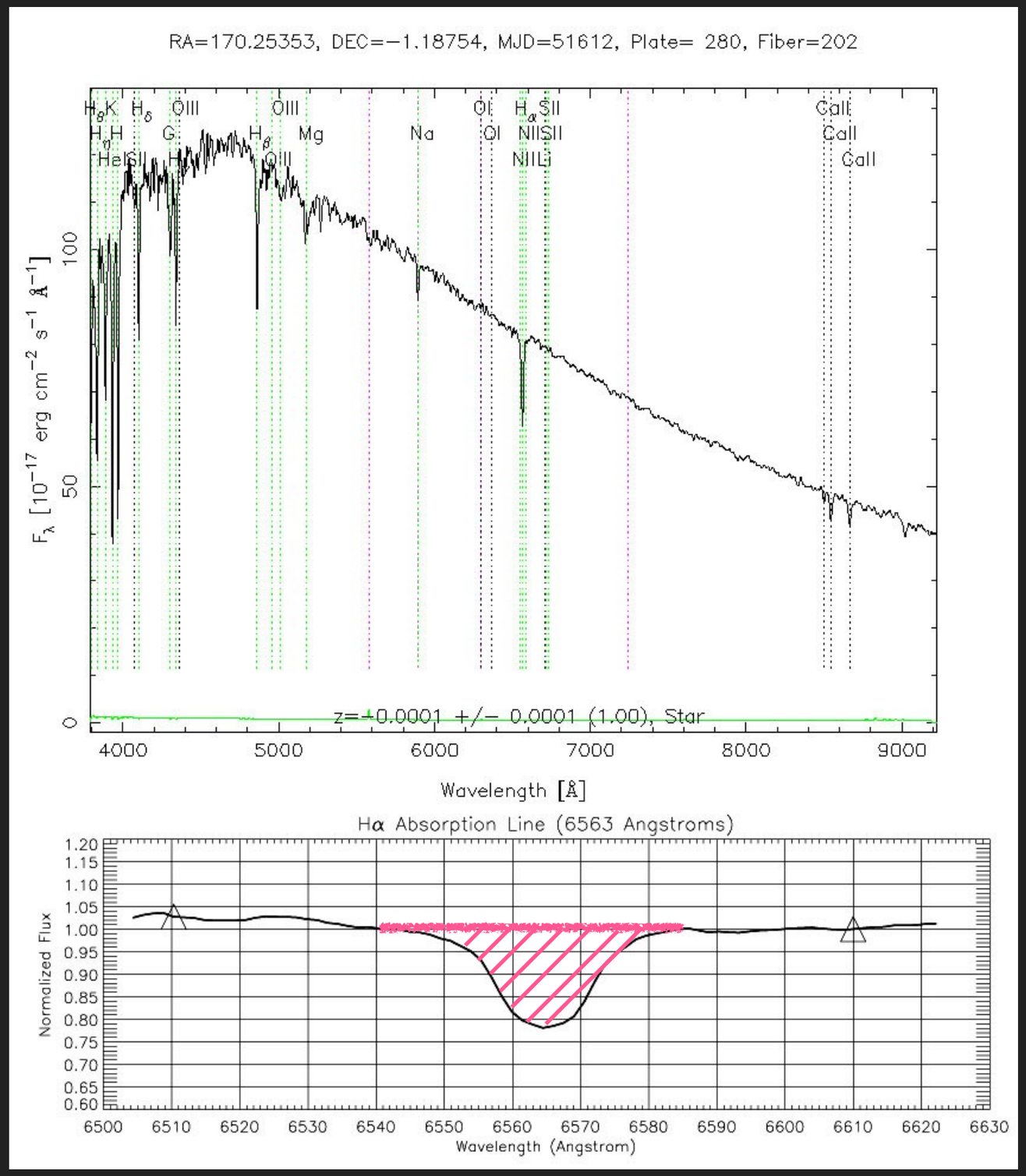
STELLAR EVOLUTION

ASTROPHYSICS

Dr H.T.Sener

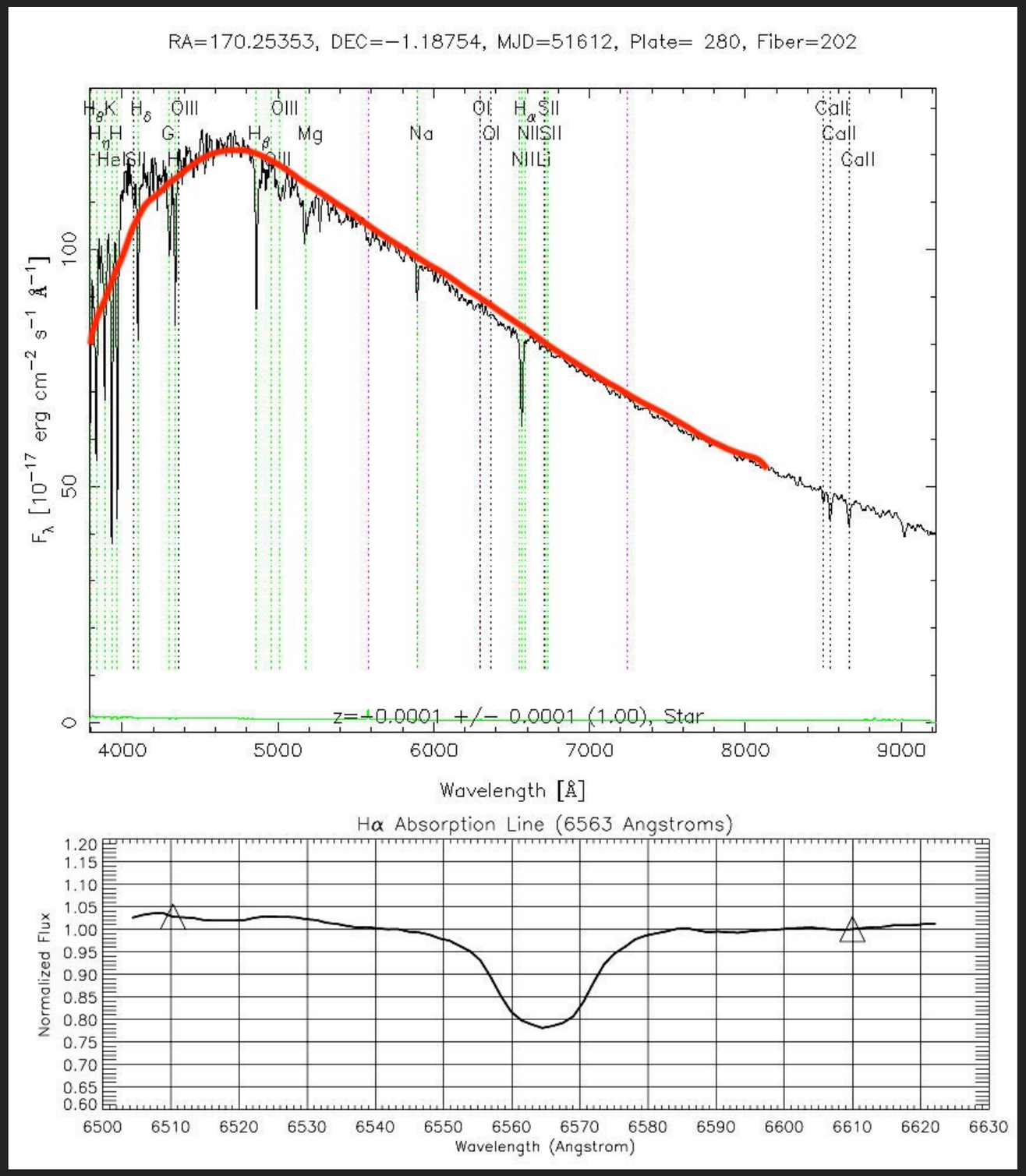
HOMEWORK



Line Strength	Spectral Type
6	A
2	B
3	F
7	G
1	K
5	M
4	O

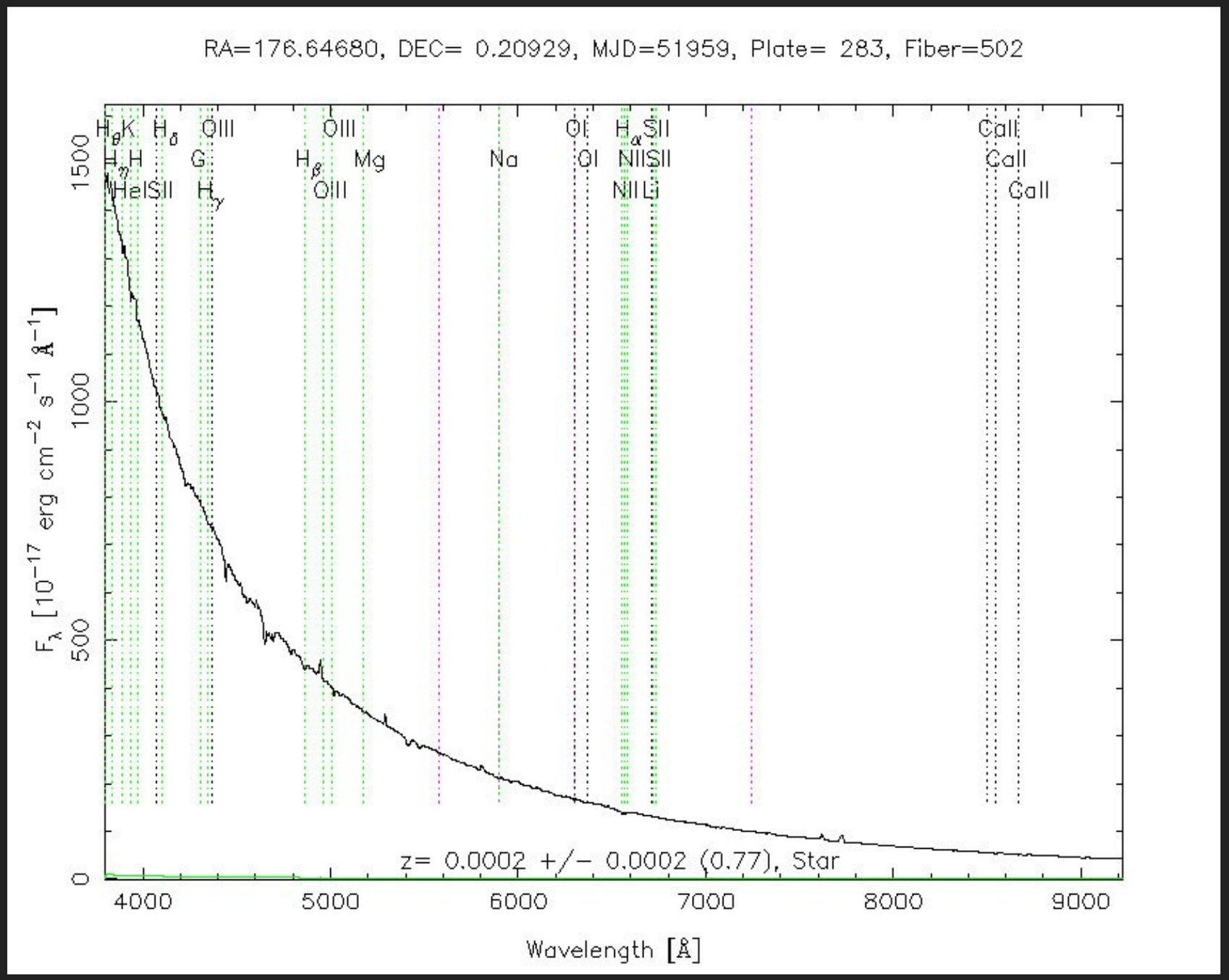
- Put the stars in an order according to the strength of their Hα absorption lines.

