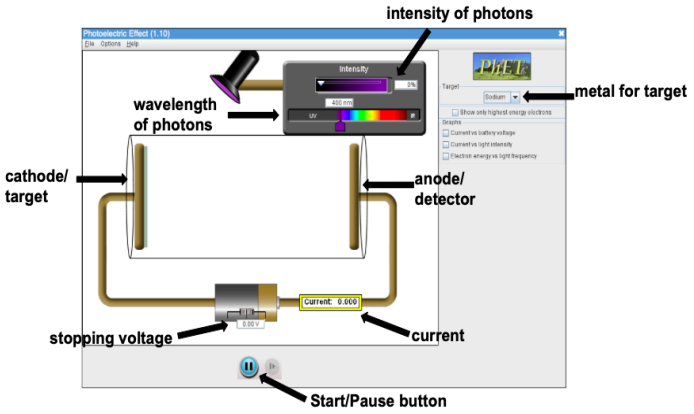
Photoelectric Effect Simulation Activity

PhET Simulation Tools



[PhET Photoelectric Effect simulation](https://phet.colorado.edu/en/simulation/legacy/photoelectric) link
(https://phet.colorado.edu/en/simulation/legacy/photoelectric)

Purpose: Students will determine the factors that are involved for an electron to be emitted from a metal by light.

Investigation: There are 4 factors that can be manipulated in this simulation: 1) the wavelength of the light that is shined on the target metal, 2) the intensity of the light, 3) the type of metal that makes up the target, and 4) the voltage of the battery. We will look at each of these factors separately and then determine what effect, if any, they have on the outcome.

***Notes:** the "ON" button is the Intensity, use the sliders or type values in to change them, give the simulation a few seconds to show any changes that may happen – they are not instantaneous, and leave the checkboxes on the right side of the screen unchecked.

1) Wavelength of light shining on the target metal

a) Control settings: metal for Target: **Sodium**; Intensity: **50%**; Battery voltage: **0.00 V**
Complete the table for each of the wavelengths. Record "YES" if electrons are emitted or "NO" if electrons are not emitted. Record any observations you make.

λ (nm)	750	600	540	535	450	350	250
e^- emitted?							
Observations							

Find the wavelength where the electrons just begin to be emitted from the metal (keep changing the wavelength until this happens). **Record that wavelength here: __ nm**
Describe the motion of the electrons at this wavelength.

b) Control settings: metal for Target: **(Zinc, Copper, Platinum, or Calcium)** (circle or highlight the one you are investigating); Intensity: **50%**; Battery voltage: **0.00 V**
Complete the table for each of the wavelengths. Record "YES" if electrons are emitted or "NO" if electrons are not emitted. Record any observations you make.

λ (nm)	700	600	500	400	300	200	100
e^- emitted?							
Observations							

Find the wavelength where the electrons just begin to be emitted from the metal (keep changing the wavelength until this happens). **Record that wavelength here: __ nm**
Describe the motion of the electrons at this wavelength.

2) Intensity of light shining on target metal
Control settings: metal for Target: **Sodium**; wavelength of light: **500 nm**; Battery voltage: 0**.00 V**
Observe the emitted electrons at the different intensities and record your observations.

Light Intensity	**5%**	**50%**	**100%**
Observations			

3) Type of metal that makes up the target
Control settings: Intensity: **50%**; wavelength of light: **300 nm**; Battery voltage: **0.00 V**
Complete the table for each type of metal at the given wavelength. Record "YES" if electrons are emitted or "NO" if electrons are not emitted. Record any observations you make.

Metal	**Sodium**	**Zinc**	**Copper**	**Platinum**	**calcium**
e^- emitted?					
Observations					

4) Battery Voltage
Control settings: Intensity: **100%**; wavelength of light: **300 nm**; metal for Target: **Sodium**
Observe the emitted electrons as you vary the battery voltage. Record your observations.

Voltage (V)	**Observations of emitted electrons**
0	
+1.00	
+2.00	
-1.00	
-2.00	

Change the voltage until you find the value where the **current is 0.000 A**. Use the Control settings for this section. (Typing values in rather than using the slider will be less frustrating and will result in better answers.) **stopping voltage= __ V**

Make a prediction.
The battery voltage needed to stop the current will **REMAIN THE SAME / CHANGE** (circle or highlight your answer) when the wavelength of the light changes.

Record the voltage(s) in the table.

Wavelength (nm)	**300**	**250**	**475**
Voltage (V)			

Conclusions:
Complete each of the sentence stems below based on your and your classmates' observations and the class discussion.

1) Wavelength of light shining on the target metal
The wavelength of the light shining on the target metal (**has / does not have**) an effect on the number of electrons that are emitted from the target metal.
I know this because

The type of metal used as the target (**does / does not**) make a difference.
I know this because

2) Intensity of light shining on target metal

The intensity of the light shining on the target metal (**has / does not have**) an effect on the number of electrons that are emitted from the target metal.
I know this because

3) Type of metal that makes up the target

The number of electrons emitted from the target metal (**is / is not**) dependent on the type of metal used for the target.
I know this because

4) Battery Voltage

The emitted electrons are affected by the battery voltage in the following ways:

The battery voltage necessary to stop the emitted electrons for a certain metal target (**remains the same / is different**) when the wavelength of the light is changed.
This may be due to