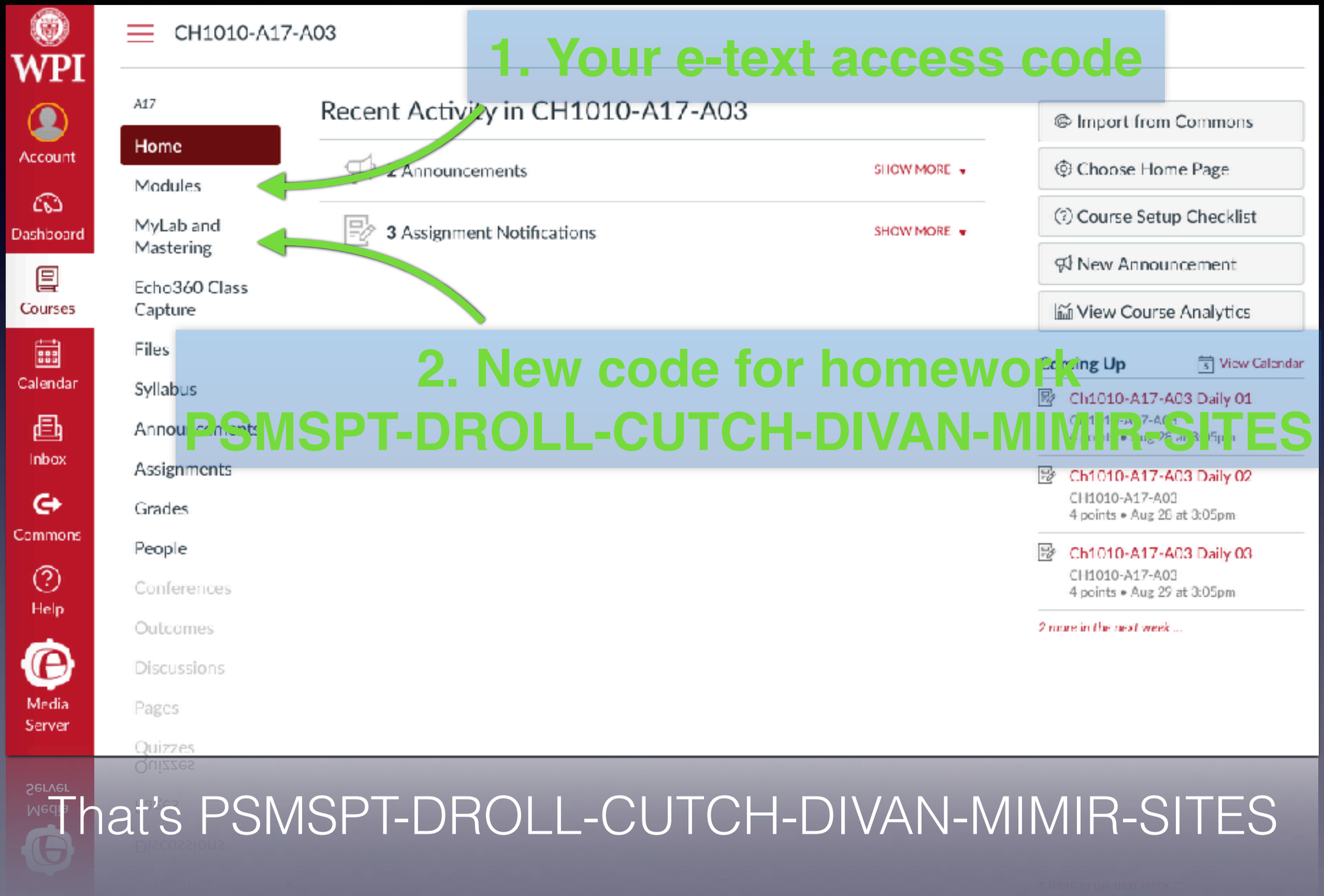

That's PSMSPT-DROLL-CUTCH-DIVAN-MIMIR-SITES

Where are we going today?

Ch1010-A17-A03 Lecture 2

- § 2.2 The Nature of Light
- § 2.2 Photoelectric Effect, Photons
- § 2.3 Atomic Spectroscopy and the Bohr Model