EXERCISE



Peak Wavelength	Spectral Type
4	O
2	B
6	A
3	F
7	G
1	K
5	M

EXERCISE



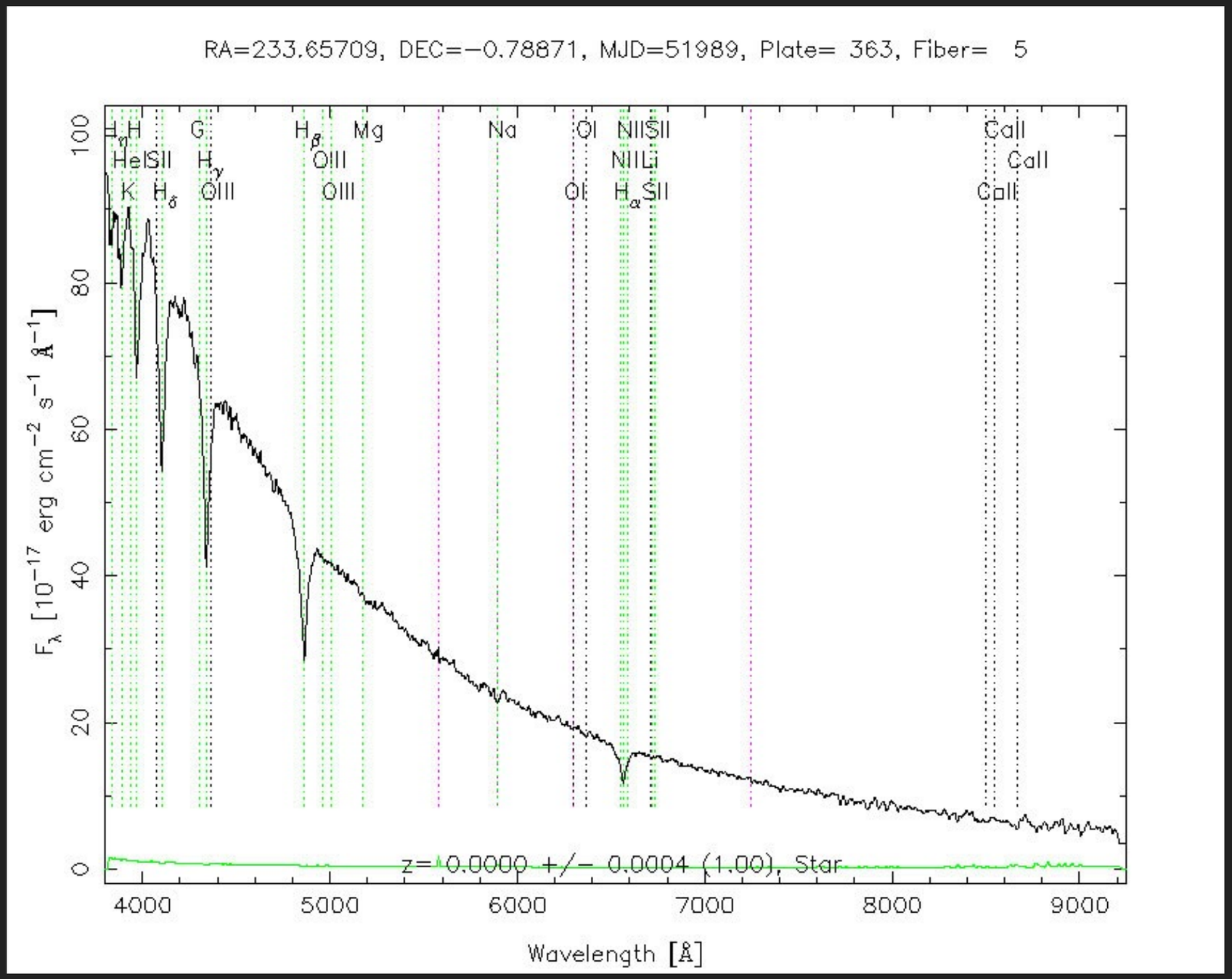
#4

$$\lambda_{max} = \frac{2897,8\ \mu m\ K}{T}$$

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	>3800
T	>7600

EXERCISE

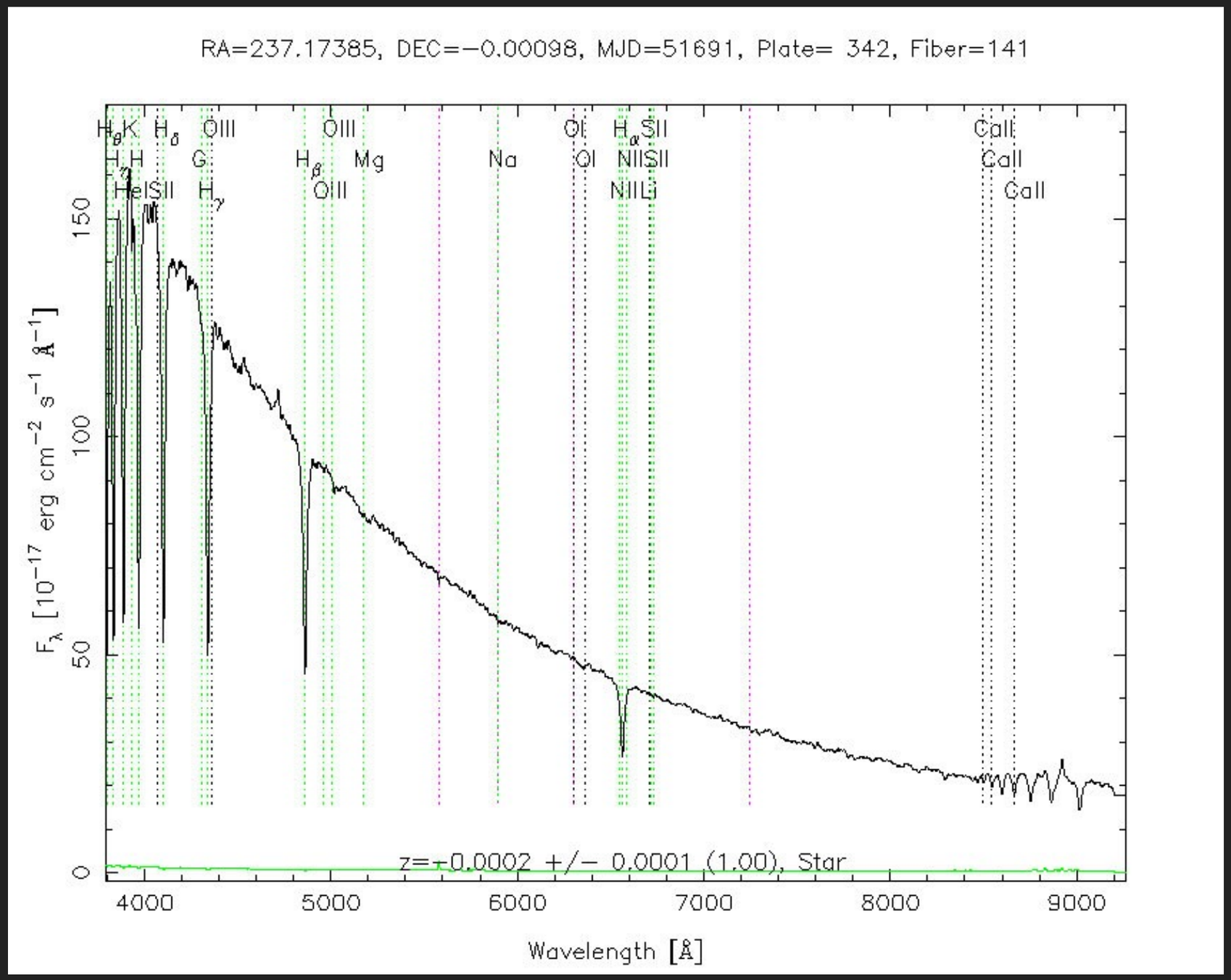


#2

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	~3800
T	~7630

EXERCISE

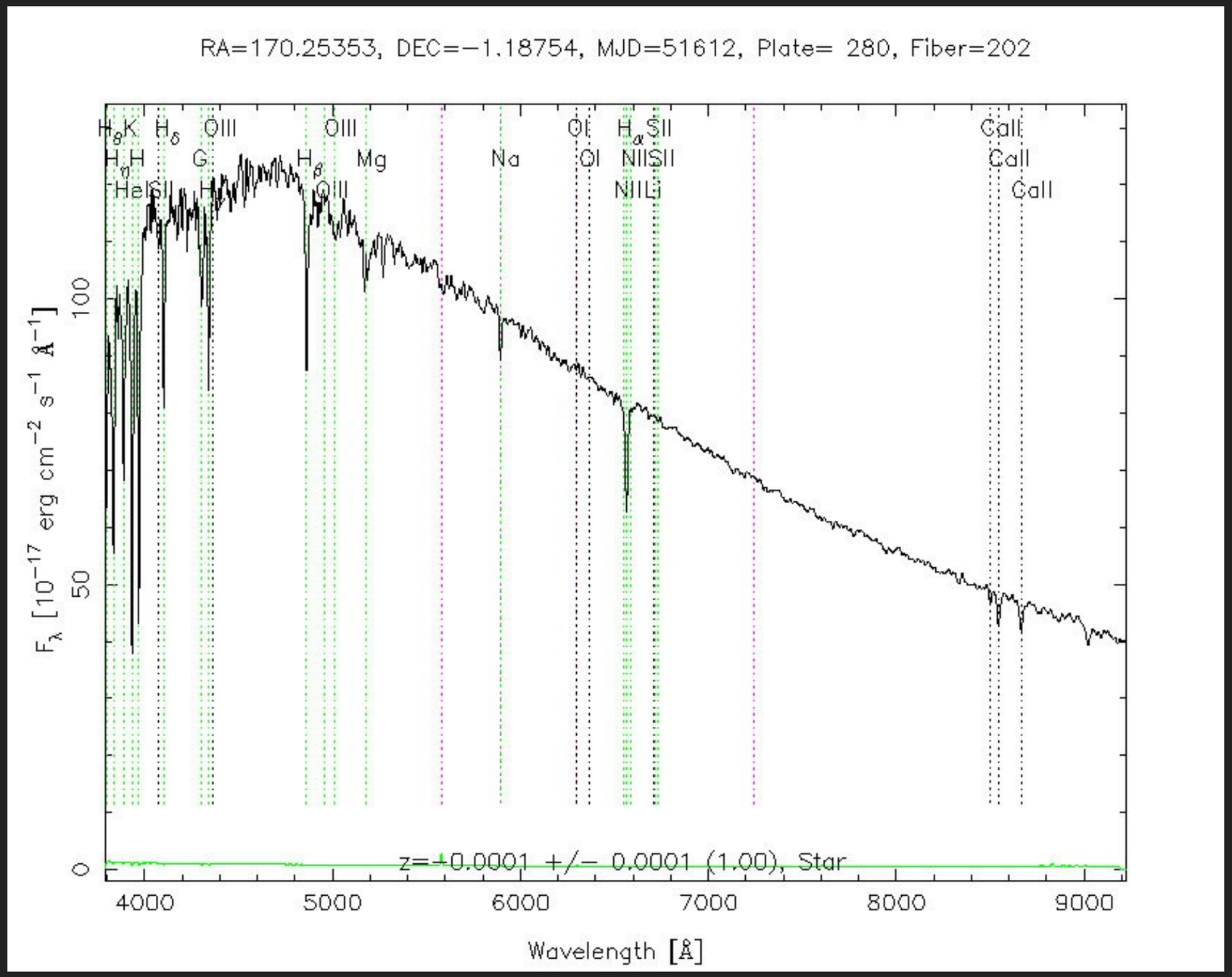


#6

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	3900
T	7435

EXERCISE

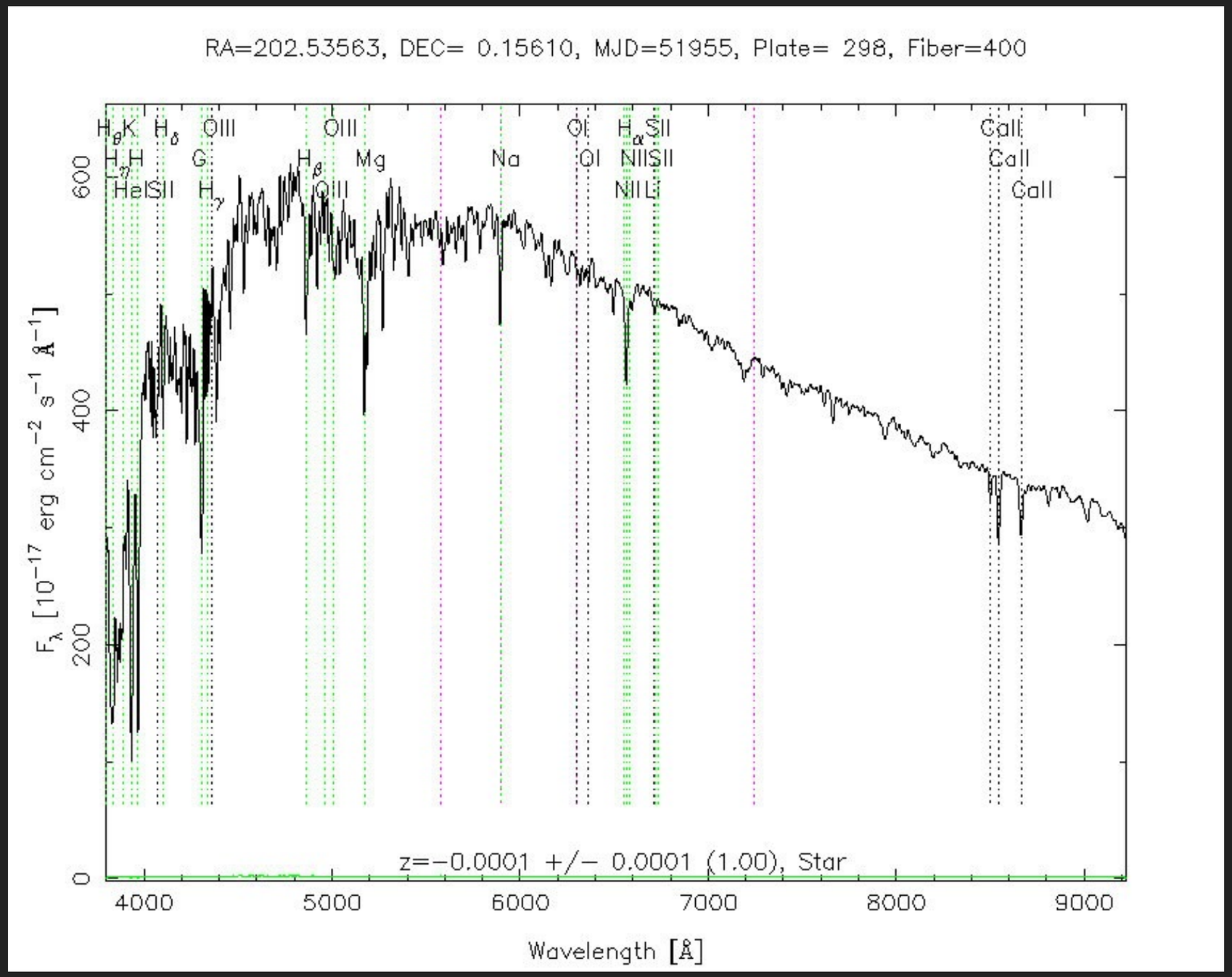


#3

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	4500
