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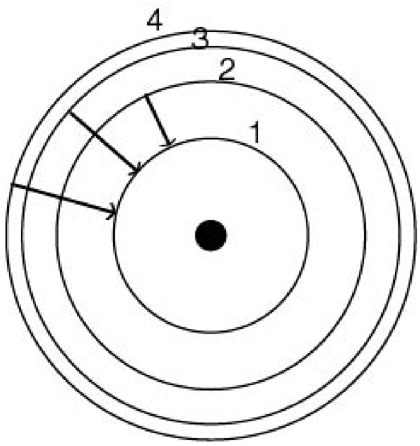
Name ____

Date ______________________ Period _______________ Exercise# __________________

What are stars and planets made of?
Student Worksheet

In "Spectra" you learned about the different types of spectra and how they are produced. In today's experiment, you will do exactly the same thing that the students did in the video. Below are a few key points.

The figure below is a simplified hydrogen atom. It has one proton and one electron. Usually the electron is on the ground level, which is level 1. The electron can get "excited" which causes it to jump to a higher level, such as level 2. In the video, you might recall, it was discussed that the atoms get excited by electrons, both in the Aurora and the neon tubes. In our experiment, the energetic electrons will be provided by a power supply, just like in the neon tubes.



Simplified hydrogen atom. Excited electrons are shown decaying to the ground level.

The excited electron will soon decay back to level 1, emitting a photon, which we will call λ_{1-2}. The symbol λ is the Greek letter lambda, which is used for the wavelength of photons. λ_{1-2} has a very specific wavelength, corresponding to the difference between the energies of level 1 and level 2.

The electron can however get excited to higher levels, such as levels 3 and levels 4. In this case other photons will be emitted, which we will call λ_{1-3} and $\lambda_{1-4.}$ These are different wavelengths that correspond to different energies.

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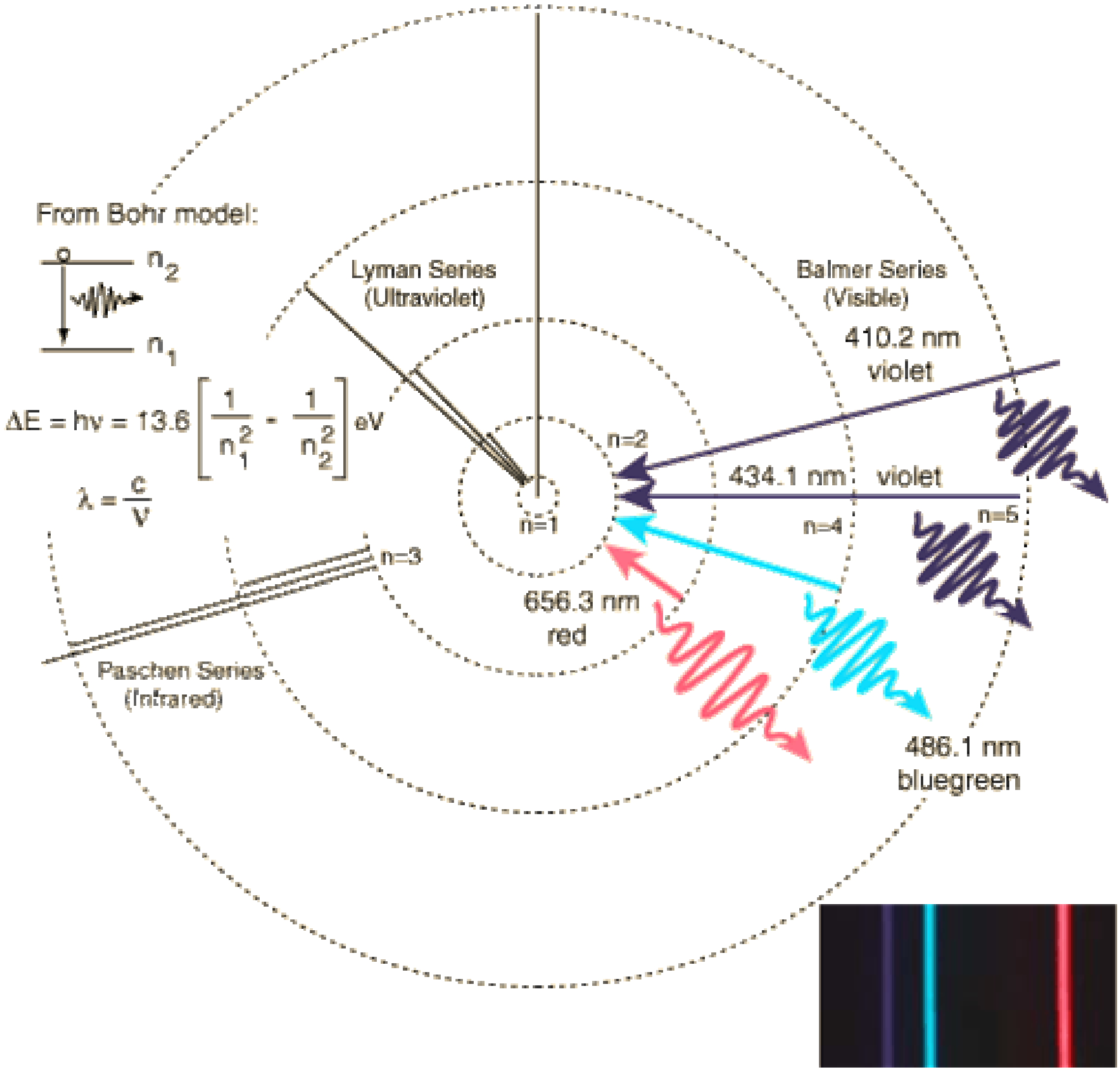
This was a simplified explanation. In “real life” even the simplest of all the atoms, has many more options for excitation, not to mention atoms of higher atomic number elements, which are even more complicated. It is interesting that there are SO many different options, that each spectrum of each atom and each molecule is so unique, just like a finger print, that this is the primary method of determining atomic and molecular composition and where most of our knowledge about the composition of the Universe comes from. On the next page a more realistic rendering of a hydrogen atom is provided.



