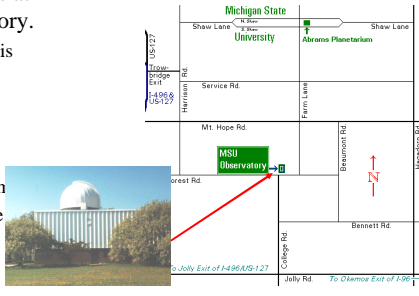


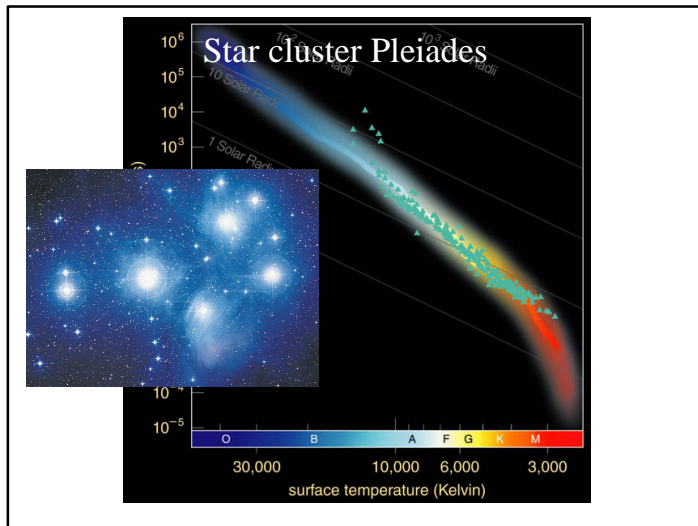
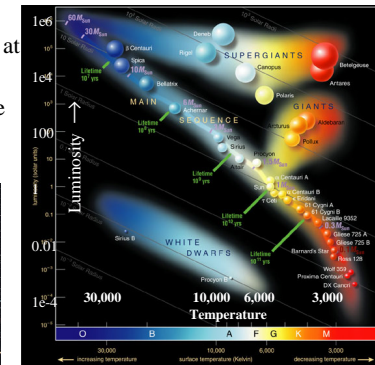
The future sun—March 18

- New policy: if you turn in more than 2 clicker paper answers, they will count 2 pts/question.
- Public viewing sessions at MSU campus observatory.
 - Fri & Sat, 9-11pm, if it is not cloudy.
 - Mar 18 & 19
 - Apr 15 & 16
 - May 13 & 14
 - 24-inch telescope in don
 - small telescopes outside
- Why does the sun die?
- What will the sun become when it dies?



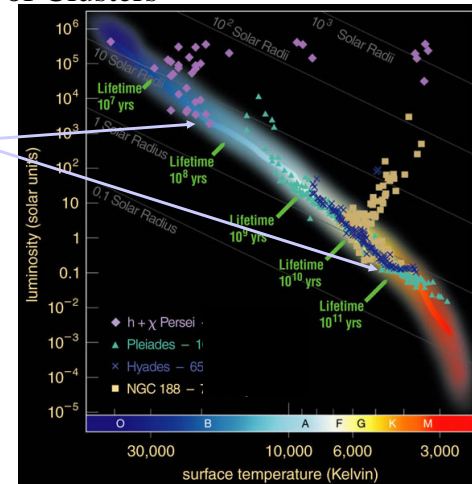
Giants are dying stars; white dwarfs are dead stars

- Evidence on giants from star clusters
- All stars in a cluster are born at once.
- 100,000 fraternal twins, some weighing 30 times me, the G star, some 1/10 me.



