Office Hrs. Wed. 12-1 PM  TH 520
Q: “At which wavelength does this function reach a maximum?” (λ_{\text{MAX}},)

A: To see, define: \( x = \frac{(kT/hc) \lambda}{e^{hc/\lambda kT} - 1} \).

\( x \) will max. out where \( \lambda \) maxes out.

The numerical value of \( x \) will give you Wien’s Law:

\[ \lambda_{\text{max}} T = 0.002897755 \text{ m K}. \]
Stephan Boltzmann Law

Not all objects emit a perfect “Black-body” spectrum. Still we we can define an effective temperature, $T_{\text{eff}}$ for them.

$$L = 4\pi R^2 \sigma T_{\text{eff}}^4.$$ 

Group Activity:
Using the Stephan-Boltzman Law, estimate your body’s **luminosity**. Make *any* approximation that helps!

Conversions:  
$[K] = ([^\circ F] + 459.67) \times \frac{5}{9}$

$$\sigma = 5.670400 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}.$$
Bolometric Magnitude

So far, we have assumed we could detect light at all wavelengths.

Then, from a measured flux, we could define the apparent magnitude of a star using:

\[
\frac{F_2}{F_1} = 100^{(m_1-m_2)/5}. \quad \text{or...} \quad m_1 - m_2 = -2.5 \log_{10} \left( \frac{F_1}{F_2} \right).
\]

Mags. defined this way are called bolometric.

In practice we observe: \( F_\lambda \) the flux of light within a certain wavelength range, bandwidth.

E.g.: Observe all light between: [500,505 nm]
The bandwidth is \( \Delta \lambda = 5 \text{ nm} \)
Filters

We may wish to deliberately restrict the wavelength range we observe using filters. Filters used in visible astronomy are:

- **U** filter: “ultraviolet”, 365 nm
- **B** filter: “blue” 440 nm
- **V** filter: “violet”: 550 nm

Each filter has a range in wavelengths.

Absolute mags. observed in these filters are: $M_U, M_B, M_V$.

Apparent mags. observed in these filters are: $m_U, m_B, m_V$, or more commonly: $U, B, V$

(note these are capital letters!)
Sensitivity of the 3 common filters.
Color Temperature

By observing at two wavelengths we “pick off” two points on the star’s light output.

This is often sufficient to give an indication of the color of the star.

In fact, Mag. differences are referred to as the star’s “color”: U-B, B-V, U-V

Recall that lower mags = brighter!
A spectrograph uses a prism or grating to split light up into different wavelengths.
Modern spectra are recorded digitally as plots of intensity vs. wavelength.
Spectrum of the Sun

The Sun emits light at UV, Visible and Infrared wavelengths.