T	6440

EXERCISE

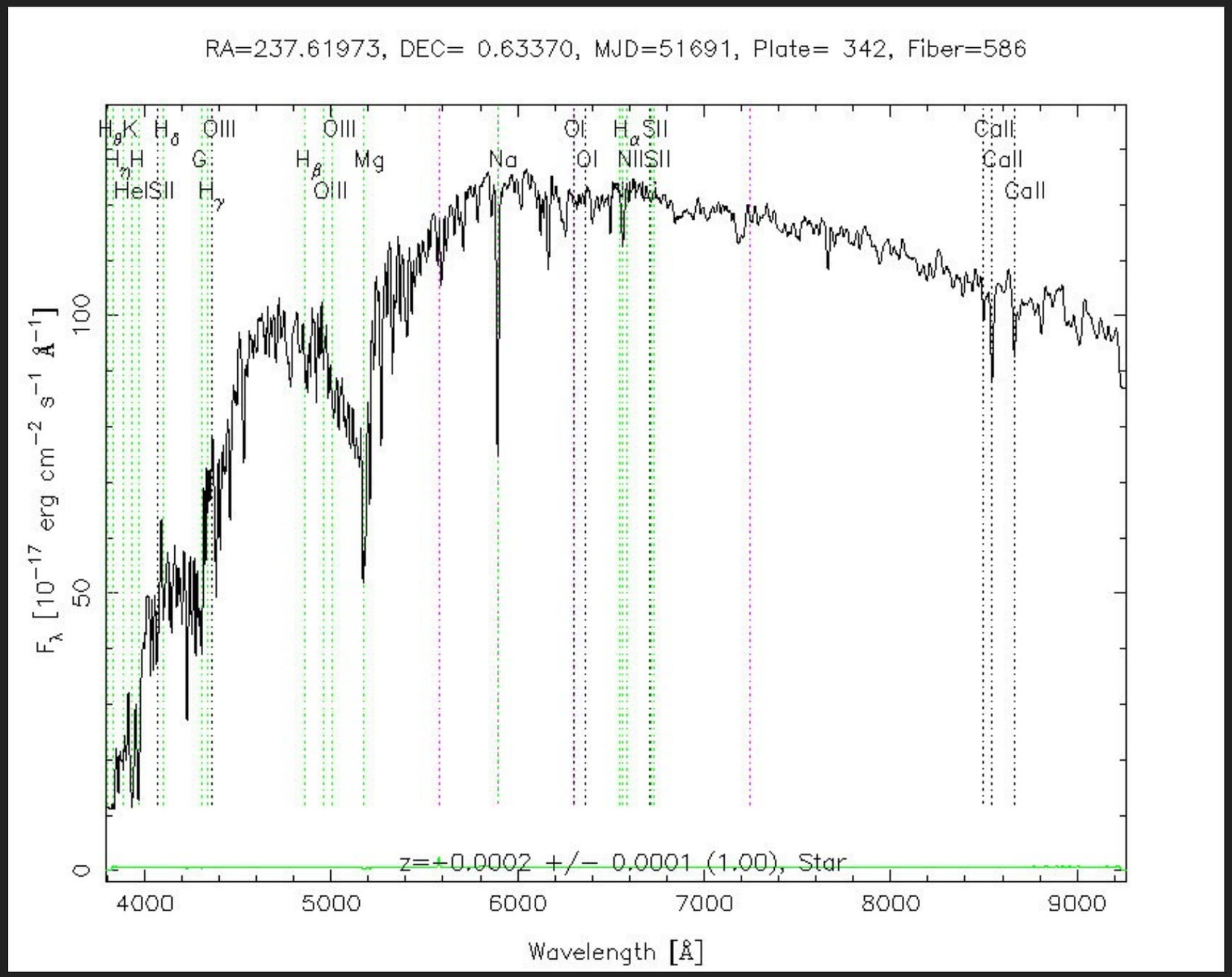


#7

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	5000
T	5800

EXERCISE

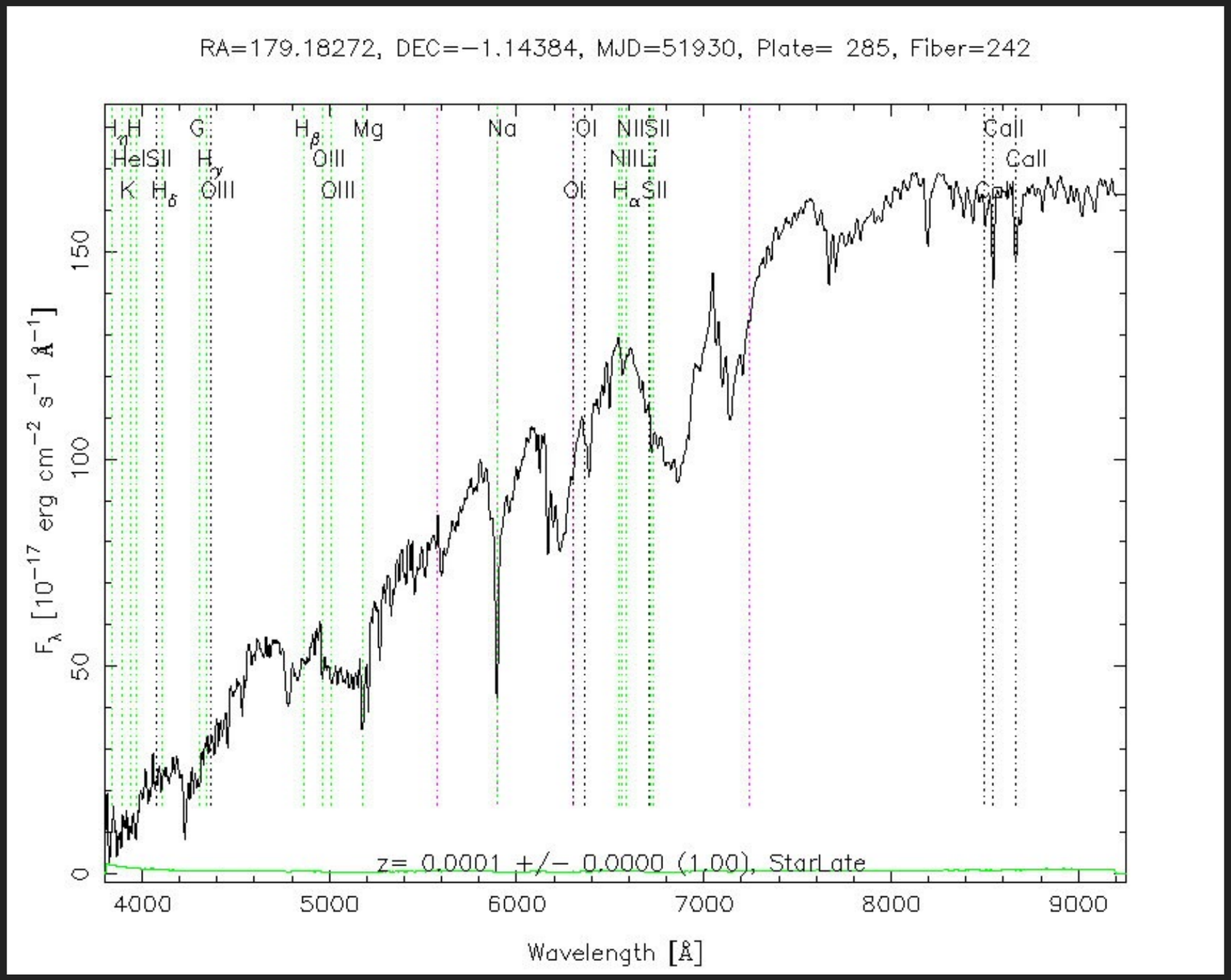


#1

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

λ_{max}	5600
T	5180

EXERCISE



#5

$$T = \frac{2.9 \cdot 10^7 [\text{Å}K]}{\lambda_{max}}$$

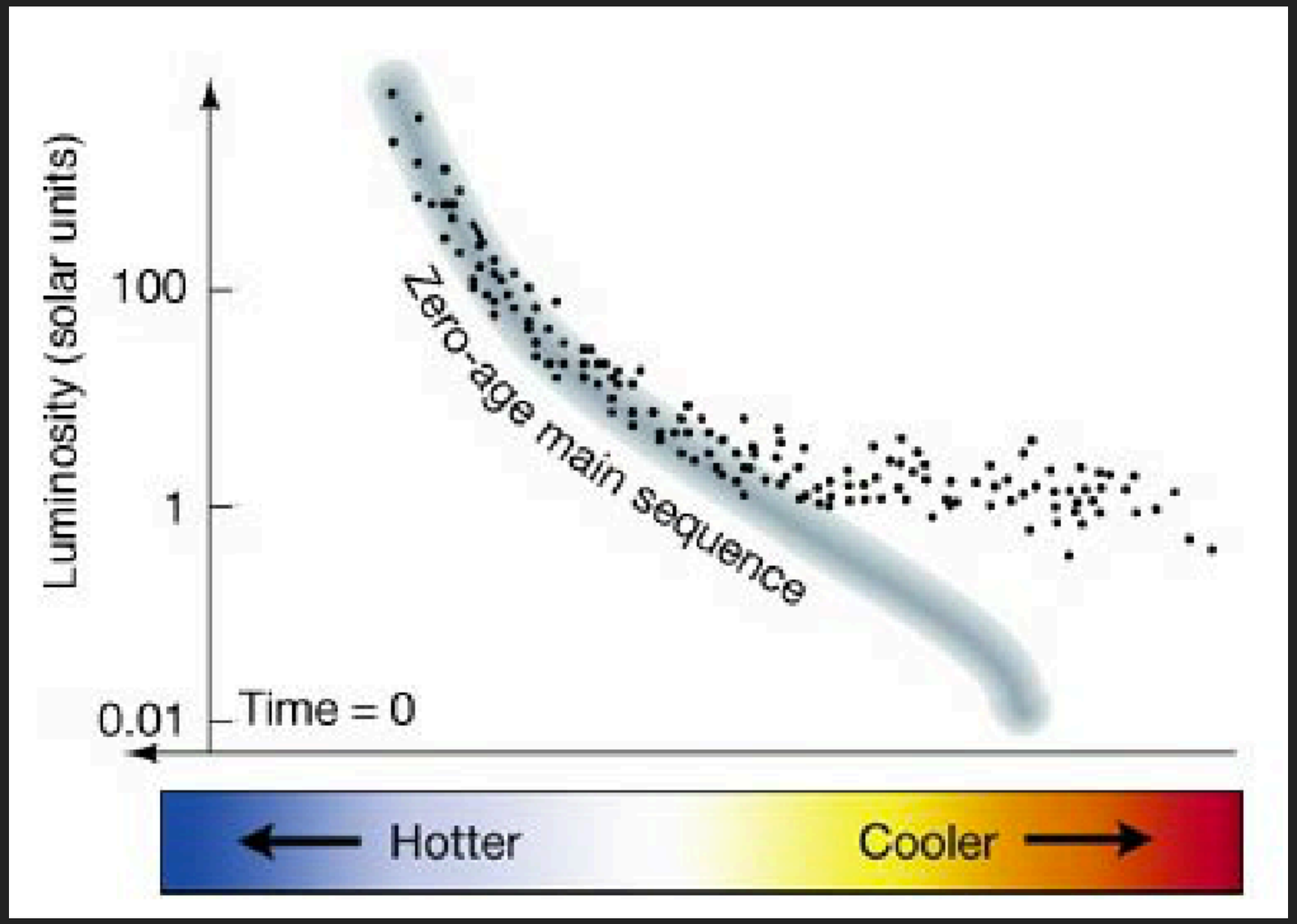
λ_{max}	8200
T	3540

EXERCISE

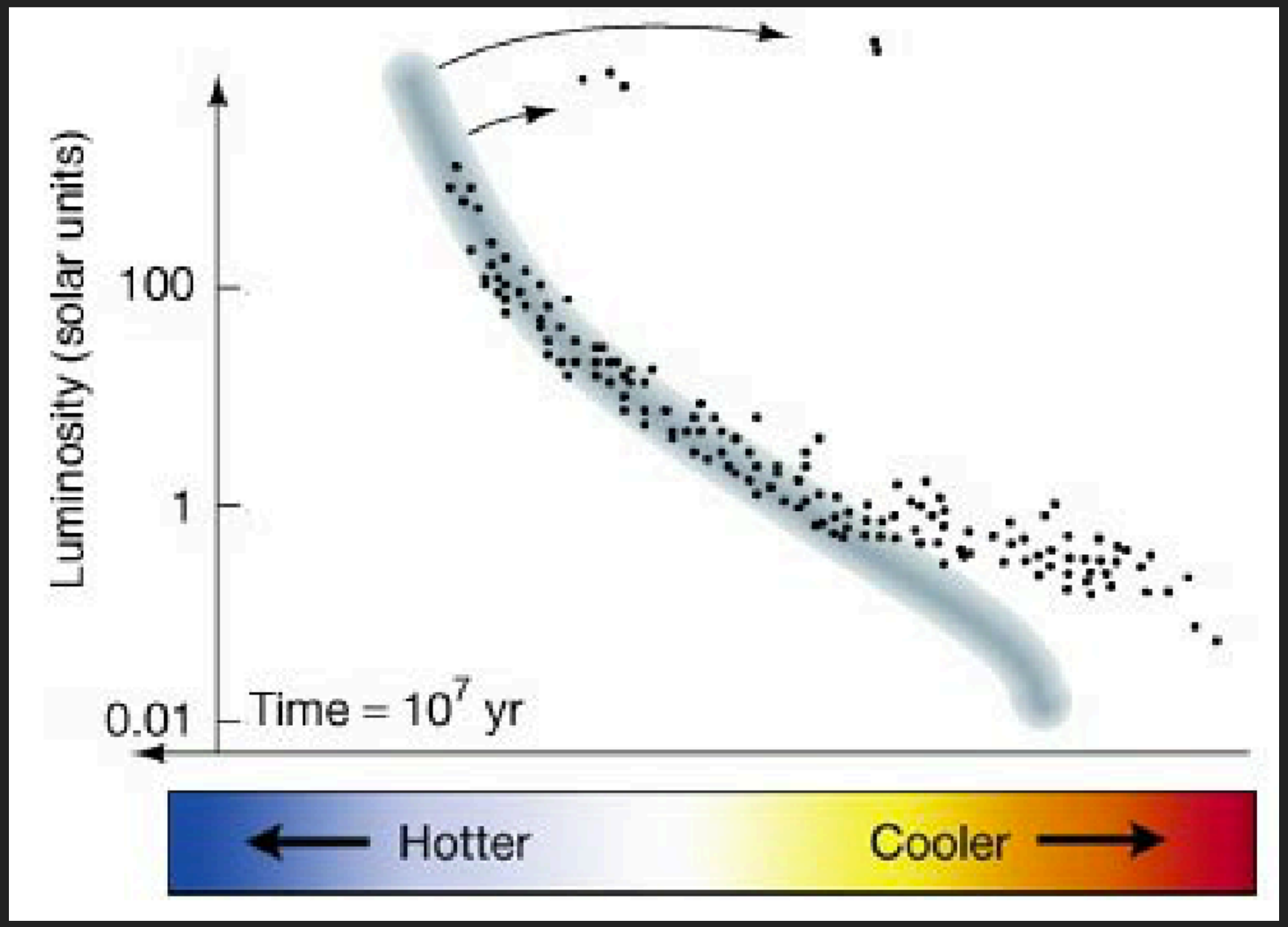
Peak Wavelength	Spectral Type	Peak Wavelength	Temperature
4	O	>3000	>7600
2	B	3800	7625
6	A	3900	7430
3	F	4500	6440
7	G	5000	5795
1	K	5600	5175
5	M	8200	3530

