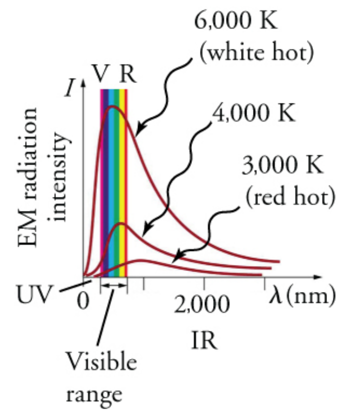

- Black absorbs _________ light
  - It also _________ that light
- Blackbody
  - Absorbs _________light
  - Re-emits _________that light
- The color that a hot object (___________) emits depends on its __________________.

- As the temperature _________, the total amount of _________increases
- While _________the wavelengths are emitted, there is one _________wavelength
- As the temperature _________, the peak wavelength gets _________
  - The increased temperature atoms move _________and the ___________of the light increases.
  - By $v = f\lambda$, the wavelength _________
- This graph does not match _________physics which is based on ___________energy
- Planck invented the idea that the frequencies emitted are based on __________________
- Energy is _________
  - Only exists in _________amounts
  - Like the number of electrons in something must be a _________number
  - $E = nhf = n\frac{hc}{\lambda}$
    - n = 0, 1, 2, 3, … (# of _________)
    - $h = 6.626 \times 10^{-34}$ J·s
    - f = frequency of light
  - Low frequency (long λ) light is _________energy
  - High frequency (short λ) light is _________energy
- Low temperature has low _________so more low ___________light
- High temperature has higher _________so more higher ___________light

- Other things that are quantized
  - _________and _________
  - _________
  - _________

How many photons per second does a typical 10W LED lightbulb produce if 80% of the electrical energy is turned into useable light with an average wavelength of 520 nm?

Physics 12-04 Quantum Nature of Light **Name: _______________**

Compare the energy of one photon of UV light (λ = 250 nm) with IR light (λ = 890 nm).

Practice Work

1. Give an example of a physical entity that is quantized. State specifically what the entity is and what the limits are on its values.
2. Give an example of a physical entity that is not quantized, in that it is continuous and may have a continuous range of values.
3. An AM radio station broadcasts at a frequency of 1,530 kHz . What is the energy in Joules of a photon emitted from this station? (HSP PP21.1) $\mathbf{1.01 \times 10^{-27}\ \boldsymbol{J}}$
4. A photon travels with energy of 1.0 eV. What type of EM radiation is this photon? (HSP PP21.2) **Infrared**
5. Why do we not notice quantization of photons in everyday experience? (HSP PP21.6)
6. Two flames are observed on a stove. One is red while the other is blue. Which flame is hotter? How do you know? (HSP PP21.7) **Blue**
7. Your pupils dilate when visible light intensity is reduced. Does wearing sunglasses that lack UV blockers increase or decrease the UV hazard to your eyes? Explain. (HSP PP21.8) **Increase**
8. The temperature of a blackbody radiator is increased. What will happen to the most intense wavelength of light emitted as this increase occurs? (HSP PP21.9)
9. How many X-ray photons per second are created by an X-ray tube that produces a flux of X-rays having a power of 1.00 W? Assume the average energy per photon is 75.0 keV. (HSP 21.22) $\mathbf{8.33 \times 10^{13}\ \boldsymbol{photons}}$
10. What is the frequency of a photon produced in a CRT using a 25.0-kV accelerating potential? This is similar to the layout as in older color television sets. (HSP 21.23) $\mathbf{6.04 \times 10^{18}\ \boldsymbol{Hz}}$
11. Find the energy in joules of photons of radio waves that leave an FM station that has a 90.0-MHz broadcast frequency. (HSP 21.31) $\mathbf{5.96 \times 10^{-26}\ \boldsymbol{J}}$
12. Which region of the electromagnetic spectrum will provide photons of the least energy? Explain. (HSP 21.32)
13. What is the efficiency of a 100-W, 550-nm lightbulb if a photometer finds that 1×10^{20} photons are emitted each second? (HSP 21.51) $\mathbf{36.1}\%$