Chemistry
Spectroscopy WebQuest Name _____

Standards guiding today's activity:

CHE.2.3	Investigate absorption and emission spectra to interpret explanations of electrons at discrete energy levels using tools such as online simulations, spectrometers, prisms, flame tests, and discharge tubes. Explore both laboratory experiments and real-world examples.
CHE.2.4	Research appropriate sources to evaluate the way absorption and emission spectra are used to study astronomy and the formation of the universe.

***You may find links that do not work. Don't give up! Let me know and let's fix them together.**

Task #1: 1. Go to the link below and answer the following questions:

Electromagnetic Spectrum (http://www.lbl.gov/MicroWorlds/ALSTool/EMSpec/EMSpec2.html)

a. What kind of electromagnetic radiation has the shortest wavelength? The longest?

b. What kind of electromagnetic radiation could be used to "see" molecules? What would be needed to see a cold virus? Explain your reasoning.

c. Why can't you use visible light to "see" molecules?

d. Some insects, like bees, can see light of shorter wavelengths than humans can see. What kind of radiation do you think a bee sees? Explain your reasoning.

Task #2 "Electromagnetic Radiation and Molecules"
Your task is to explore how 4 different forms of electromagnetic radiation affect common molecules. Click this link: https://phet.colorado.edu/en/simulation/molecules-and-light OR Go search for phet.colorado.edu and click "Play with Simulations." Use the search bar at the top of the page to find an activity called "Molecules and Light". Turn on the light source and shine the light at the chosen molecules and see how those molecules interact with different forms of radiation.
Choose 4 molecules in addition to water, and describe how the forms of light interact with the molecules. Use a brief description to write about the effects of microwave, infrared, visible, and ultraviolet light on the molecule.

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Molecule	Effect of microwave	Effect of Infrared	Effect of Visible	Effect of Ultraviolet
H_2O	molecule rotates	molecule waggles	no effect	no effect
a)				
b)				
c)				
d)				

Task #3: Spectra and what they tell us

GO to the following link and read up on types of spectra and how they're used:
https://imagine.gsfc.nasa.gov/science/toolbox/spectra1.html

Define: Black hole:

Neutron star:

Supernova explosion:

https://imagine.gsfc.nasa.gov/science/toolbox/

On the front page of this site, there is a picture of the electromagnetic spectrum that has pictures of objects that are approximately the same size as the type of waves shown. a) What is an object that is about the same size as a radio wave?

b) What is an object that's about the same size as a microwave?

c) What is an object that's about the same size as an x-ray?

e) What is a spectrum and what kind of objects can be studied using spectroscopy?

**g) Describe 4 things that astronomers can learn from spectral lines (last paragraph of "basic" page and first paragraph of "advanced" tab page)?

h) A spectrum is shown of a star, Cassiopeia A (Cas A) is shown. What type of spectrum is it and what instrument collected it?

i) What do the 'bumps' represent on the the Cas A spectrum?

k) How does the line emission spectrum of Helium compare to that of Hydrogen?

3-l) Click on the Astronomer's toolbox tab on the left. Read through this page and choose either "Gravitational Waves" or "Cosmic Rays" to read more about. Write a brief description of something you learned here and one interesting fact:

m) Click on the Cosmic Objects tab. Choose any three objects to investigate.

Cosmic Object	How we classify or understand them:

n) Click on the "Observatories" tab to learn about how we study these objects. Click on the satellite showcase and browse the satellites used by astronomers. Choose two of our space satellites and describe them. What are they like and what can they do? Who placed them in space?

Satellite	Information

Task #5: Line Spectra Analyze & Conclude

We can look at another type of line spectrum – the absorption spectrum. The color you observe is due to the reflection or transmission of unabsorbed wavelengths of light. When white light passes through a sample and then a diffraction grating (3D glasses), dark lines show up on the continuous spectrum of white light. These lines correspond to the wavelengths of the photons absorbed by the solution.

1. How does the existence of spectra help to prove that energy levels in atoms exist?

2. How can the single electron in a hydrogen atom produce all of the lines found in its emission spectrum?

3. How can you predict the absorption spectrum of a solution by looking at its color?

4. How can spectra be used to identify the presence of specific elements in a substance?

Real-World Chemistry

5. How can absorption and emission spectra be used by the Hubble space telescope to study the structures of stars or other objects found in deep space?

6. The absorption spectrum of chlorophyll *a* indicates strong absorption of red and blue wavelengths. Explain why leaves appear green.

7.Read the two standards at the top of the first page. Describe at least two ways the activities in this exercise and in the flame test lab and in-class assignments have helped you to meet this standard.

*For fun: https://imagine.gsfc.nasa.gov/educators/programs/spaceforensics/