CLUSTERS IN HR DIAGRAM

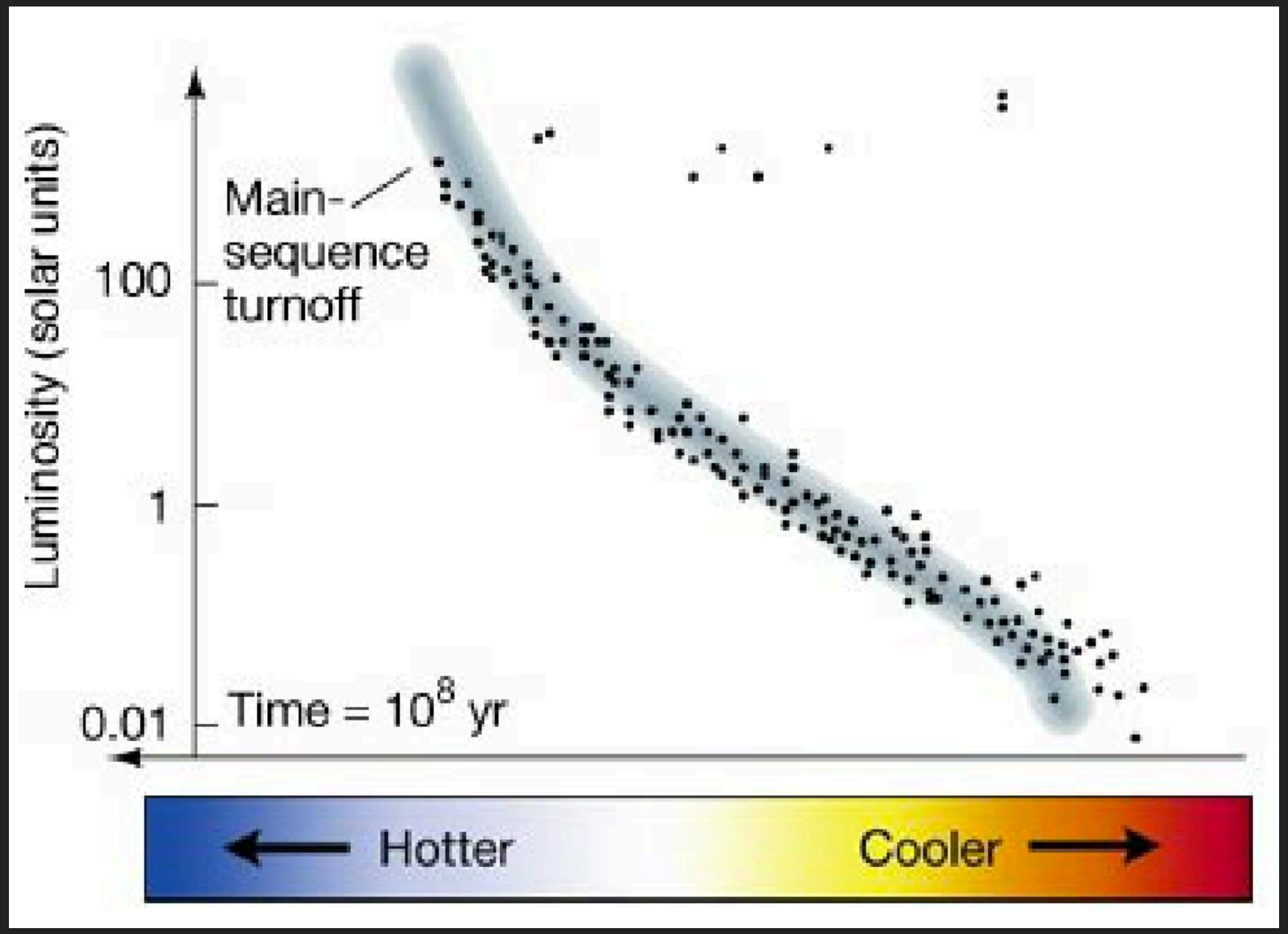
CLUSTERS IN HR DIAGRAM



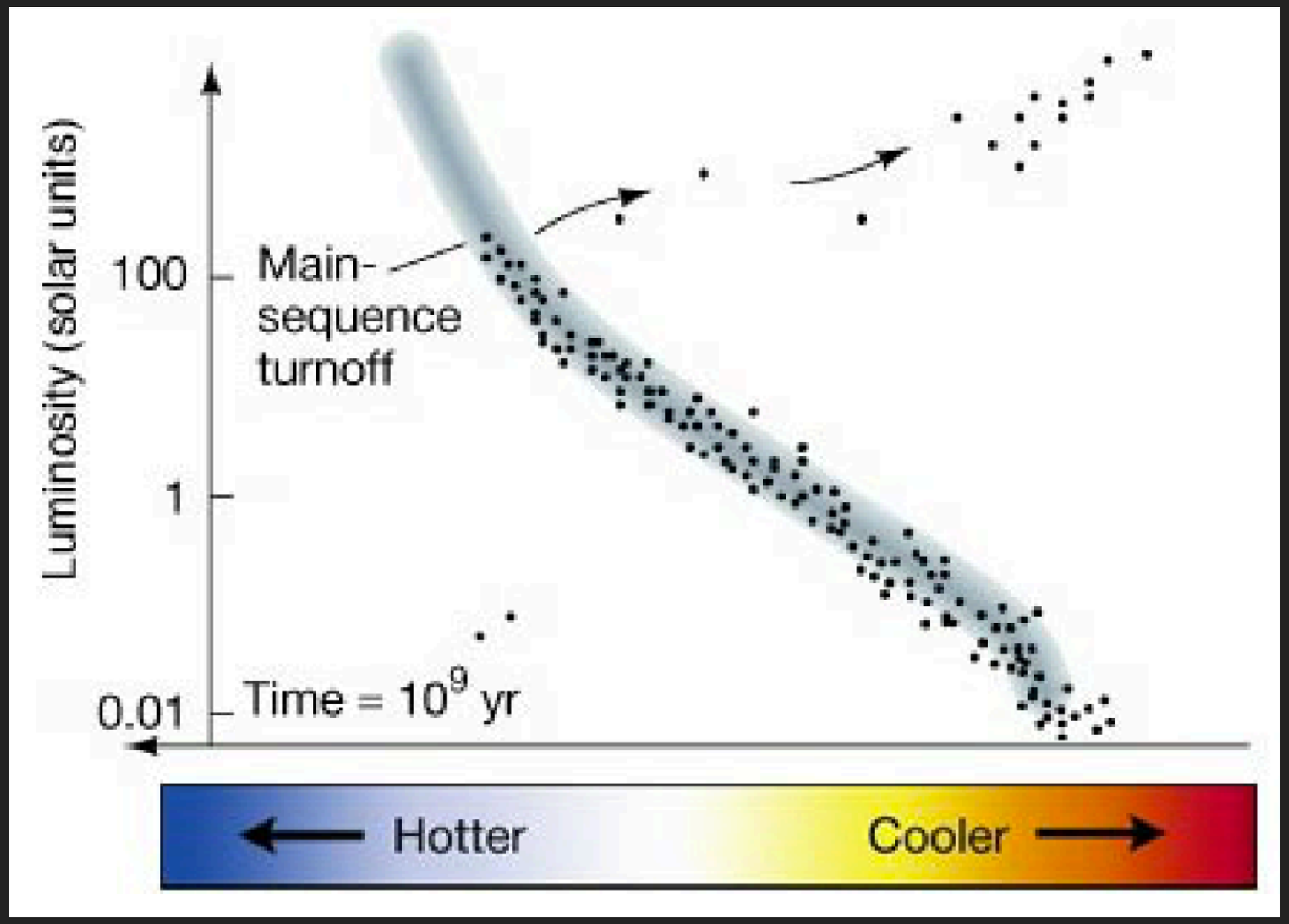
CLUSTERS IN HR DIAGRAM



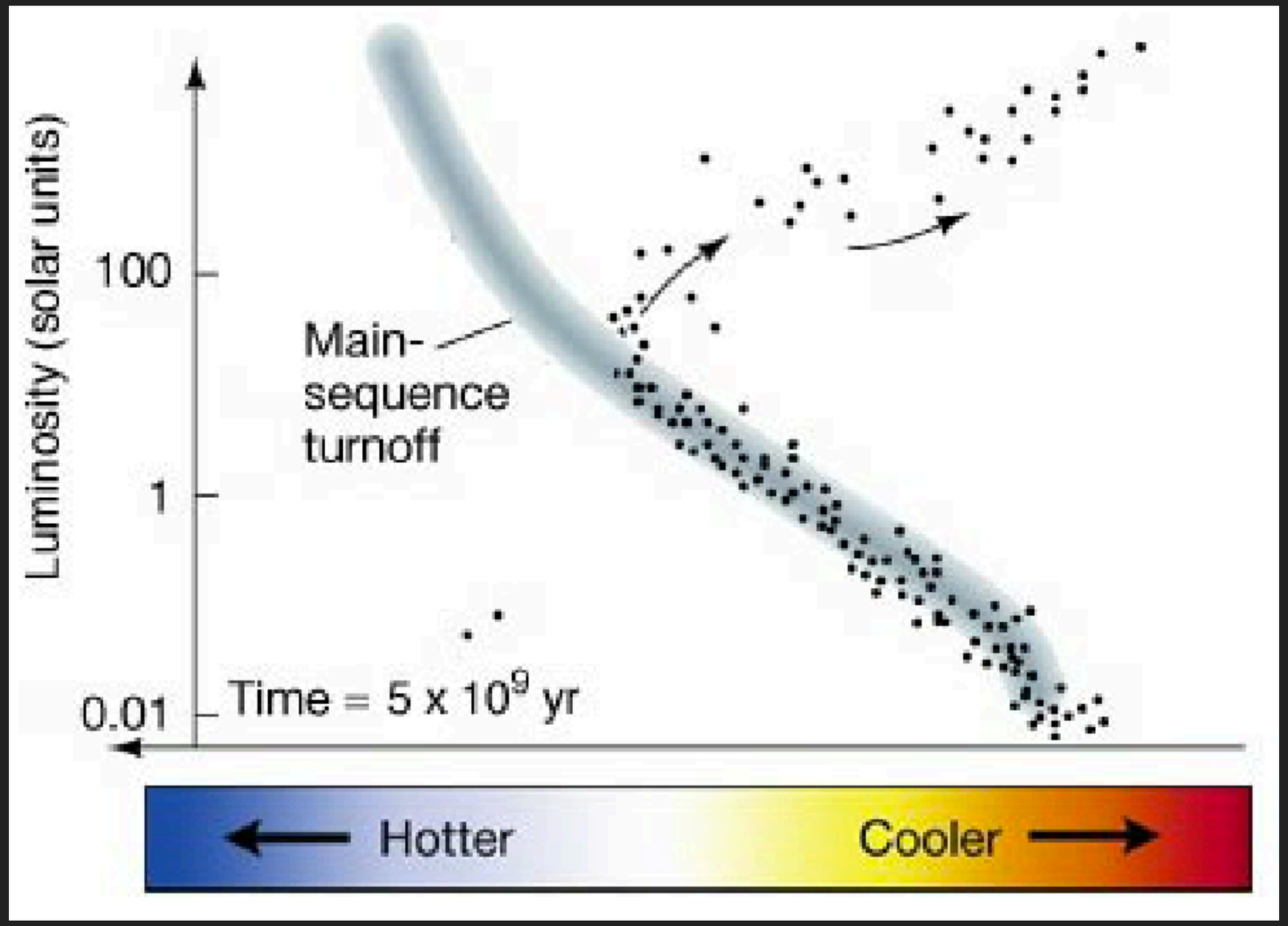
CLUSTERS IN HR DIAGRAM



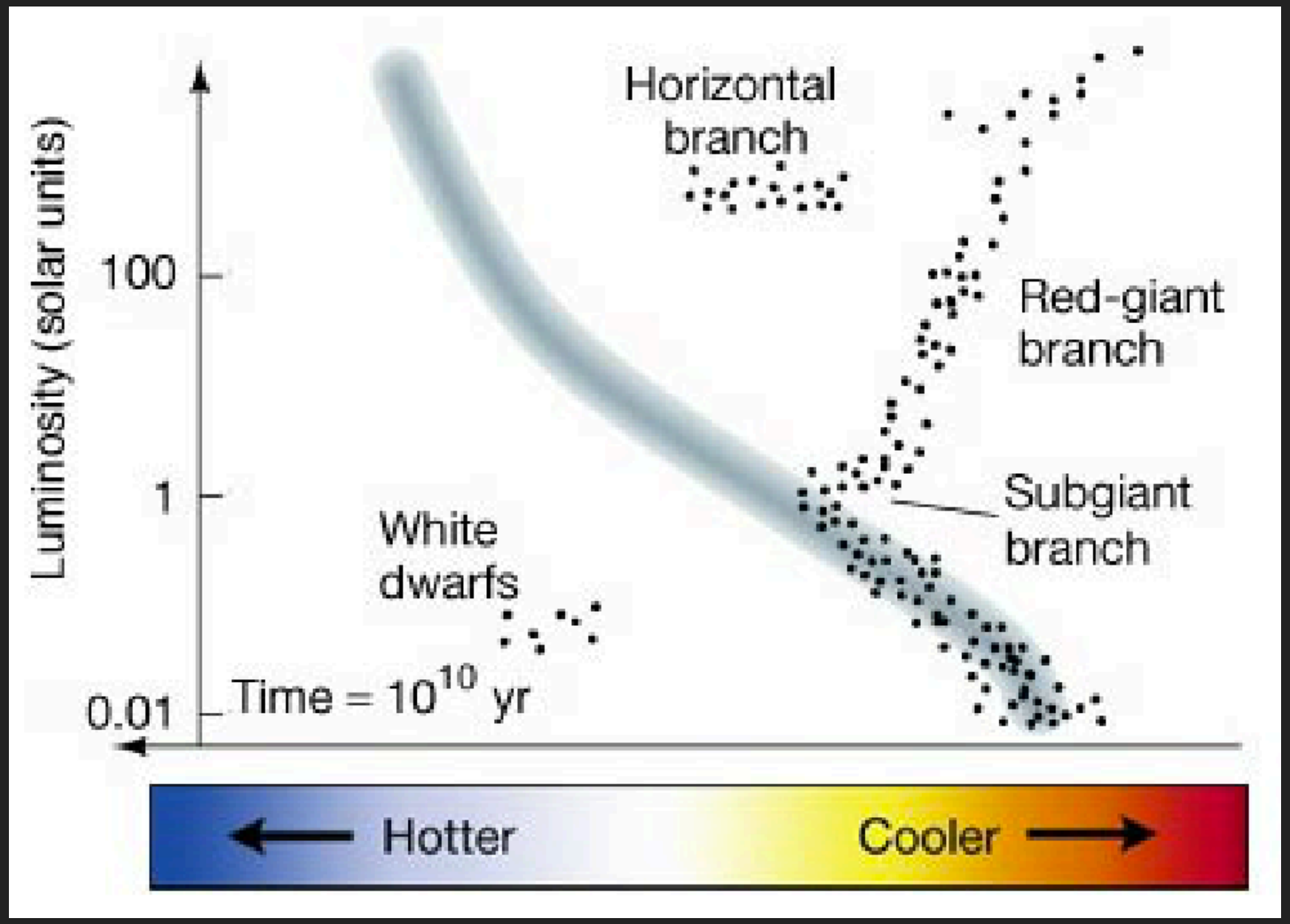
CLUSTERS IN HR DIAGRAM