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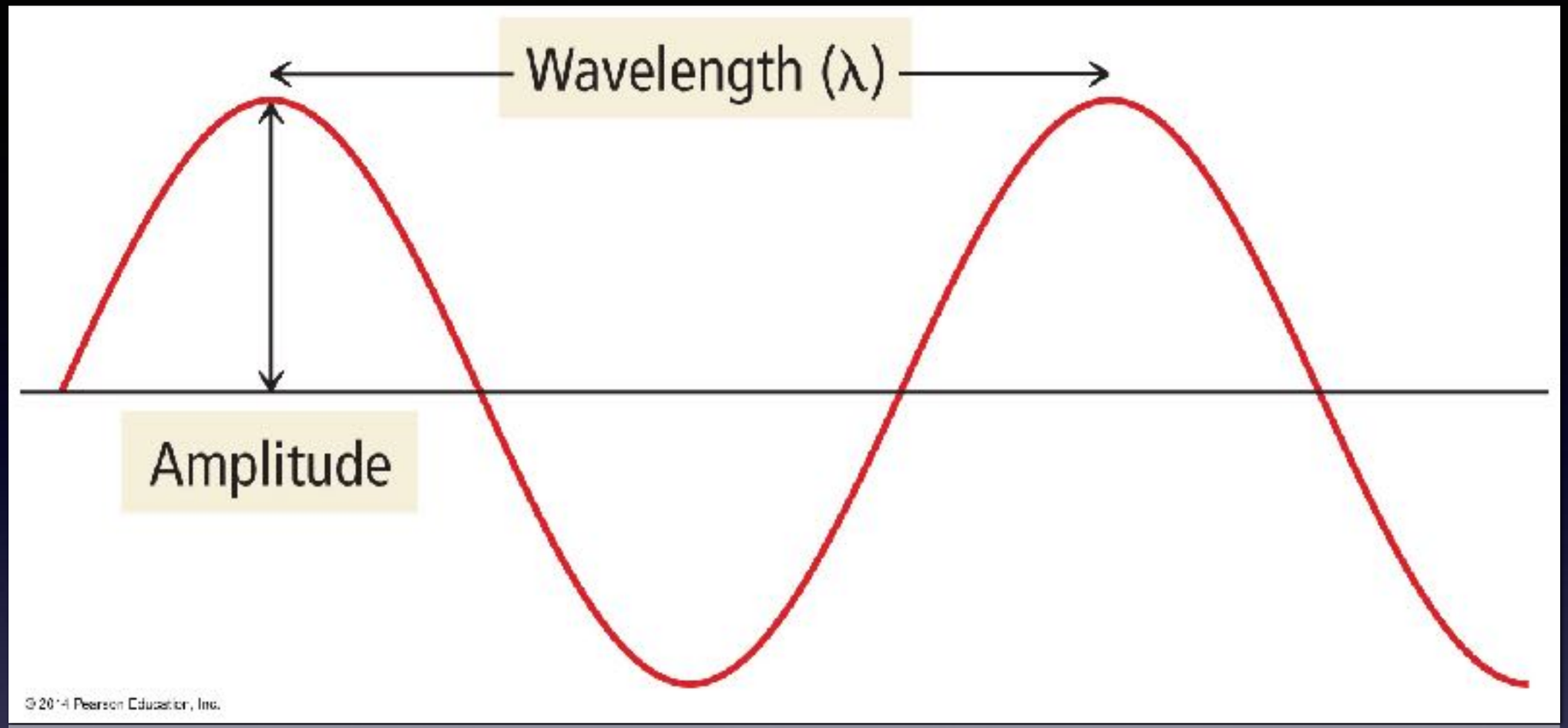


Tro
pg 77

- What's the relationship between…
  wavelength, frequency, and speed of propagation?

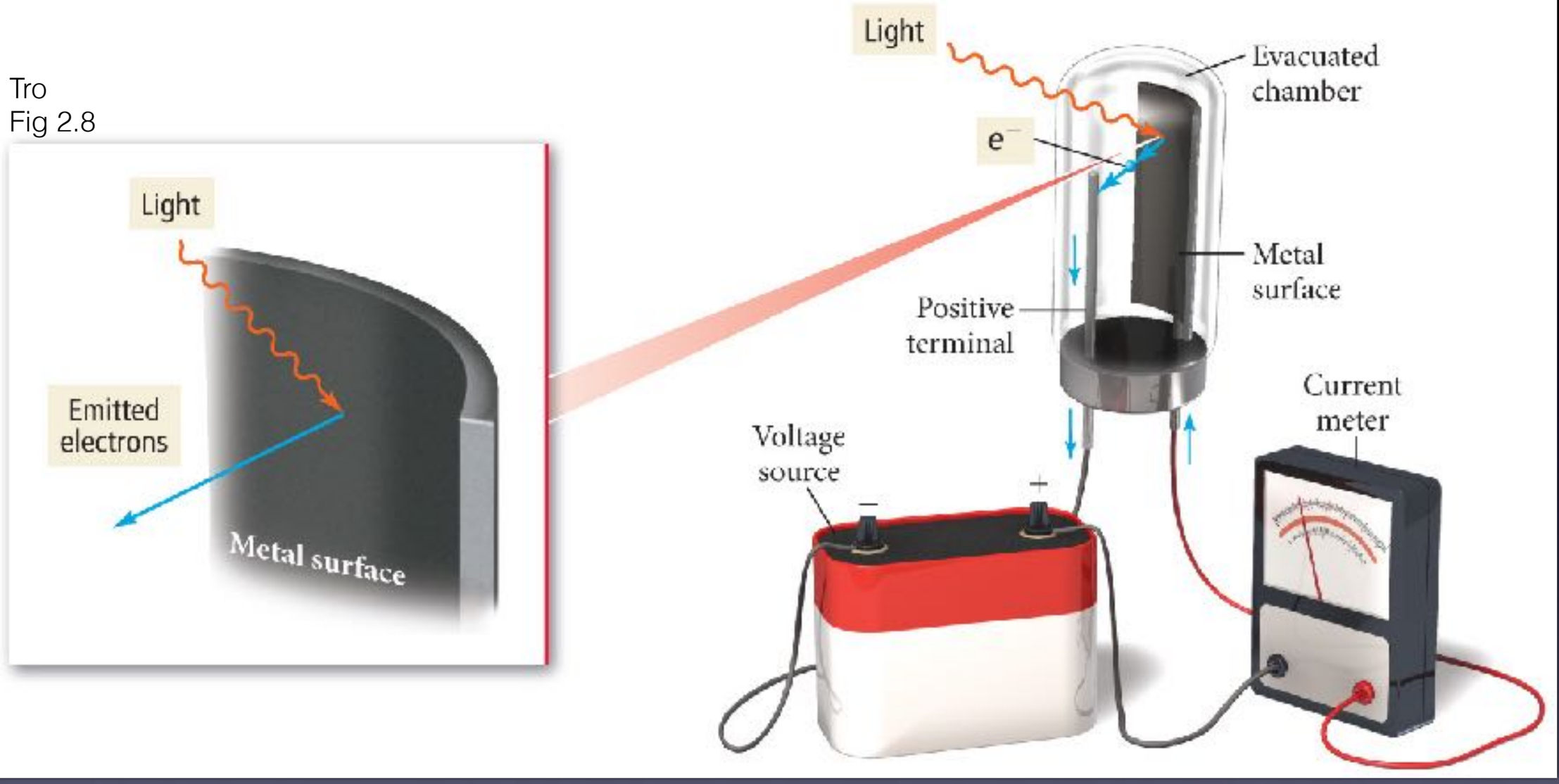
- You're responsible for knowing this!