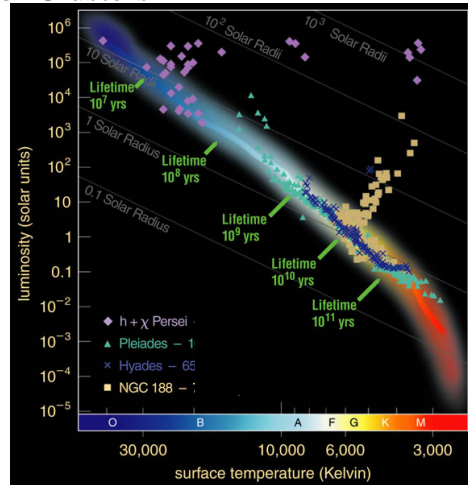
HR Diagram of Clusters

- Not all fainter stars were observed
- In what ways are HR diagrams of $H+\chi$ Perseus, Pleiades, Hyades, & NGC188 different?
 - Perseus is hotter than Pleiades
 - Not all stars are on MS
 - Perseus has small range of luminosity

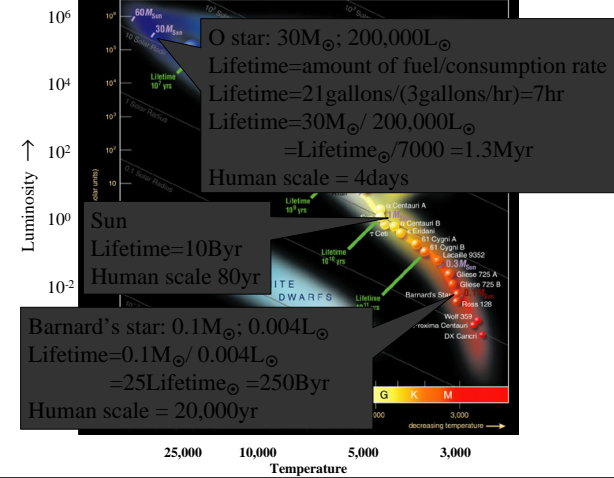


HR Diagram of Clusters

- In what ways are HR diagrams of H+ χ Perseus, Pleiades, Hyades, & NGC188 different?

