Lesson Title:	**Spectral Detective**
Subject Area:	Science
Grade Level:	7th
Duration:	3 – 5 days
Format (#students/group):	The students work in pairs.
Overview:	The students follow a set of directions to build a spectroscope and then use it to identify different light bulbs and various chemical elements.
Educational Standards:	Classify substances by their physical and chemical properties. Visible light is an example of electromagnetic radiation and different substances produce different spectra of light.
Unit Question:	How can physical and chemical properties be used to identify substances?
Focus Question/ Purpose:	How do scientists identify what substances are in objects that are too far away for scientists to directly observe (i.e. stars, planets, etc.)?
Desired Outcomes:	The students will be able to read and follow a written set of directions to build a working spectroscope. The students will use the spectroscope to identify unknown substances. The students will identify problems with the design and develop a solution to one or more of the problems.
Activity Details/ Instructions:	Activity 1: 1. Select the **Build Your Own Spectroscope** link (http://coolcosmos.ipac.caltech.edu/cosmic_games/spectra/makeGrating.htm). 2. Follow the directions to make your own spectroscope. 3. Point the spectroscope's slit at the first light bulb. Record the type of light bulb in the data table. 4. Look through the opening at the top of the spectroscope and adjust the spectroscope until you see a spectrum (rainbow). 5. Use your phone or iPod to take a picture of the spectrum. 6. Sketch the spectrum in the data table. 7. Compare the picture to the spectra on the **Light Bulb Spectra Sheet**. Look for the closest match. 8. Determine which known spectrum matches the type of light bulb and record its letter on the data table below. 9. Repeat for the other light bulbs. Activity 2: 1. Point the spectroscope's slit at the first light discharge tube. Record the letter on the discharge tube in the data table below. 2. Look through the opening at the top of the spectroscope and adjust the spectroscope until you see a spectrum (rainbow). 3. Use your phone or iPod to take a picture of the spectrum. 4. Sketch the spectrum in the data table below. 5. Compare the pictures to the spectra on the **Known Chemical Element Spectra Sheet**. Look for the closest match. 6. Determine the type of chemical element and record on the data table below. 7. Repeat for the other light bulbs.

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	Design Challenge:
	• Choose at least one aspect of the spectroscope to improve.
	• Possible ideas:
	  o Make the spectroscope more portable.
	  o Reduce the amount of ambient (extra) light that enters the spectroscope.
	  o Make the spectrum more sharp and clear (focused).
	  o Have the spectroscope use fewer materials.
	  o Make it easier to take a picture using the spectroscope.
	  o Improve any other problems that you encountered.
	• Build it and test it. Make any additional changes/modifications.
	• Write a set of directions to build the new spectrometer.

Safety:	The students need to cut the boxboard carefully. The students must not touch the light sources with their hands or spectroscopes.
Potential Cost:	The spectroscope uses a cereal box and compact disk that can be brought from home or donated. Various types of light bulbs can be purchased from a hardware store for around $5 - $15. The power source for the chemical element gas discharge tubes costs about $130. The chemical element gas discharge tubes cost about $20 apiece. The power supply and discharge tubes can be borrowed from a high school or college.
Supplies (source):	Cereal box – from home Compact disk – from home or an office supply store Rulers and protractors – from school Cell phone or other digital camera – student's own device Light bulbs – from a hardware store Power supply and gas discharge tubes – from a high school/college or Amazon.com
Developed by:	Mark Hackbarth
Date:	Fall 2014
Key Words:	STEM, Spectroscope, Spectrometer, Properties of Matter, Electromagnetic Spectrum, Light, Elements, Waves, Energy
Other Resources:	Spectroscope video link: https://www.youtube.com/watch?v=SPgYrsONgwU