One square meter of Earth’s surface receives 1370 watts of power (1370 joules per second, or with the units from class, $1.37 \times 10^{10}$ ergs per second) of solar energy - enough to power about 20 light bulbs.

1. Imagine that we build a gigantic hollow shell completely encasing the Sun just outside Earth’s orbit. What would its surface area be (in square meters)? ($SA = 4\pi r^2$, 1 AU = $1.5 \times 10^{11}$ m)

2. What total power (in watts) would the entire mega-shell receive from the Sun?

3. Use your answer from part 2 to write down the luminosity (total power emitted) of the Sun in ergs per second (1 watt = $10^7$ erg/s).

4. The largest thermonuclear bomb ever exploded released about 250,000 terajoules ($2.5 \times 10^{17}$ joules) of total energy. How many thermonuclear bombs per second would have to be exploded to generate the amount of power released by the Sun?
How Do Quantities Scale?

\[ Brightness = \frac{L}{4\pi d^2} \quad L = 4\pi R^2\sigma T^4 \]

1. If stars A and B have the same luminosity, but star A is twice as far away as star B, how much brighter or dimmer would star A appear (compared to the brightness of star B)?

2. Now let’s say that star A appears 8 times brighter than star B. We know that stars A and B are the same distance from us, so what does this tell us about their luminosities?

3. What is the ratio of the luminosities of stars A and B \( (L_A/L_B) \) if stars A and B have the same temperatures but the radius of star A is 3 times larger than the radius of star B?

4. What is the ratio of the luminosities \( (L_A/L_B) \) if the temperature of star A is twice the temperature of star B but the radius of star A is \( 1/4 \) the radius of star B?

5. If the luminosity of star A is 64 times that of star B and we know that the temperature of star A is twice that of star B, what is the ratio of their radii \( (R_A/R_B) \) ?