$\lambda \nu = c$

$\lambda = c / \nu$

The photoelectric effect

Tro
Fig 2.8

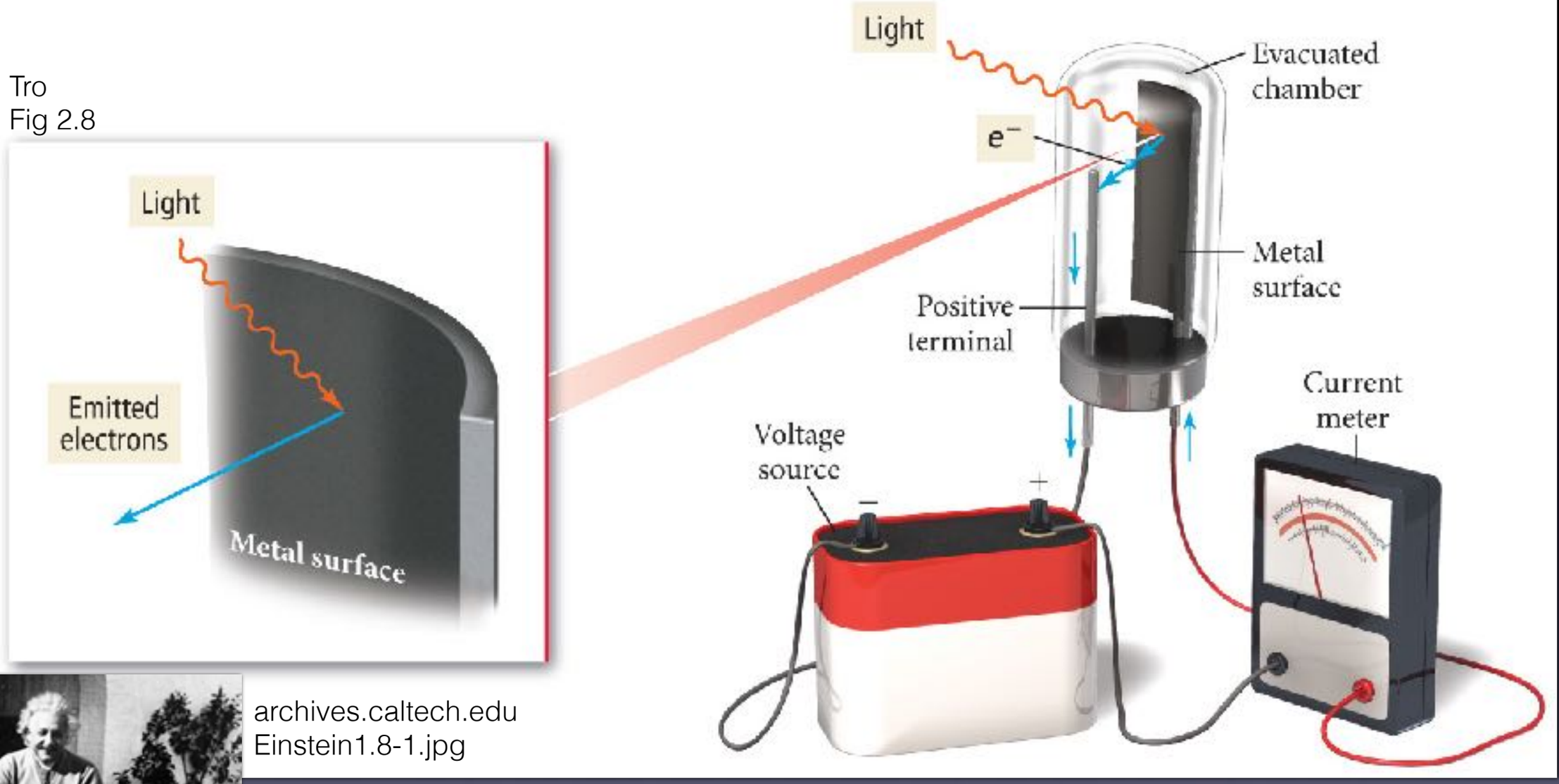


Observation

Intense red light would not produce current
but dim blue light would produce current