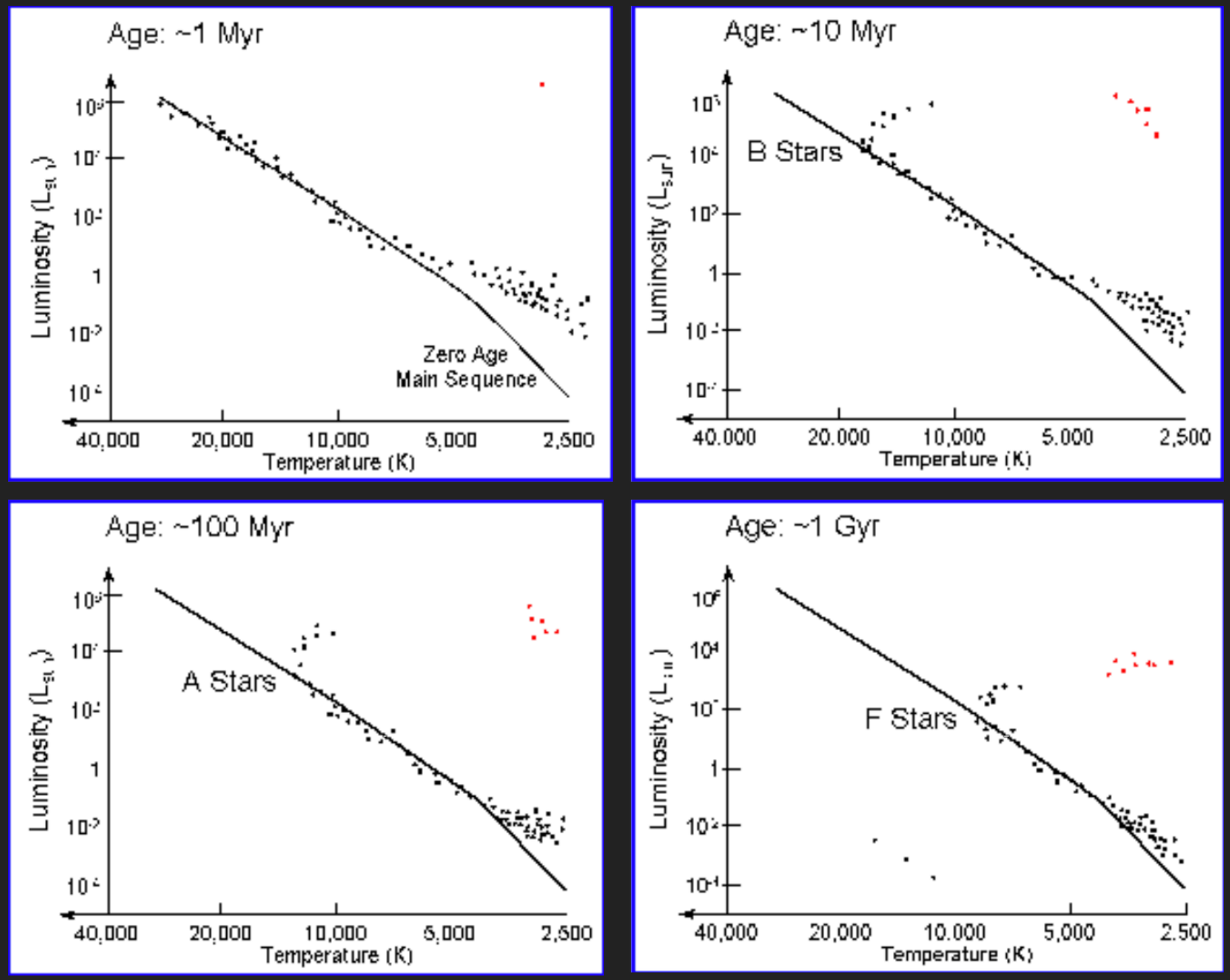
CLUSTERS IN HR DIAGRAM



CLUSTERS IN HR DIAGRAM



TURN OFF POINT OF CLUSTER: AGE

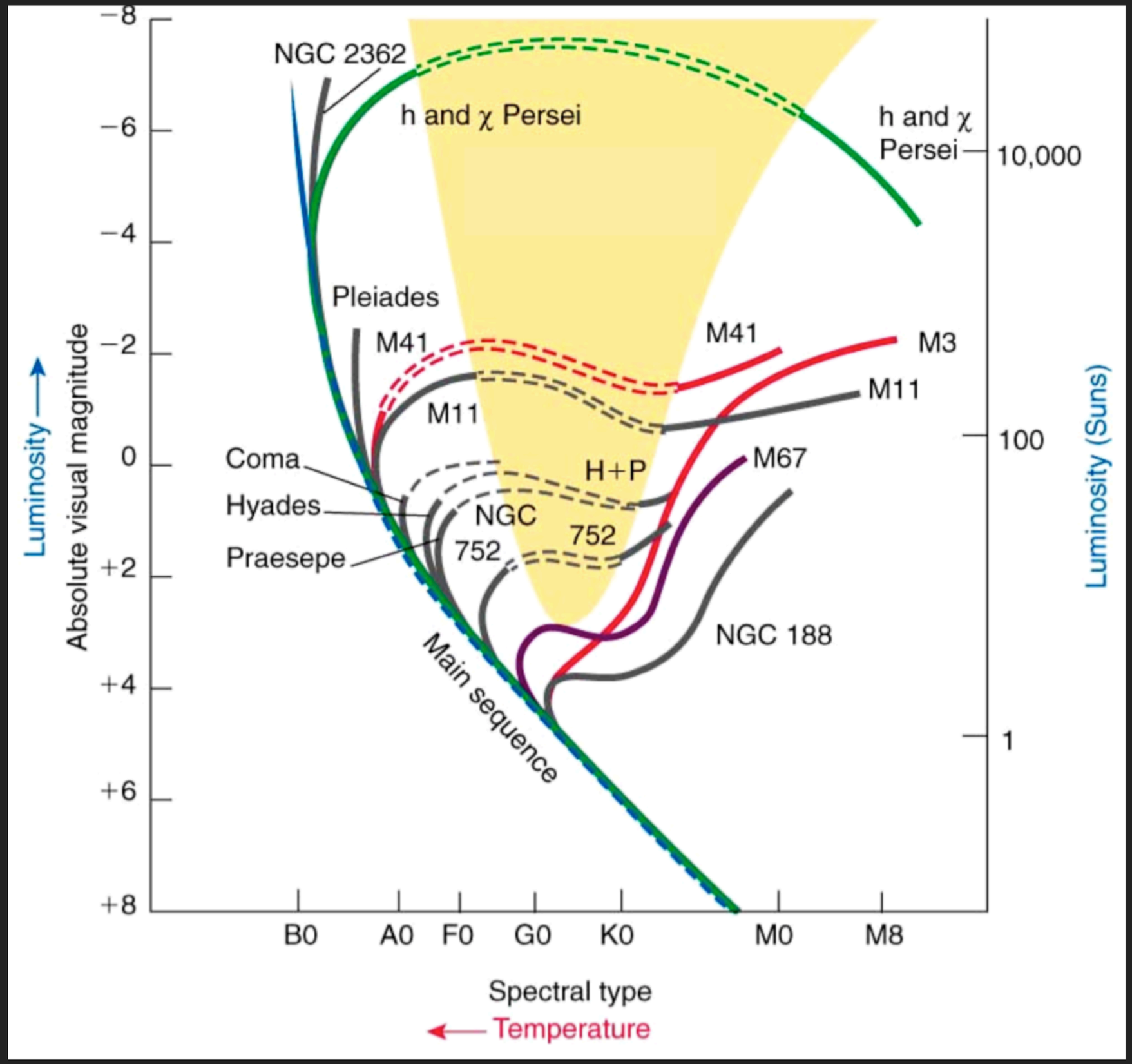


HR DIAGRAM FOR CLUSTERS

OPEN CLUSTERS

- Up to a few thousand stars
- Loosely bound
- Live a few hundred million years
- @spiral & irregular galaxies
