

In this activity, you will conduct a virtual laboratory to analyze how atomic emission spectra are formed and how they differ by element.

Virtual Lab: PhET Neon Lights and Other Discharge Lamps

You can access this simulation at: <https://phet.colorado.edu/en/simulation/discharge-lamps>

Part One: Relating Energy Changes to Light

- a. Open the simulation, and choose Continuous for Electron Production.
- b. Select Configurable for Atom Type, set the number of levels to two, and click the box next to Spectrometer. Initially, the difference between the first and second energy levels is very great.

1. According to the spectrometer, what is the approximate wavelength of the light that is emitted?

- c. Click and drag the 2 in the energy level diagram about a quarter of the way down.

2. What are the color and wavelength of the light that is emitted?

- d. Continue to slide the second energy level closer to the first energy level.

3. As the electron falls back to the first energy level, what happens to the wavelength of the emitted light?

4. Based on your observations, what is the relationship between the wavelength and the energy of the emitted light?

Part Two: Multiple Energy Level Changes

- a. Choose Hydrogen for Atom Type.
- b. In the diagram, click the atom that is between the two charged plates and drag it to the left.

1. What happens to the Energy at Collision line on the right-hand side of the energy diagram?

- c. Keep the atom at a location where the Energy at Collision line is near the top of the diagram and above all of the energy levels.

- d. Start the simulation and let it run for 15 seconds.

2. Where do most of the emission spectrum lines occur? What does this indicate about the energy of the emissions?

3. To what energy level do the electrons fall when these emissions occur?

4. How many different visible (between 400 and 700 nm) emissions occur?

- e. Turn on Squiggles and click Run in Slow Motion.

5. Between which energy levels do the visible emissions occur?

6. Based on your observations, how is the wavelength of the emitted light related to the difference between the energy levels?

Part Three: Multiple Atoms

a. Click Multiple Atoms at the top of the page, and click Spectrometer under the energy diagram.

1. Does changing from one hydrogen atom to multiple hydrogen atoms change the wavelengths of the emitted light?

b. Switch the atom to sodium.

2. How does the difference between the energy levels of a sodium atom compare to the difference between the energy levels of a hydrogen atom?

3. How do the wavelengths of the sodium atom emissions compare to the wavelengths of the hydrogen atom emissions?

4. Do these emission wavelength values support your understanding from Part One of the simulation? Explain.