The photoelectric effect

Tro
Fig 2.8

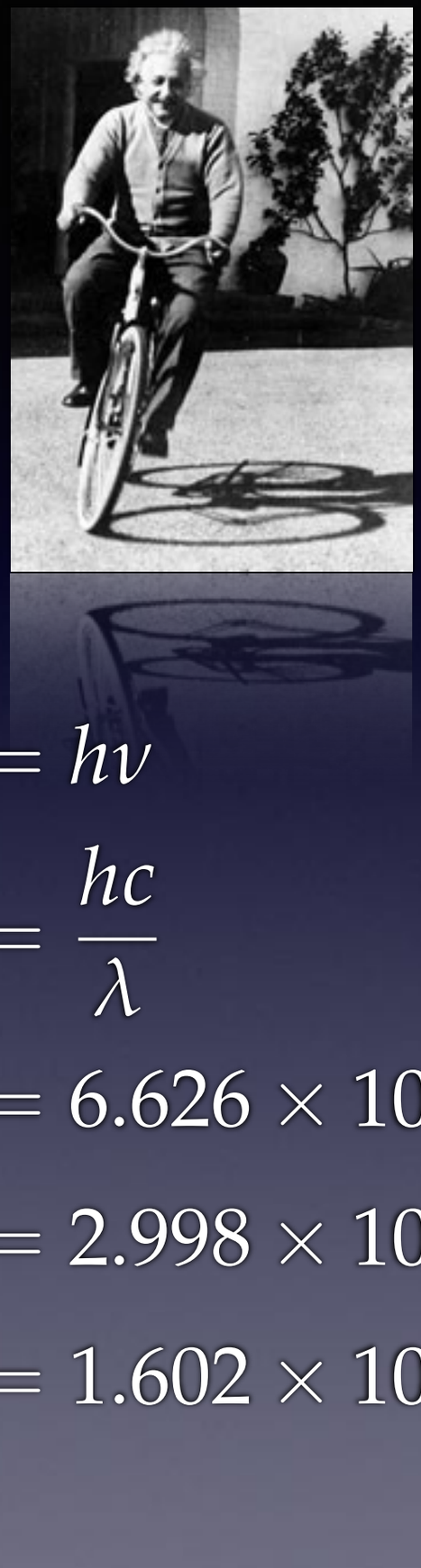


archives.caltech.edu
Einstein1.8-1.jpg

Conclusion

Energy of light is related to its color

Power is related to its intensity



Energy of light is related to its color