- Star formation is active

HR DIAGRAM FOR CLUSTERS

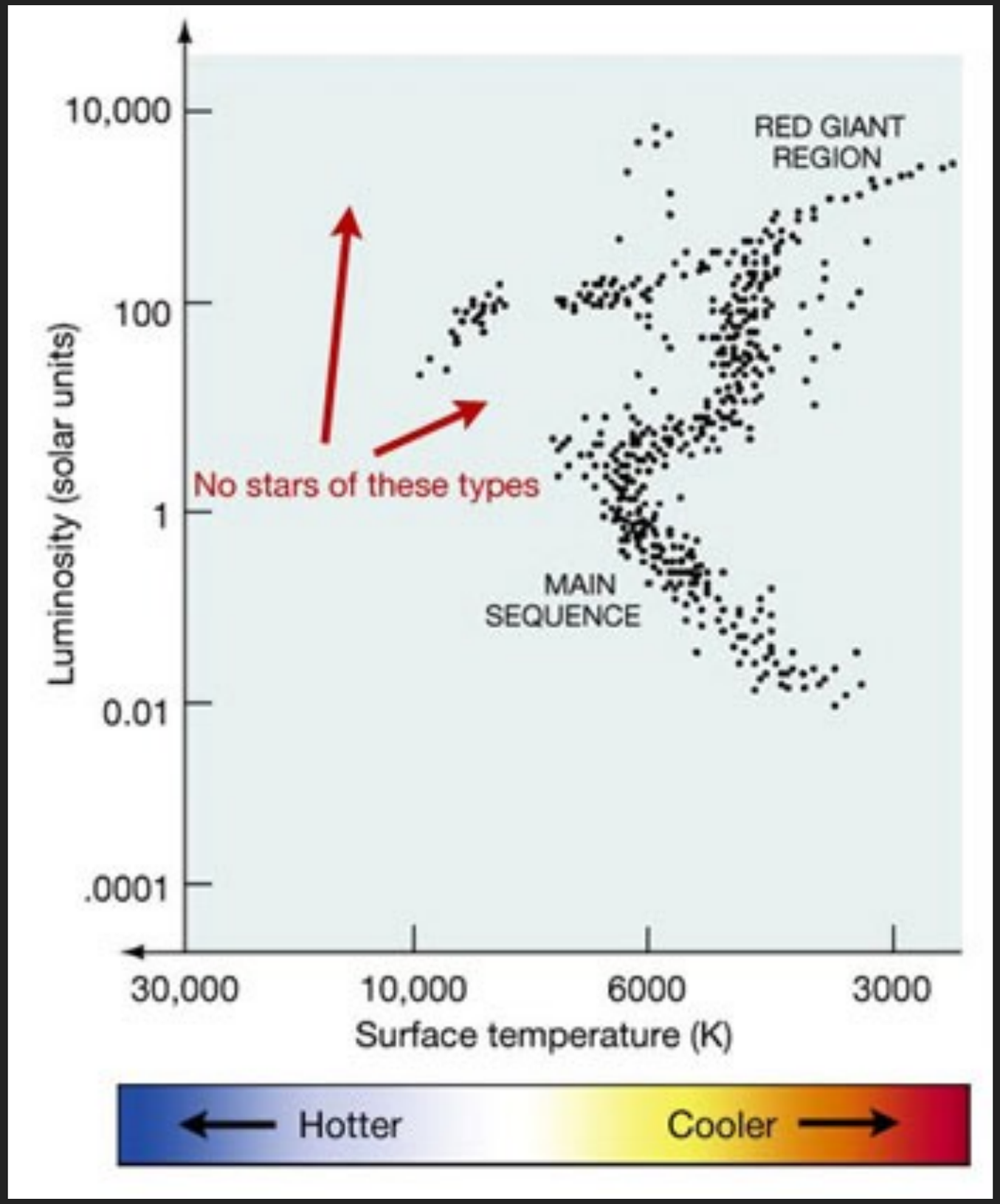


HR DIAGRAM FOR CLUSTERS

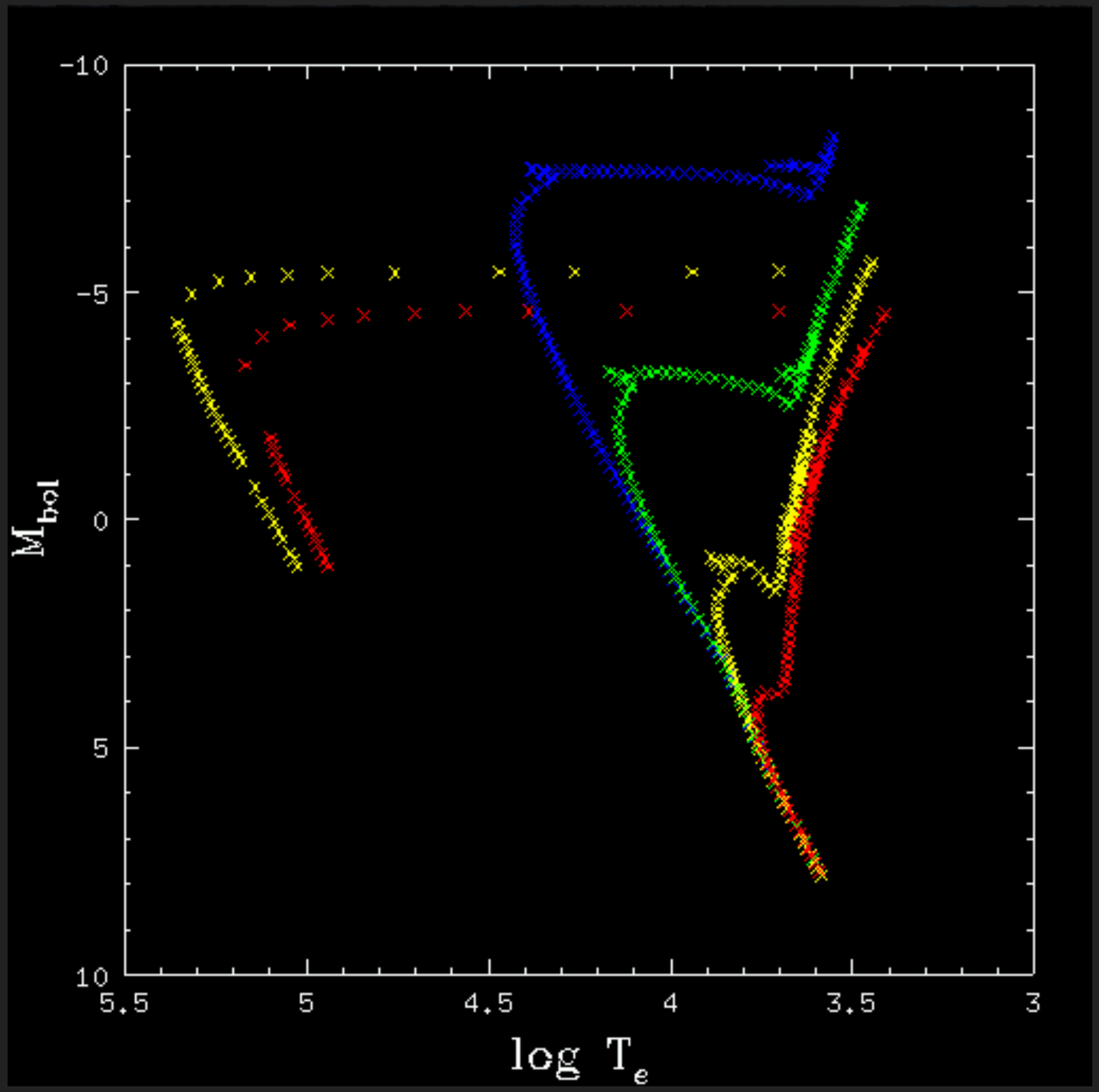
GLOBULAR CLUSTERS

- Tightly bound by gravity
- Spherical
- Dense in the centre
- @ Halo
- Very old:10.000 to millions (PopII)

