

[SQUEAKING] [RUSTLING] [CLICKING]

VIVIAN SONG: In this video, we will be going over a Goodie Bag number two which is about electronic transitions. What you'll need are four LEDs-- white, blue, green, and red-- and one spectrometer. The objectives in this video are to understand photon absorption and emission, apply the Bohr Model, and use the spectrometer to see sample spectra.

The conceptual questions you should keep in mind are, how do electrons transition to different energy levels? And why is spectroscopy a method of material characterization? As a reminder, the Bohr Model can be used to model these electronic transitions, assuming that there's only one electron in the atom.

So right now, I'm going to draw my energy axis and three different energy levels that my electron can hop into. So this is one, and two, and three. So let's say that our electron starts in the ground state. And it absorbs some energy and can hop to a higher energy level. But in doing so, at this higher energy level, it is in a more unstable state.

Eventually, it'll want to return to that more stable state. And when it does so, it emits energy in the form of a photon. So emit photon and absorb energy. These different electronic transitions can be tracked with this equation.

So the change in energy is equal to minus $13.6z^2$ times $1/n_f^2$ minus $1/n_i^2$. Where z is the atomic number, and f is the final state of the electron. And i is the initial state of the electron. And this change in energy is in electron force.

So remember that these electronic transitions are quantized since these energy levels are not continuous, but they're integers. This means that the photon that the electron emits is going to have a certain set of different wavelengths. And we can see that with this equation energy equals hc/λ , where energy is equal to this change in energy. h is Planck's constant. c is the speed of light. And λ is the wavelength of our emitted photon.

After looking at the red and white LEDs through the spectrometer, you should see something like this. Notice how for the red LED, mostly the red and orange bands are visible. Whereas for the white LED, almost all the colors are visible. Another thing that you could explore is using your spectrometer to look at the ceiling lights and seeing how that spectra would differ from the spectra that you observed from your LEDs.

In summary, electrons absorb and emit photons of different wavelengths because electronic transitions are quantized. By capturing this information, the spectrometer becomes a very useful tool for characterizing our materials.