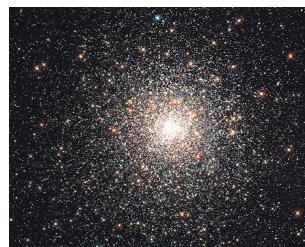


Stars with high mass live a short life



H-R Diagrams of star clusters

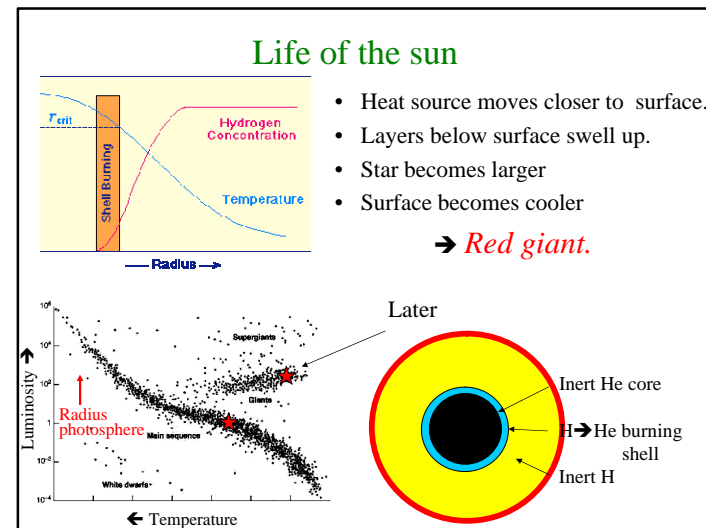
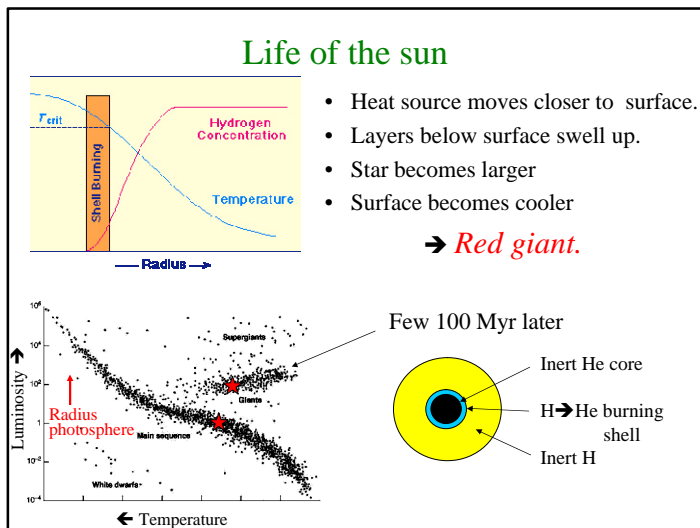
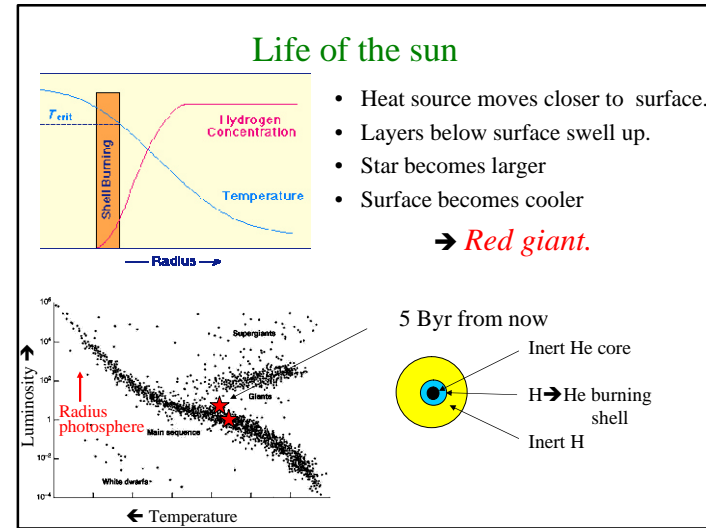
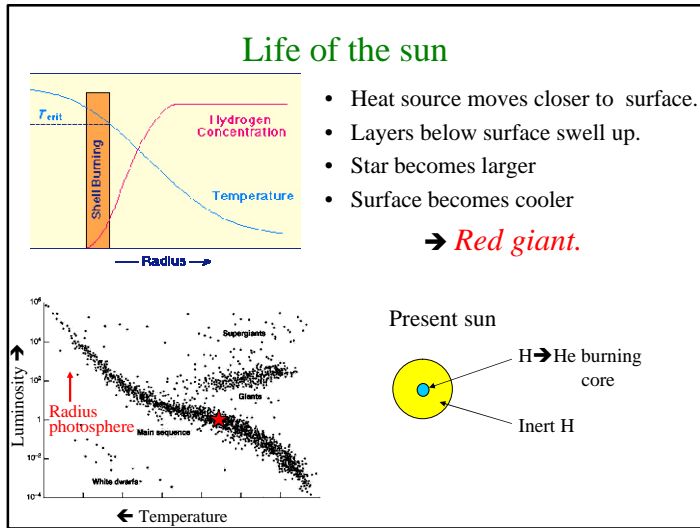
- There are no A stars in M80 because
 - they never formed.
 - they died and disappeared
 - all stars became redder as they get older.
 - they are too faint to see.



H-R Diagrams of star clusters

- The hottest dwarfs in Pleiades are A stars. The hottest dwarfs in M15 are F stars. Pleiades is ____ than M15.
 - older
 - younger





After helium is used up

Reaction	Min. Temp.
$4\ ^1\text{H} \rightarrow\ ^4\text{He}$	$10^7\ ^\circ\text{K}$
$3\ ^4\text{He} \rightarrow\ ^{12}\text{C}$	2×10^8
$^{12}\text{C} +\ ^4\text{He} \rightarrow\ ^{16}\text{O},\ \text{Ne},\ \text{Na},\ \text{Mg}$	8×10^8
$\text{Ne} \rightarrow\ \text{O},\ \text{Mg}$	1.5×10^9
$\text{O} \rightarrow\ \text{Mg},\ \text{S}$	2×10^9
$\text{Si} \rightarrow\ \text{Fe peak}$	3×10^9

Triple-alpha process

- Contraction heats center
- Helium starts to burn.