Power is related to its intensity

$$\mathbf{E} = h\nu$$

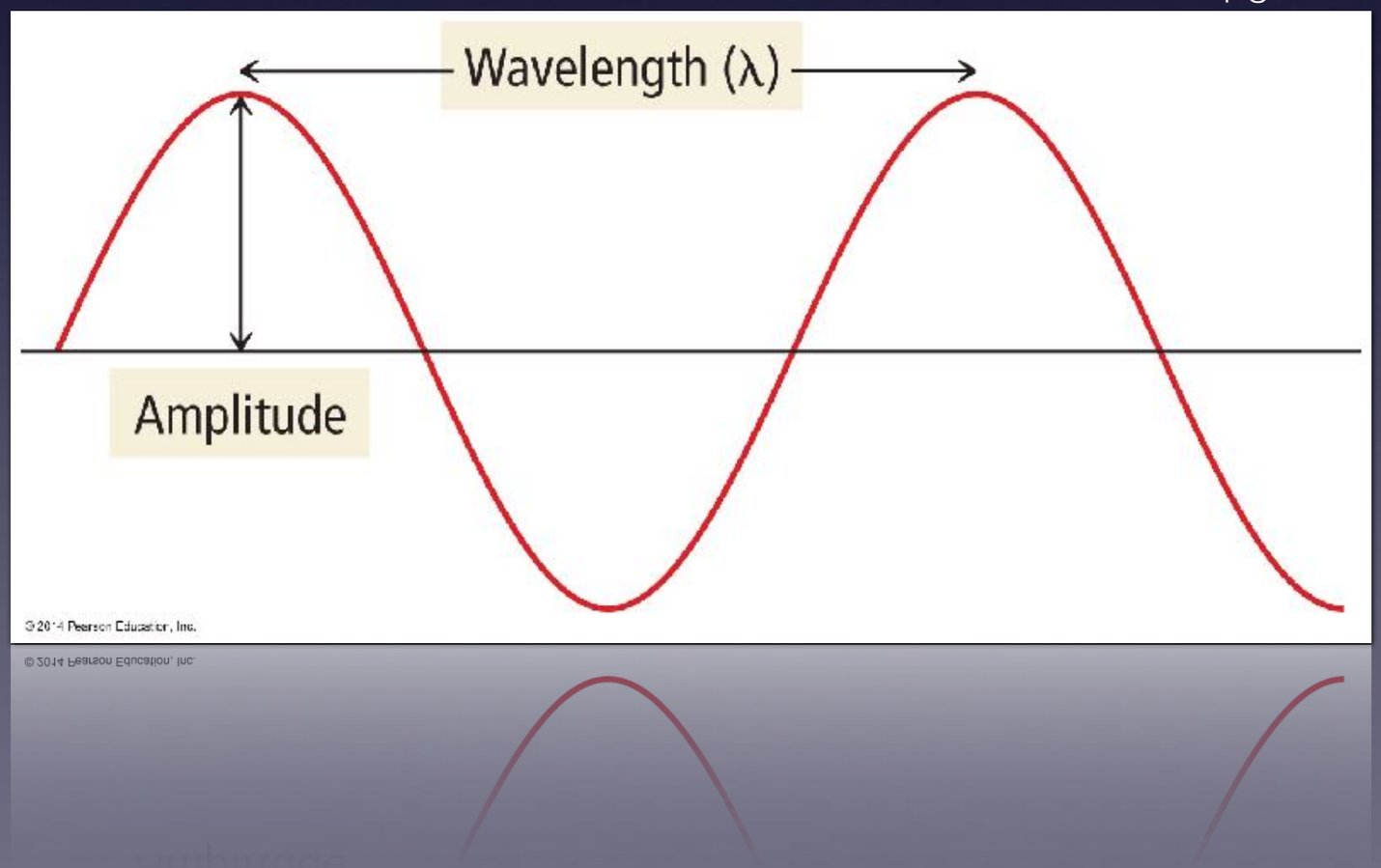
$$\mathbf{E} = \frac{hc}{\lambda}$$

$$h = 6.626 \times 10^{-34}\ \mathrm{J\,s}$$

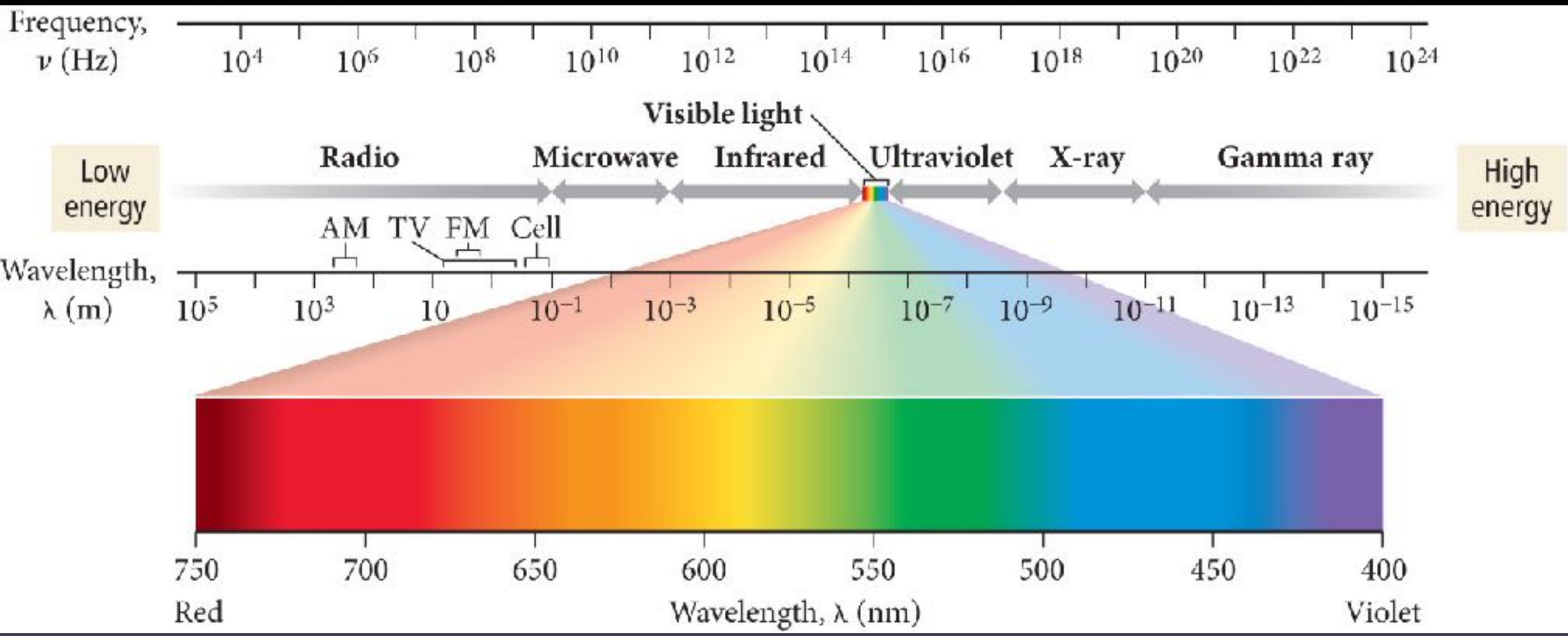
$$c = 2.998 \times 10^{8}\ \mathrm{m\,s^{-1}}$$

