## Science Objectives

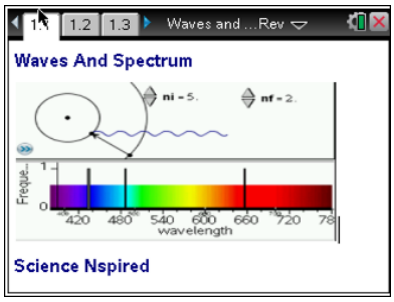
- Students will study the relationship between wavelength, frequency, and color.
- Students will calculate wavelengths and frequencies.
- Students will calculate the energy of electromagnetic radiation using Planck's Constant.
- Students will study the energy changes as electrons change energy levels in an atom.
- Students will learn about the Balmer, Paschen, and Lyman Series.
- Students will calculate the energy change that an electron undergoes when changing energy levels using the Rhydberg Constant.

## Vocabulary

- Balmer Series
- electromagnetic radiation
- frequency
- Lyman Series
- Paschen Series
- photons
- Planck's Constant
- Rhydberg Constant
- speed of light
- visible spectrum
- wavelength

## About the Lesson

- This lesson involves the relationship between waves and electron energy jumps within the atom.
- As a result, students will:
  - Study the relationship between wavelength, frequency, and color.
  - Calculate wavelengths and frequencies.
  - Calculate the energy of electromagnetic radiation using Planck's Constant.
  - Study the energy changes as electrons change energy levels in an atom.




**TI-Nspire™ Technology Skills:**

- Download a TI-Nspire document
- Open a document
- Move between pages
- Capture a data point using ctrl .

**Tech Tips:**

Make sure that participants understand how to capture a data point using ctrl .

**Lesson Materials:**

*Student Activity*

- Waves_and_Spectrum_Student.doc
- Waves_and_Spectrum_Student.pdf

*TI-Nspire document*

- Waves_and_Spectrum.tns

- Learn about the Balmer, Paschen, and Lyman Series.
- Calculate the energy change that an electron undergoes when changing energy levels using the Rhydberg Constant.

## TI-Nspire™ Navigator™

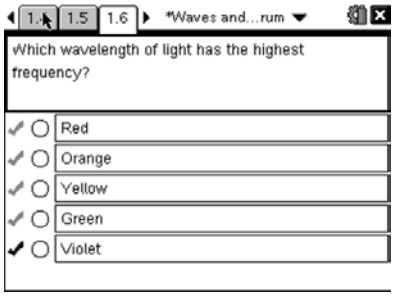
- Send out the .tns file.
- Monitor student progress using Screen Shots.
- Use Live Presenter to spotlight student answers.

## Activity Materials

- *Waves and Spectrum*.tns document
- TI-Nspire™ Technology

## Discussion Points and Possible Answers

**Move to page 1.6.**




Q1. Which wavelength of light has the highest frequency?

**Answer:** Violet

Q2. Calculate the frequency of light with a wavelength of 400nm.

**Answer:** 7.49 $x10^{14}$/s

Q3. Calculate the wavelength of light in nm if the frequency is 1.5 $x10^{18}$ Hz.

**Answer:** 2.0$x10^{-1}$ nm

Q4. Which color of light has the highest energy?

**Answer:** Violet

Q5. Calculate the energy for red light with a frequency of 4.15 x$10^{14}$ Hz.

**Answer:** 2.75 x $10^{-19}$ J

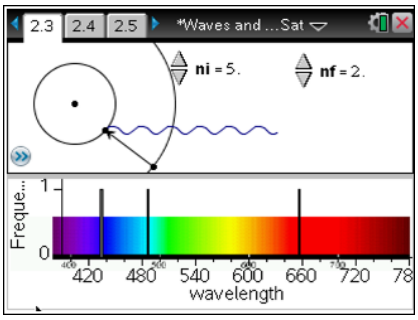
Q6. How much energy is released from a photon with a wavelength of 555 nm?

**Answer:** 3.58 x $10^{-19}$ J

Q7. What is the frequency of a photon that releases 4.00x$10^{-21}$ J?

**Answer:** 6.04 x$10^{12}$ Hz

On Page 2.3, *ni* is the initial energy level where the electron starts, and *nf* is the energy level where the electron lands.




- Press ctrl . to capture the wavelength of light on the spectrum.
- Capture *ni* until the value is 10.
- Change *nf* to 2, and repeat until *ni* is 10 again.

Note: The only wavelengths that will appear within the range of 400 nm to 700 nm are visible light wavelengths.

- Change the value of *ni*, and press ctrl . to capture each of the electron drops.

Q8. What electron movements produce visible light?

**Sample Answers:** Suggested responses: 3-2, 4-2, 5-2, 6-2

Q9. Calculate the energy for the 4 wavelengths of light generated in the graph which is known as the Balmer series.

**Sample Answers:** Suggested responses: 3.03x$10^{-19}$J, 4.09x$10^{-19}$J, 4.58x$10^{-19}$ J, 4.84x$10^{-19}$ J

Q10. Calculate the ΔE for an electron moving from the n=4 to n=3.

**Answer:** 1.06x$10^{-19}$ J

**TI-Nspire Navigator Opportunities**

Make a student a Live Presenter to illustrate energy changes for the Balmer, Paschen, and Lyman Series. Throughout the lab, discuss the activity with students using Slide Show. At the end of the lab, collect the .tns files and save to Portfolio.

## Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

## Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.