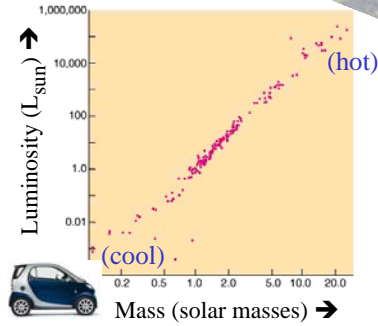


## Fuel economy & lifetimes



Models show:  
Main sequence is where stars burn  
 $4\text{ H} \rightarrow \text{He}$

Spectral Type	Surface Temp.	Mass ( $M_{\odot}$ )	Lifetime (yrs)
O (hot)	40,000	40	$10^6$
B	28,000	16	$10^7$
A	10,000	3.3	$5 \times 10^8$
F	7,500	1.7	$3 \times 10^9$
G	6,000	1.1	$9 \times 10^9$
K	5,000	0.8	$10^{10}$
M (cool)	3,000	0.4	$2 \times 10^{11}$

- Mass = fuel for  $\text{H} \rightarrow \text{He}$  burning.
- Luminosity = rate at which fuel is used.
- $M/L \rightarrow$  lifetime of star.

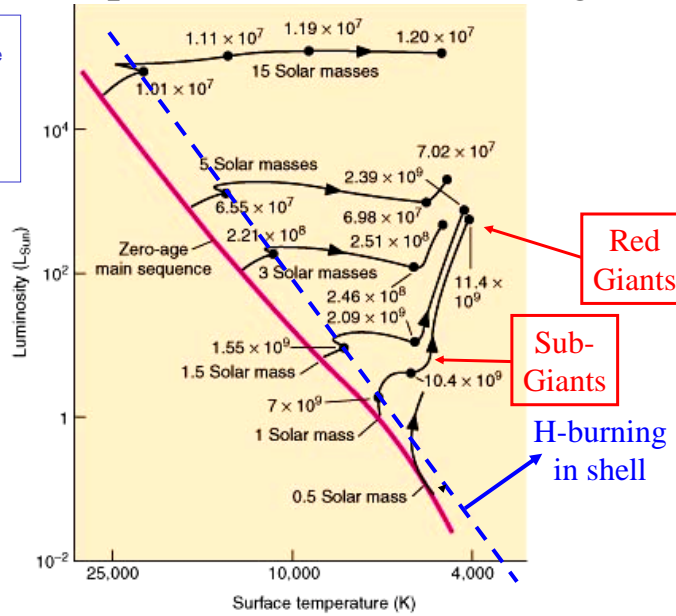
Hot O star:  $M/L = 20/100,000 = 0.0002$  time units.

Cool M star:  $M/L = 0.2/0.01 = 20$  time units.

## Predicted paths of stars on HR diagram

Announcements:  
Today's Notes are on the web.

Hwk 5 - 31 March  
Hwk 6 - 5 April  
Midterm 3 - 7 Apr



see figs [12.12, 12.14]

[Interactive HR Diagram](#)

# Star clusters are the testing ground [11.3]

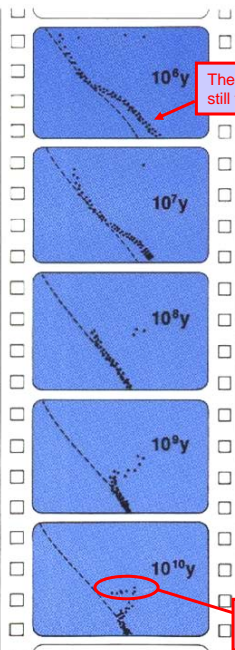


Open Clusters: formed in disk of Galaxy. Some recently-formed, some middle-aged.



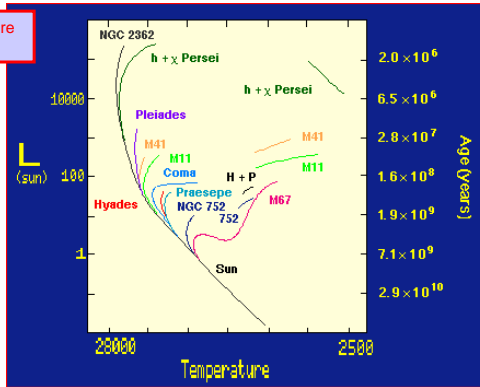
Globular Clusters: ~ 150 in spherical distribution in our Galaxy. All are very old.

# Star clusters are snapshots of stellar evolution



These stars are still forming.

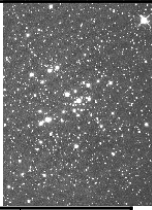
Horizontal branch: Core helium burning.



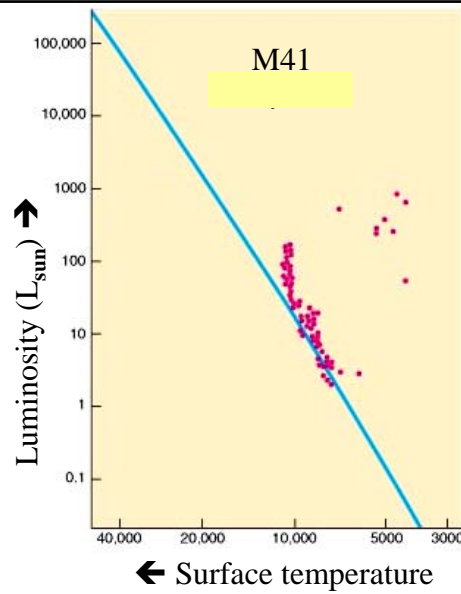
- All stars in a given cluster formed at same time.
- But with a wide range in masses.
- **Main sequence turnoff** = stars just finishing main sequence evolution.

[Interactive HR Diagram](#)  
[HR - The Movie](#)

## H-R Diagram of a young cluster



Spectral Type	Surface Temp.	Mass ( $M_{\odot}$ )	Lifetime (yrs)
O5	40,000	40	$10^6$
B0	28,000	16	$10^7$
A0	10,000	3.3	$5 \times 10^8$
F0	7,500	1.7	$3 \times 10^9$
G0	6,000	1.1	$9 \times 10^9$
K0	5,000	0.8	$10^{10}$
M0	3,000	0.4	$2 \times 10^{11}$



## Globular clusters.

Spectral Type	Surface Temp.	Mass ( $M_{\odot}$ )	Lifetime (yrs)
O5	40,000	40	$10^6$
B0	28,000	16	$10^7$
A0	10,000	3.3	$5 \times 10^8$
F0	7,500	1.7	$3 \times 10^9$
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M0	3,000	0.4	$2 \times 10^{11}$