$$1\ \mathrm{eV} = 1.602 \times 10^{-19}\ \mathrm{J}$$

Tro
pg 77

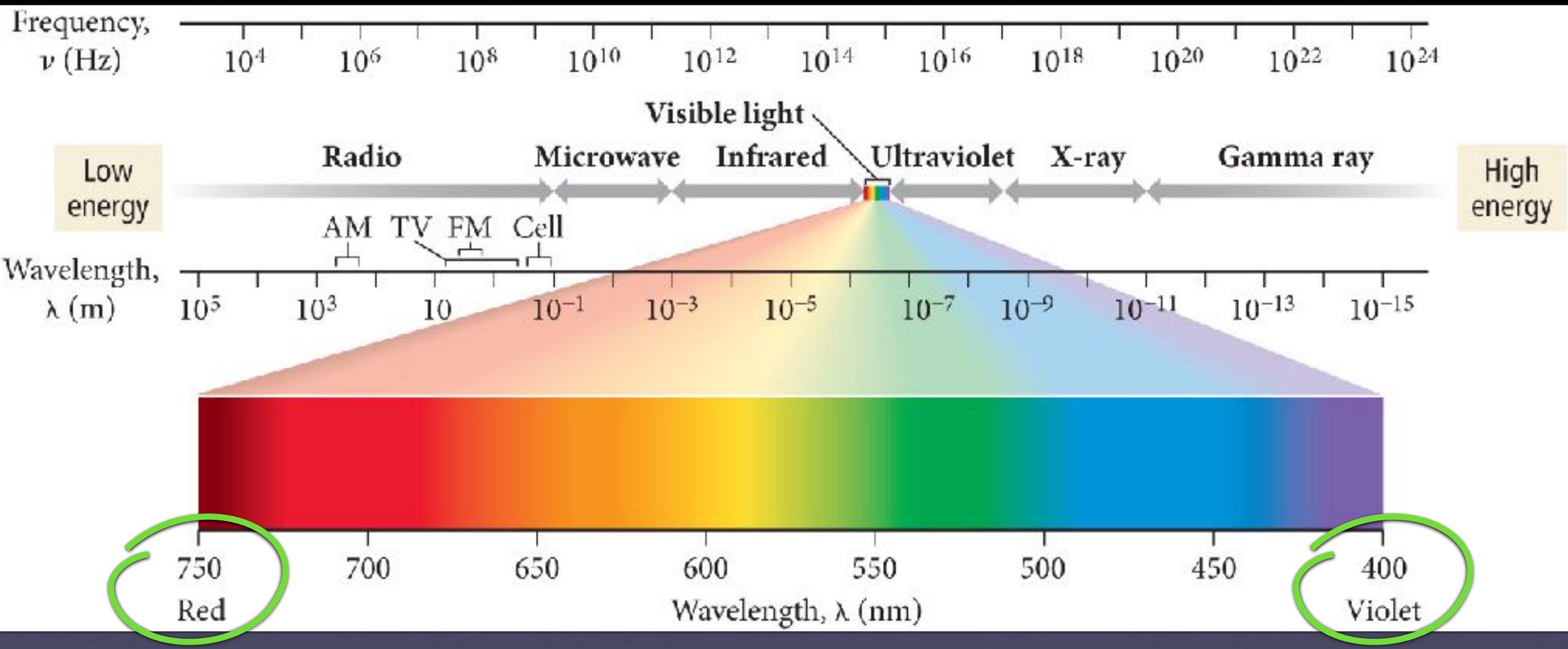


Tro, Fig 2.5


Frequency, ν (Hz)
10^4 10^6 10^8 10^10 10^12 10^14 10^16 10^18 10^20 10^22 10^24
Visible light
Low energy
Radio
Microwave
Infrared
Ultraviolet
X-ray
Gamma ray
High energy
AM
TV
FM
Cell
Wavelength, λ (m)
10^5 10^3 10 10^-1 10^-3 10^-5 10^-7 10^-9 10^-11 10^-13 10^-15
750 700 650 600 550 500 450 400
Red
Wavelength, λ (nm)
Violet