HR DIAGRAM FOR CLUSTERS



ISOCHRONE



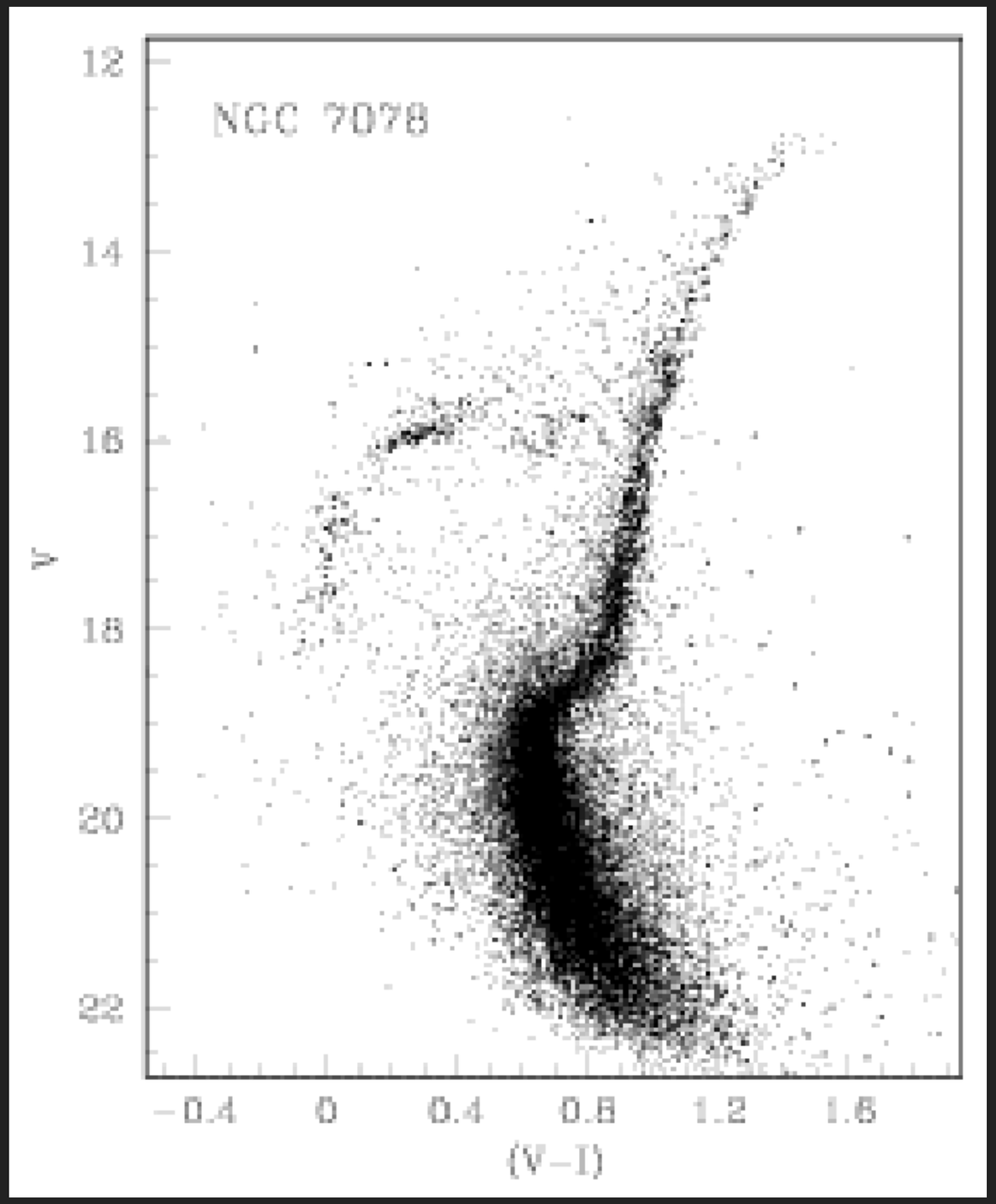
10 million years

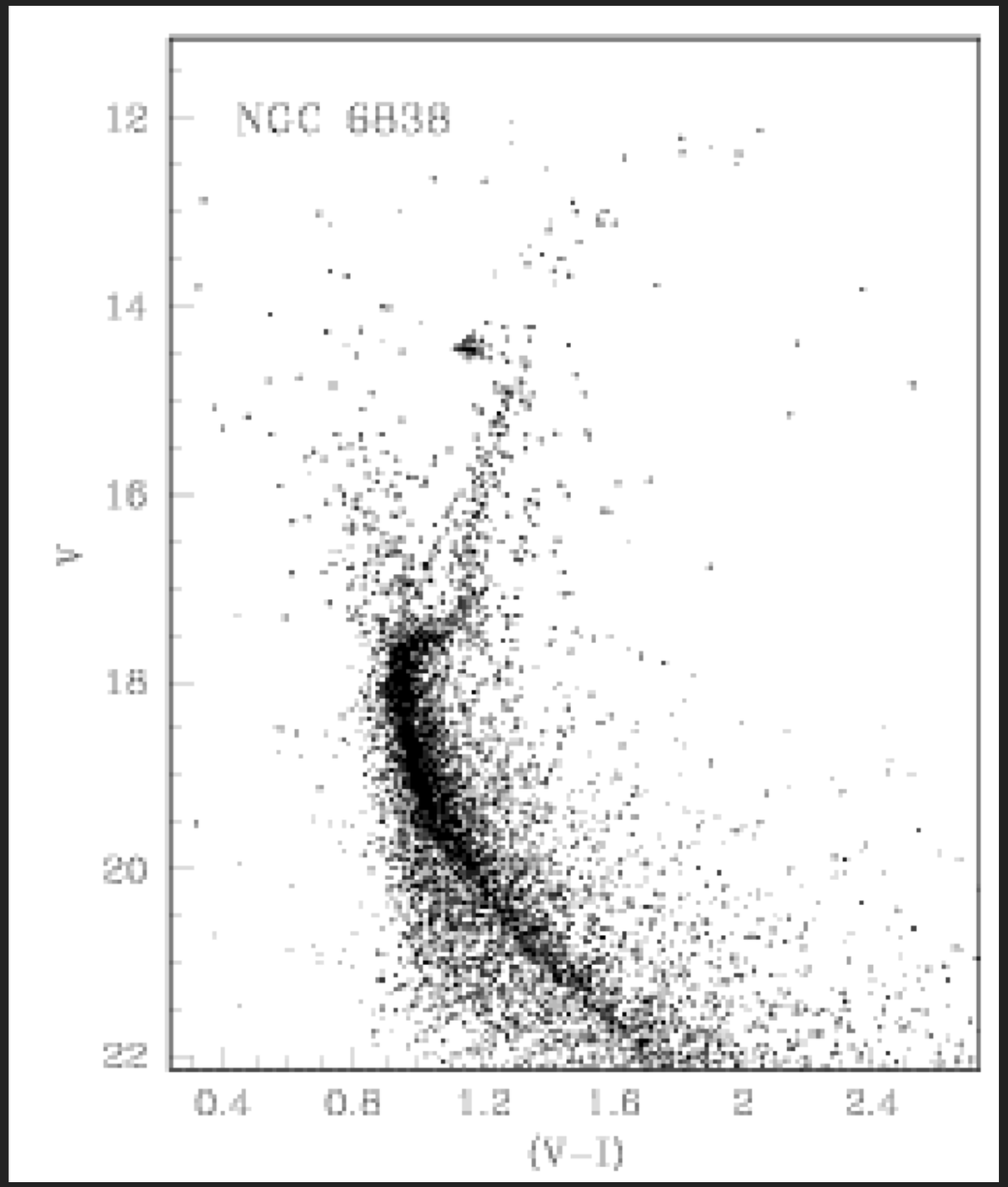
100 million years

1 billion years

10 billion years

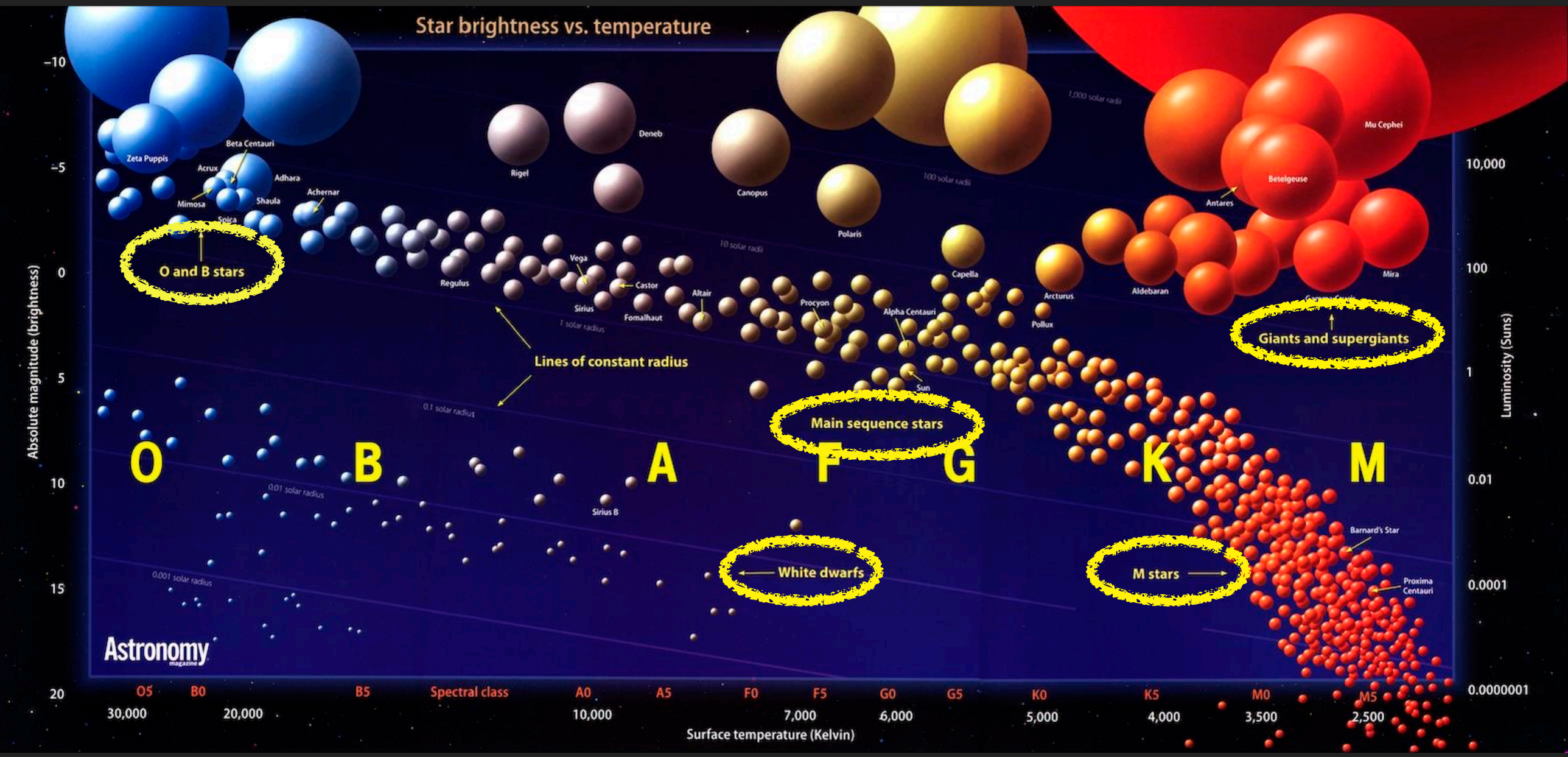
HOMEWORK



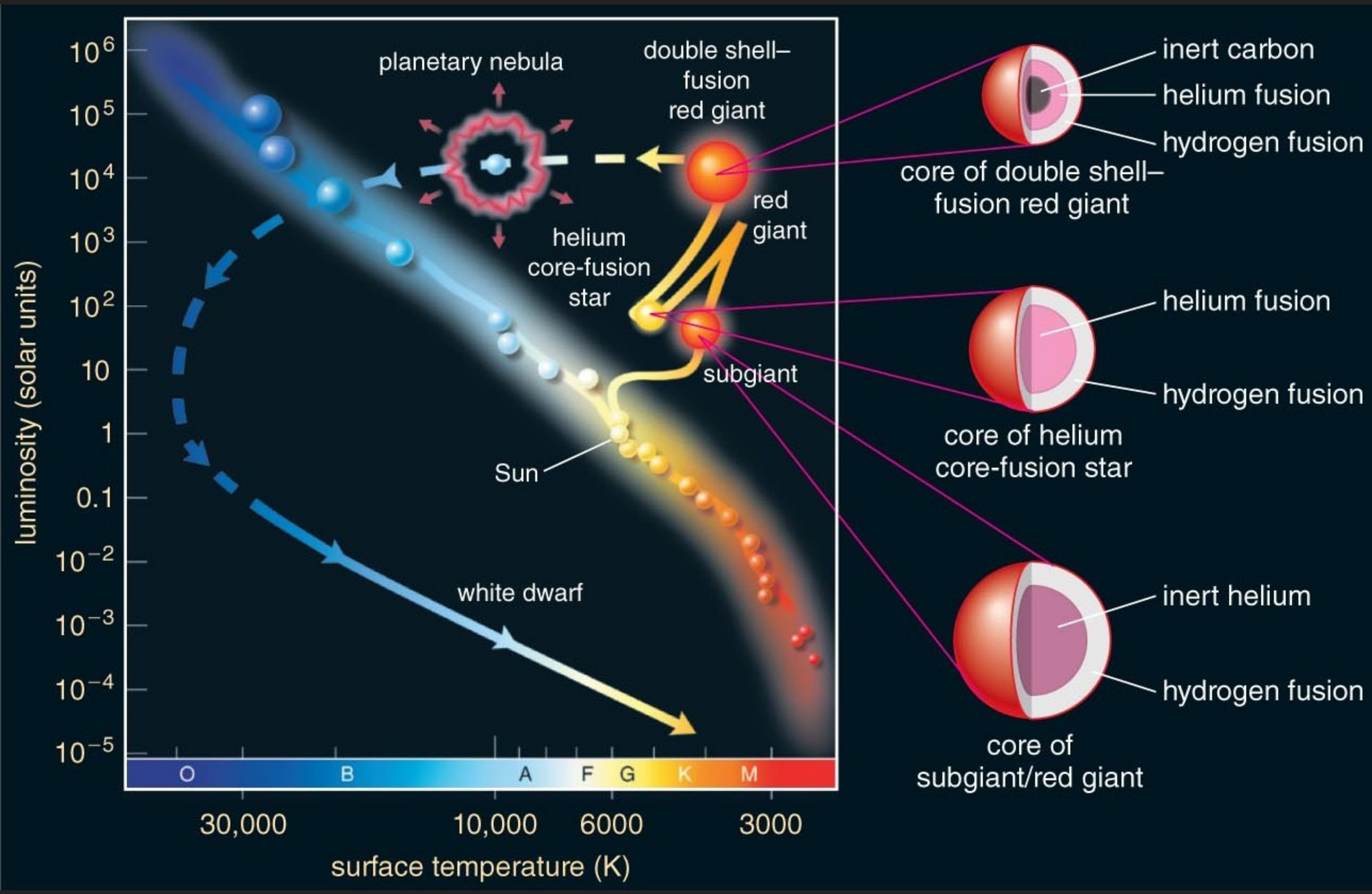


- Try to find the turn off point and put into an age order

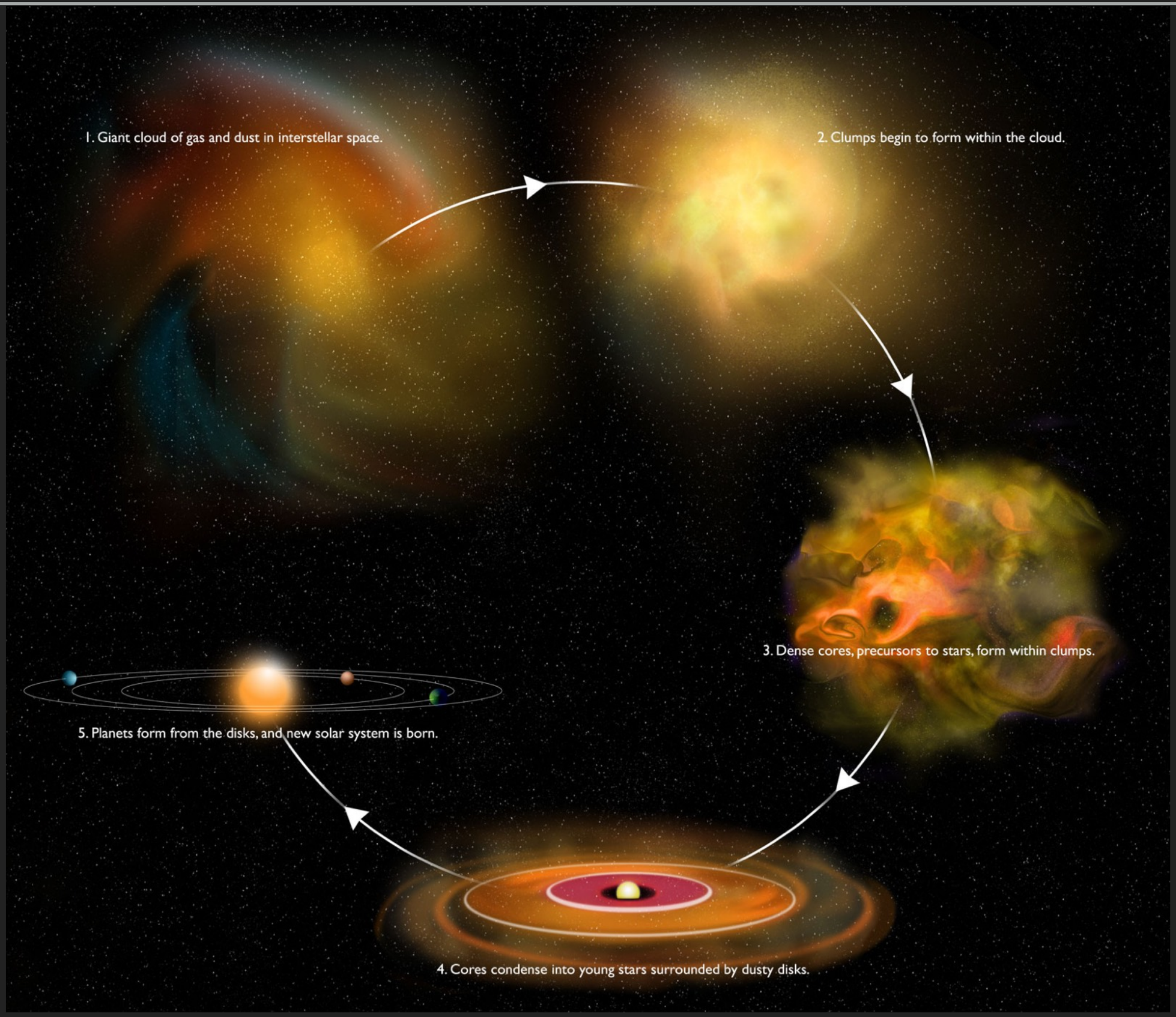
STARS ON HR DIAGRAM



HR DIAGRAM – EVOLUTION



TOWARDS MAIN SEQUENCE



Images not to scale CREDIT: Bill Saxton, NRAO/AUI/NSF

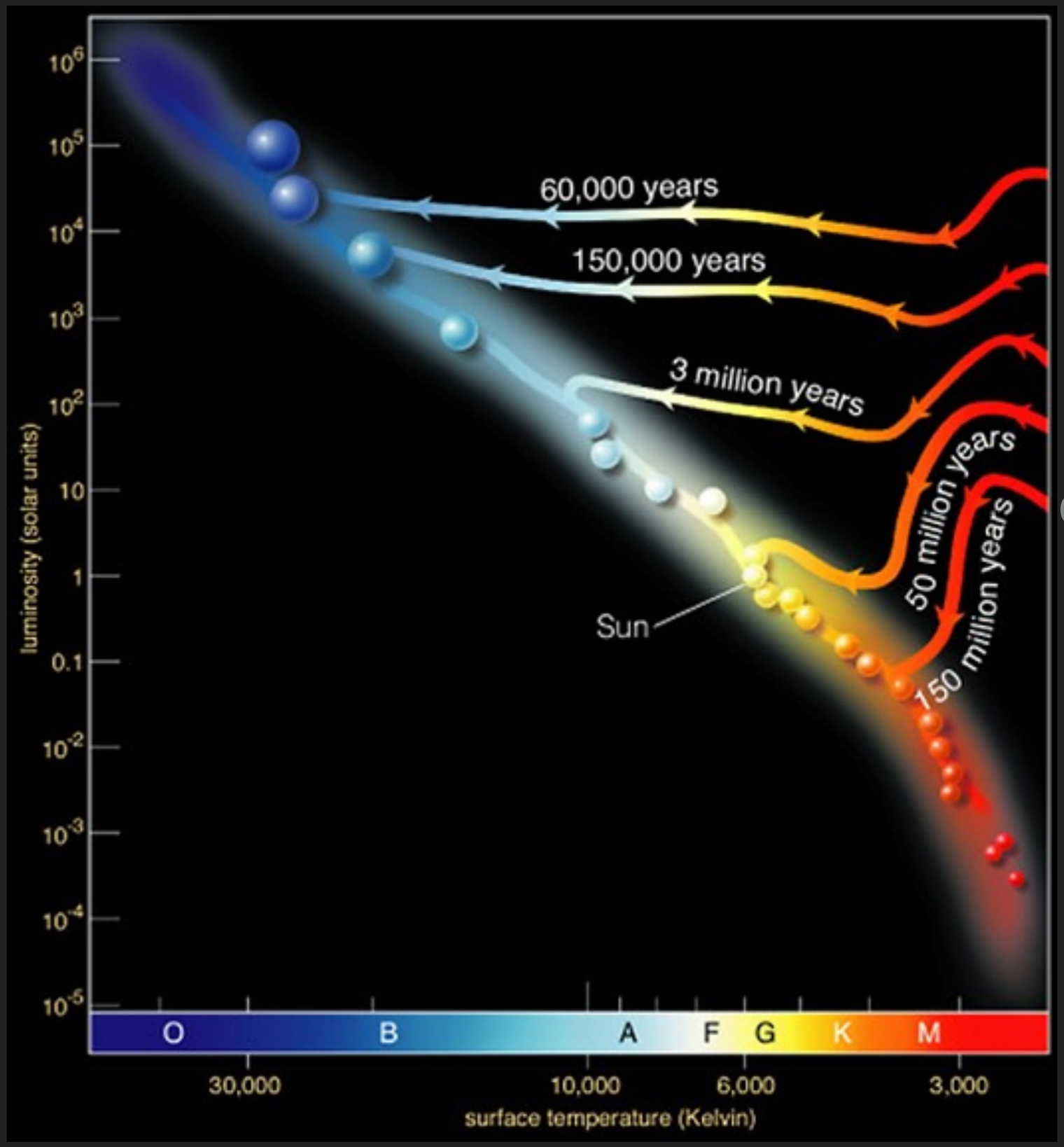
PROTOSTARS

- Earliest phase of stellar evolution
