

Instructor's guide This activity follows Planck spectral distribution

Google “phet blackbody spectrum” and open the simulation.

1. a) At what wavelength is the peak in spectral intensity
 - λ_{peak} for a black rock on the Earth’s surface,
 - λ_{peak} for the black walls of a pizza oven,
 - λ_{peak} for a light bulb,
 - λ_{peak} for the sun.
- b) Check that the peak wavelength decreases with temperature following a $1/T$ relationship.
2. a) Use the numerical integration feature (the checkbox labelled “intensity” near the upper-right corner of the graph) to find the total intensity, in units of W/m^2 , emitted by
 - a black rock on the Earth’s surface,
 - the black walls of a pizza oven,
 - the surface of a tungsten light bulb filament,
 - the surface of the sun.
- b) Check that these intensities are proportional to T^4 . Note, the quick way to check involves ratios: Does $\frac{I_1}{I_2} = \left(\frac{T_1}{T_2}\right)^4$?
3. How cold should you make an object if you want zero thermal radiation emitted?
4. (Extra—if your group has time)
 - a) For an incandescent light bulb with a filament surface area of A , estimate how efficiently it converts electrical energy into visible photons. Hint: you will need to estimate the following ratio:
$$\frac{\text{Electromagnetic radiation in visible wavelengths}}{\text{Total electromagnetic radiation}} = \frac{A \int_{400 \text{ nm}}^{700 \text{ nm}} S_{\lambda}(\lambda, T) d\lambda}{A \int_0^{\infty} S_{\lambda}(\lambda, T) d\lambda}$$
 - b) Estimate the filament surface area A for a 60 W light bulb.