Practice conversions…

Tro, Fig 2.5



$$\mathbf{E} = h\nu$$

$$\mathbf{E} = \frac{hc}{\lambda}$$

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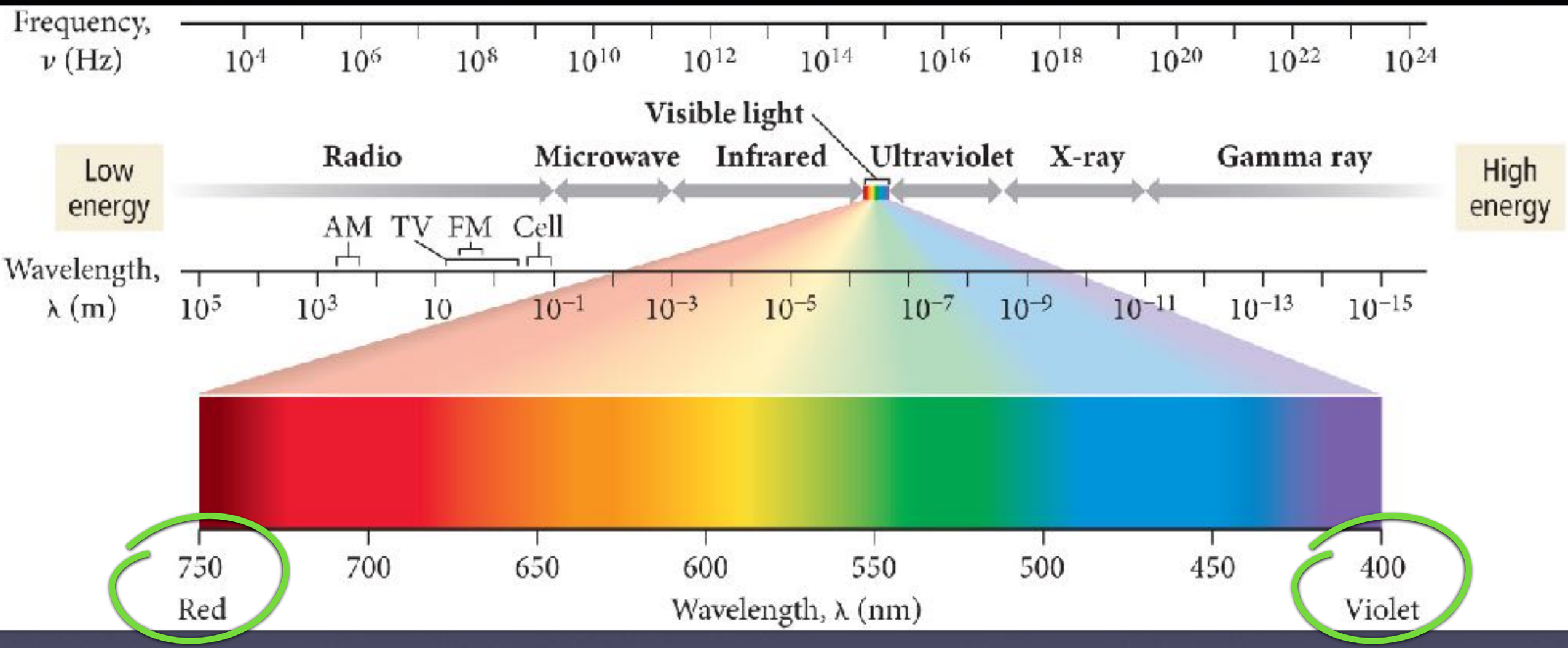
Practice conversions…

Tro, Fig 2.5



1.653 eV
2.648×10^{-19} J

3.099 eV
4.966×10^{-19} J

These are the kinds of problems I love giving on exams…

- The bandgap of TiO_2 is 3.2 eV, what wavelength of light does that correspond to?

$$\mathbf{E} = h\nu$$

$$\mathbf{E} = \frac{hc}{\lambda}$$

$$h = 6.626 \times 10^{-34}\ \mathrm{J\,s}$$

$$c = 2.998 \times 10^{8}\ \mathrm{m\,s^{-1}}$$

$$1\ \mathrm{eV} = 1.602 \times 10^{-19}\ \mathrm{J}$$

- The principal wavelengths of an Ar^+ laser are 488 nm and 512 nm. What is that energy in J? What is that energy in eV?

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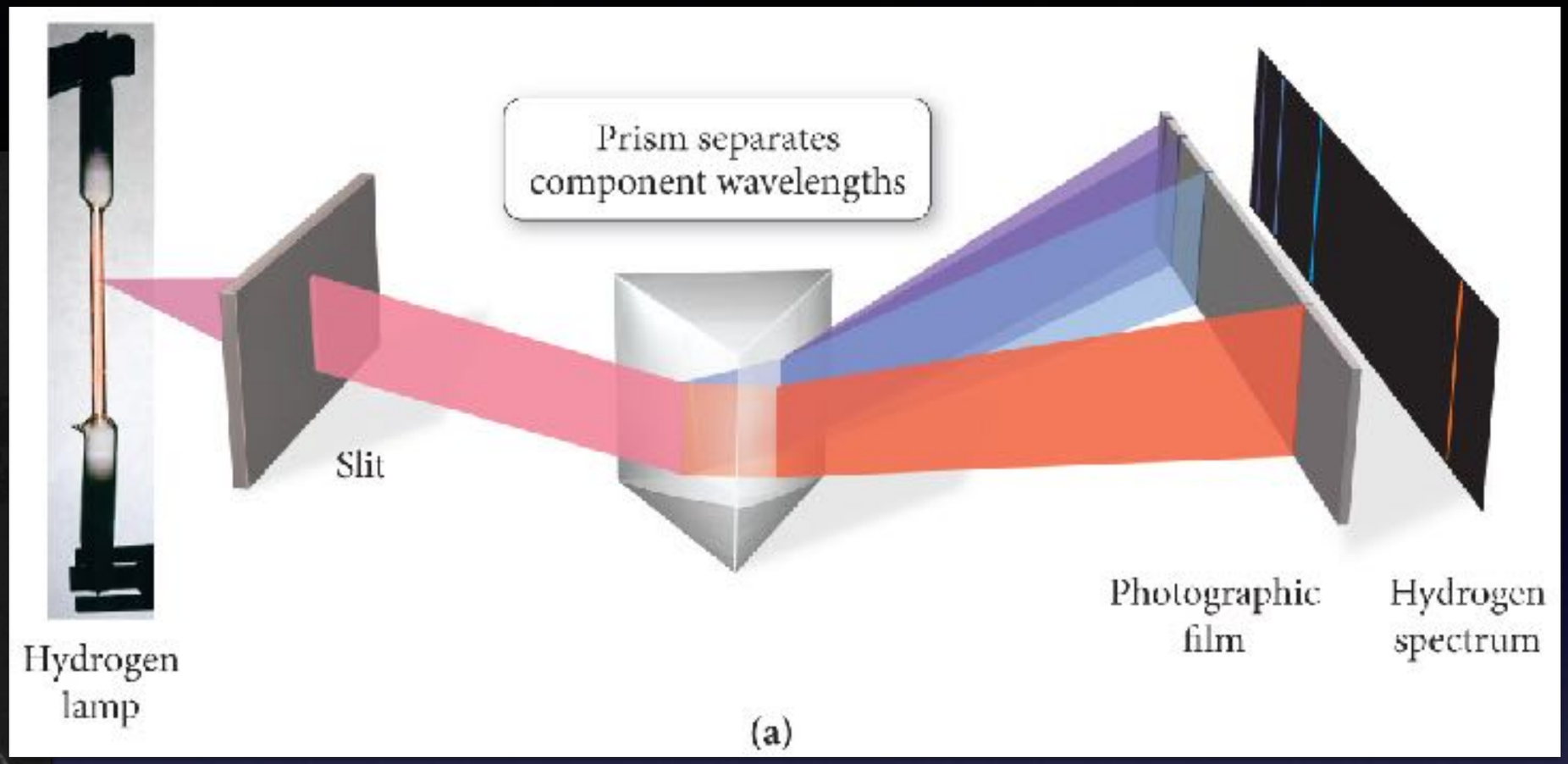
Balmer.jpeg