- Molecular clouds

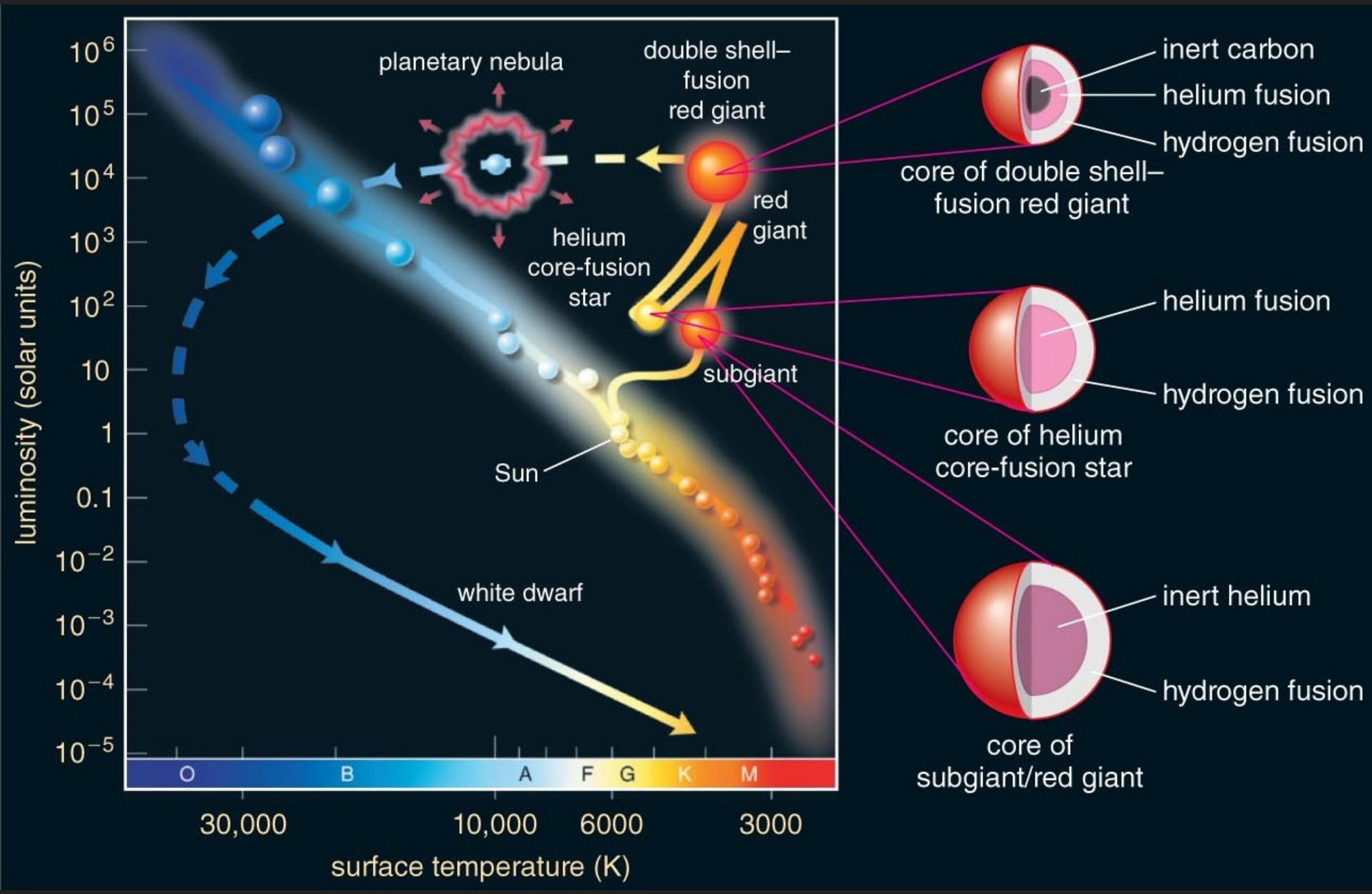
  Stellar nursery
- Molecular Hydrogen (H_2)
- Infrared
- Pillars of Creation

  @Eagle Nebulae
- Left: 4 Lightyears long

PROTOSTARS


60,000 years
150,000 years
3 million years
50 million years
150 million years
Sun
15M⊙
9M⊙
3M⊙
1M⊙
0.5M⊙
luminosity (solar units)
10^6
10^5
10^4
10^3
10^2
10
1
0.1
10^-2
10^-3
10^-4
10^-5
O
B
A
F
G
K
M
30,000
10,000
6,000
3,000
surface temperature (Kelvin)

MAIN SEQUENCE



REFERENCES

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- http://voyages.sdss.org/expeditions/expedition-to-the-milky-way/star-clusters/hr-diagrams/