

Photoelectric Effect Simulator

Classroom worksheet · Interactive simulation: <https://lkforge.com/tools/physics/photoelectric-effect/>

Name: _____ Date: _____

Learning objectives

- Relate photon energy to frequency.
- Explain the threshold frequency and work function.
- Show why the effect supports the particle model of light.

Variables to change

- Light frequency (color)
- Light intensity
- Metal (work function)

Procedure

1. Shine low-frequency (red) light on the metal and watch for emitted electrons.
2. Increase the frequency toward blue/UV until electrons are emitted.
3. Increase the intensity below the threshold frequency and observe.
4. Above threshold, increase intensity and note the electron count and energy.

Observations

Record whether electrons are emitted versus frequency and intensity, and their maximum kinetic energy.

Questions

1. Write the energy of a photon.

2. What is the threshold frequency?
3. Below the threshold, does raising the intensity eject electrons?
4. Above threshold, what does raising intensity change?
5. Write the photoelectric equation for maximum electron energy.

Answer key (instructors)

- **1.** $E = h \cdot f$, where h is Planck's constant.
- **2.** The minimum frequency whose photon energy equals the work function; below it, no electrons are emitted regardless of intensity.
- **3.** No — intensity adds more photons but each is still too weak; frequency, not brightness, sets the energy per photon.
- **4.** It ejects more electrons per second, but not their maximum kinetic energy.
- **5.** $KE_{\text{max}} = h \cdot f - \phi$, where ϕ is the work function.

Light delivers energy in photons of energy hf . Electrons escape only when a single photon carries at least the metal's work function, so there is a threshold frequency independent of intensity — direct evidence for the particle nature of light ($KE_{\text{max}} = hf - \phi$).