Tro, Fig 2.11a

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Visible_spectrum_of_hydrogen.jpg

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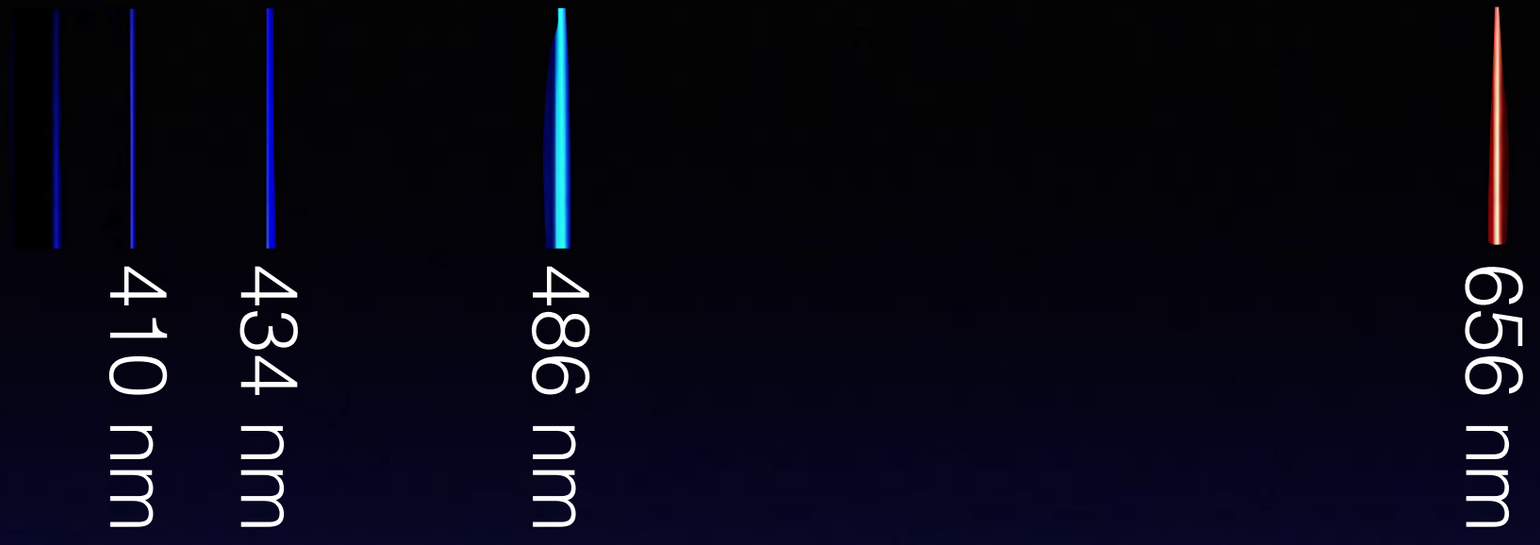
Visible_spectrum_of_hydrogen.jpg



$$\lambda = 364.56\,\mathrm{nm}\left(\frac{n^2}{n^2-4}\right)$$

Practice:
What's the wavelength of the next line in the Balmer series?

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Rydberg%2C_Janne.jpg

$$\lambda = 364.56\,\text{nm}\left(\frac{n^2}{n^2-4}\right)$$

$$\lambda = 364.56\,\text{nm}\left(\frac{n^2}{n^2-2^2}\right)$$

$$\frac{1}{\lambda} = \frac{0.01097}{\text{nm}}\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$$

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Rydberg%2C_Janne.jpg

$$\lambda = 364.56\,\text{nm}\left(\frac{n^2}{n^2-4}\right)$$

$$\lambda = 364.56\,\text{nm}\left(\frac{n^2}{n^2-2^2}\right)$$

$$\frac{1}{\lambda} = \frac{0.01097}{\text{nm}}\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$$

For Balmer series, this number is 2.

What if this number was 3?

Where did we go today?

Ch1010-A17-A03 Lecture 2

- § 2.2 The Nature of Light
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Next time…

- § 2.3 The Great Dane
- § 2.4 Matter as Waves

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