“Scientific” rendering of a hydrogen atom with key lines is shown above. The formulas on the left enable you to calculate the energy of the photons. You will be learning about this in High School.

In addition to learning about the composition of the Universe, scientists are also able to tell if the emitting objects is moving and with what speed (Doppler effect), the magnitude of magnetic fields (Zeeman splitting), the magnitude of electrical fields (Stark broadening) and much, much more.

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What you will be doing:

1) Open your book to page 485 and look at Figure 2. It shows spectra of neon, hydrogen, helium, and sodium.
2) Pick up your spectrometer. The “active element” is a diffraction grating that is located near the eyepiece. Point it at the light source that your teacher will provide. Look for a scale. You should see either lines or a continuum, depending on the light source. **There will be other light bouncing off the spectrometer. Make sure to look at the scale.**
3) You teacher will excite some “mystery” gases. Match up the spectra that you see with the spectra in the book. Write the names in the spaces below: Where you able to identify which ones they where?

(a) ________________ (b)_________________ (c) _______________ (d) ______________

4) Now you are ready to map out the spectra. In the space below write the name of the gas and draw the spectrum. Use colored pencils, if you have some. The wavelengths are in nanometers, which scientists abbreviate as nm.
5) A good thing to do at home is to read pages 484-487 in your textbook as it will tell you more about spectra and tie it in with stars and galaxies.

(a) Name of gas: _______________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) _________________ (b) __________________ (c) ______________________

Notes: ____

Name of gas: _______________

750 700 650 600 550 500 450 400 350 nm

(b) Key lines: (a) _________________ (b) __________________ (c) ______________________

Notes: ____

(c) Name of gas: _______________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) _________________ (b) __________________ (c) ______________________

Notes: ____

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(d) Name of gas: ________________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) __________________ (b) ___________________ (c) _______________________

Notes: ____

Name of gas: ________________

750 700 650 600 550 500 450 400 350 nm

(e) Key lines: (a) __________________ (b) ___________________ (c) _______________________

Notes: ____

(f) Name of gas: ________________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) __________________ (b) ___________________ (c) _______________________

Notes: ____

(g) Name of gas: ________________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) __________________ (b) ___________________ (c) _______________________

Notes: ____

(h) Name of gas: ________________

750 700 650 600 550 500 450 400 350 nm

Key lines: (a) _________________ (b) ___________________ (c) _______________________

Notes: ____

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