1. For a high mass \((M > 8 \, M_\odot)\) star: the outer envelope is ejected as a supernova remnant, and the inert iron core implodes into either a neutron star or a black hole \([10 \text{ pts}]\).

2. For a low mass \((M \sim 1 \, M_\odot)\) star: outer envelopes become a planetary nebula, while inert core becomes a white dwarf \([10 \text{ pts}]\).

3. According to Wien’s law, a blackbody emits the maximum flux in its continuum spectrum at a wavelength \(\lambda_{\text{peak}}\) that is inversely proportional to its surface temperature \(T\):

\[
\lambda_{\text{peak}} = \frac{W}{T},
\]

where \(W = \text{Wien’s constant} = 2.9 \times 10^{-3} \text{ m K}\).

Thus, stars that emit a large fraction of their flux at ultraviolet wavelengths \((\lambda \sim 2 \times 10^{-8} \text{ m})\) have surface temperatures of \(\sim 100,000 \text{ K}\). Such hot stars are very massive and have lifetimes of only a few million years. They are therefore only present in recent sites of star formation. \([10 \text{ pts}] = 4 \text{ pts for applying Wien’s law, 3 pts for stating that hot stars are very massive stars, 3 pts for stating that high mass stars have short lifetimes.}\]

4. Stefan-Boltzmann law: The total flux \(F_{\text{surf}}\) emitted at the surface of a star (or blackbody) over all wavelengths is proportional to the fourth power of its surface temperature \(T\):

\[
F_{\text{surf}} = \sigma T^4
\]

where \(\sigma = \text{Stefan-Boltzmann constant} = 5.7 \times 10^{-8} \text{ J s}^{-1} \text{ m}^{-2} \text{ K}^{-4}\).

Flux at surface of a star of radius \(R\):

\[
F = \frac{L}{4\pi R^2}
\]

Hence,

\[
L = 4\pi R^2 \sigma T^4 \propto R^2 T^4
\]

Flux that we receive at distance \(d\)

\[
f = \frac{L}{4\pi d^2} \propto \frac{R^2 T^4}{d^2}
\]

If the radius and surface temperature of a star both double, the flux that we receive rises by a factor of 4x16 or 64. \([10 \text{ pts}] = 7 \text{ pts for } f \propto (R^2 T^4/d^2) + 3 \text{ pts for math.}\]

5. \(B-K = m_B - m_K = -2.5 \log(f_B/ f_K) = 3.2 \text{ mag.}\)

If the flux of the galaxy at blue wavelengths rises by a factor of 100, the \(B-K\) color falls by 5 magnitudes to -1.8 mag. \([10 \text{ pts}] = 6 \text{ pts for showing relation of color to flux + 4 pts for math.}\]