

John Nalan
PHYS 6980
Physics Unit: The Atom

Objectives:

- Students will be able to explain the structure of the atom.
- Students will be able to distinguish between line spectra and continuous spectra.
- Students will be able to tell the difference between emission and absorption spectra.

Pre-requisites

- Students have already learned about light and diffraction.

Day One - Discussion and Activity

Conduct a classroom discussion about the history of the atoms. Key points to discuss include:

1. Late in the 19th century people knew that atoms existed, that they had negatively charged electrons, and that they were electrically neutral.
2. People suspected protons must exist and that they were much heavier than electrons.
3. J.J. Thomson, the discoverer of the electron, guessed that the atom was filled with a large positively charged substance.
4. Ernest Rutherford conducted an experiment showing the true structure of the atom.
5. Completely discuss Rutherford's experiment where he bombarded a very thin gold plate with alpha particles and found that most went right through the foil, but some were deflected or even bounced back. Rutherford concluded that the atom was mostly empty with only a very small and centralized proton area.

To give student a sense of how Rutherford did his experiment and how he came to the conclusions he did, the students do the following activity.

1. Hang a large sheet on the wall and place ten pie tins on it. In groups, blindfold a student and from about 10 feet away have them throw ten rubber stoppers at the wall and record the number of "hits". Collect the data and determine a class hit percentage.
2. Repeat the activity with five pie tins and one pie tin. Notice how the hit percentage decreases. As an example, place a nickel on your largest wall and ask students how often they think they hit it. Tie this into the results and conclusion of Rutherford.

After class, students should understand that an atom is mostly empty space. It has a nucleus in the center and electrons that occupy the huge empty space.

Day Two – Discussion and Spectroscope Lab

Conduct a classroom discussion about how the electrons are arranged around the nucleus and discuss an atom's emission spectra. Key points to discuss include:

1. Remind students about the continuous light spectrum we saw earlier this year when we put white light through the spectroscope.
2. Note gases given off characteristic colors when high voltage is applied. Will these lights filled with gas also show a continuous spectrum?

Have the students set up the spectroscope with light from one element. Have them draw what they see. They should notice right away that the spectrum is not continuous. Let them observe and draw the spectra from other gases.

1. Explain how each element has its own distinct spectra and show the students several examples.
2. Discuss how the elemental make-up of objects that emit light can be determined by the emission spectrum and the intensity of the spectra.
3. Explain how an absorption spectrum is created by passing white light through gas vapor.

At the end of the day students should understand how emission spectra can be used to determine the element or elements that make up a light source.