Exercise walk-through

Stars and the Universe ▪ 6.2

eXercise

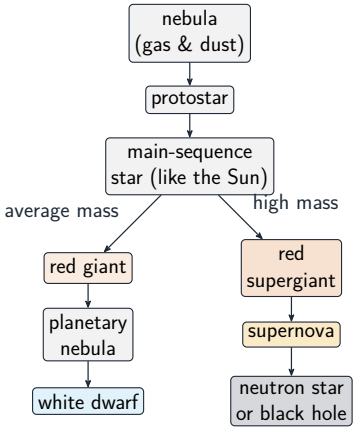
You must be able to

- describe the Sun (fusion of hydrogen to helium) and galaxies
- describe a star's life cycle (by mass)
- explain redshift as evidence for an expanding Universe

Method — Life cycle & redshift

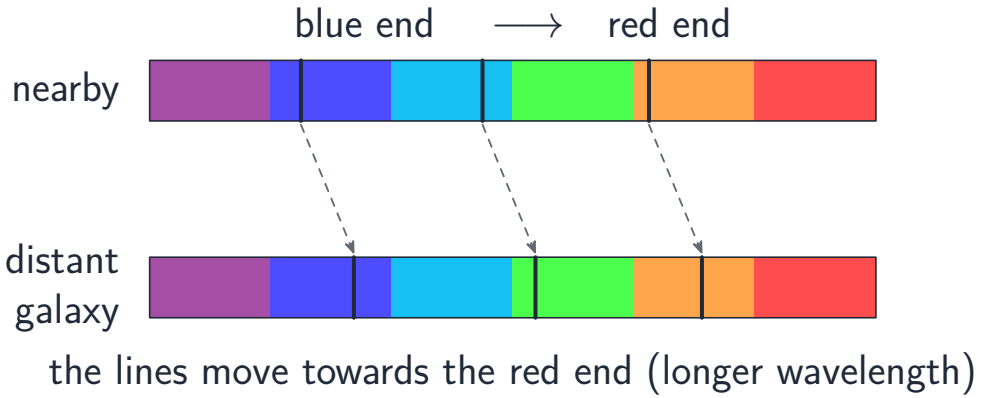
Sun: a medium star, powered by fusion of hydrogen into helium. **Hubble:** $H_0 = \frac{v}{d}$, and age $\approx \frac{1}{H_0}$.

Method — Life cycle & redshift



A flow chart of a star's life, branching by mass

Method — Life cycle & redshift



Spectral lines of a distant galaxy shifted toward the red end

Practice 2.1 ▪ 1 mark

State the nuclear reaction that powers the Sun.

Solution 2.1

Worked steps

nuclear fusion (of hydrogen nuclei into helium) B1.

Practice 2.2 ▪ 1 mark

State what a light-year measures.

Solution 2.2

Method: Life cycle & redshift

Worked steps

distance (the distance light travels in one year) B1.

Exam-style 3.1 ▪ 1 mark

Redshift of light from distant galaxies is evidence that the Universe is:

A shrinking

B expanding

C unchanging

D rotating

Solution 3.1

Method: Life cycle & redshift

A shrinking

B expanding ✓

C unchanging

D rotating

Worked steps

B. Redshift shows galaxies are receding — the Universe is expanding.

Exam-style 3.2 ▪ 3 marks

A medium-mass star like the Sun runs out of hydrogen fuel.
(a) Describe what it becomes, in order, after this.
(b) State what is left at the very end.

Solution 3.2

Method: Life cycle & redshift

Worked steps

(a) it swells into a red giant M1; throws off its outer layers as a planetary nebula M1; leaving a white dwarf A1.
(b) a white dwarf B1.

Exam-style 3.3 ▪ 2 marks

The Hubble constant is about $H_0 = 2.2 \times 10^{-18}$ s^{-1}.
(a) Estimate the age of the Universe in seconds.
(b) State one other piece of evidence for the Big Bang.

Solution 3.3

Method: Life cycle & redshift

Worked steps

(a) age $\approx \dfrac{1}{H_0} = \dfrac{1}{2.2 \times 10^{-18}}$ M1; $= 4.5 \times 10^{17}$ s A1.

(b) the cosmic microwave background radiation (CMBR) B1.