Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per \_\_\_

**Discharge Lamps PhET: Electron Transitions in Atoms**

Learning Goals: Be able to explain how energy is transferred between free electrons and electrons in atoms and how this energy is related to the photons released by atoms.

Run the simulation at <https://phet.colorado.edu/en/simulation/discharge-lamps>

**1-atom tab**

1. Use the drop-down menu to choose the Configurable Atom (instead of Hydrogen). You can select the # of empty electronic energy levels in the configurable atom and adjust their location by dragging. Move the atom about in the discharge tube. You may wish to change the Electron Production to Continuous. Turn on the Spectrophotometer and Squiggles).
   1. Start with only two electron levels. What do you notice about the color of the squiggle as you drag the second level up and down?

Experiment with different numbers of energy levels and spacings. You may turn the squiggles on and off as needed. Use slow motion and/or switch to single electron production if you find it difficult to see what is happening.

* 1. Consider the following True/False statements and circle the correct response:

True False If the spacing between two electronic energy levels in atom A is larger than in atom B, then the wavelength of the light emitted by atom B will be longer.

True False If the spacing between two electronic energy levels in atom A is smaller than in atom B, then fewer photons will be emitted by atom B.

True False Photons are emitted as electrons in the atom jump up in energy.

True False The colors emitted by an atom depends on how much kinetic energy the free electron has when it hits the atom.

True False The colors emitted depends on the number of free electrons passing through the lamp.

True False When a free electron hits an atom, the atom is always excited to the highest energy level possible.

True False The kinetic energy of the free electron at the point of collision increases as the voltage of the battery increases.

True False The kinetic energy of the free electron at the point of collision is higher if the atom is closer to the source of electrons.

True False The only way to emit IR photons is if there are empty electronic energy levels really close to the ground state (lowest energy level).

True False When atomic electrons are excited to a higher level, they always return to their lowest energy level by jumping down one level at a time.

1. Choose the hydrogen atom and let the simulation run for a few seconds.
   1. As it runs, how many lines appear in the visible portion of the spectrum? What colors are they?
   2. Make sure the Squiggles are on. All of the visible transitions are the result of electrons falling to which energy level (n= )?
   3. How does the number of transitions in the UV region (below 400 nm) compare to the number of transition in the visible region of the spectrum? Why do you think this is?
   4. What do you observe when you lower the voltage to around 20 volts? Explain why.

**Multiple Atoms tab**

1. Run the sim using hydrogen for a few seconds. Then switch to sodium.
   1. What do you notice about the spacing of the electron levels of these two elements?
   2. As the sodium sim runs, what do you notice about the number of transitions in the UV, visible and far IR portions of the spectrum? Explain your observations, referring to your answer to 3a and comparing its spectrum to that of hydrogen.