Create Your Own Spectroscope Lesson Plan

Beckman Center Collection Area: Spectrophotometer
Grade: Middle School (recommended 7th or 8th grade)
Subject Area: Science, English Language Arts
Duration: 1 hour

Objectives:
Goals:

1. Students will be able to investigate different types of light sources and their properties when seen through a spectroscope
2. Students will be able to describe a spectrophotometer and how diffraction grating of light allows this tool to work
3. Students will be able to explain the difference between a spectroscope and a spectrophotometer

Standards:
Next Generation Science Standards:
MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials
MS-PS4.B Electromagnetic Radiation – When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
Common Core State English Language Arts Standards:
CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks
CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)

Materials:

1. Small box (shoe box sized)
2. 1 CD
3. Aluminum foil
4. Tape
5. Scissors
6. Pencil
7. Coloring supplies (optional)
8. Student Handout
9. Various light sources (e.g fluorescent light bulbs, incandescent bulbs, indirect sunlight, element tubes, if available)

Classroom Activities:

1. Warm-up Discussion: Have you ever seen a rainbow? What makes a rainbow? What do you need to make a rainbow? Can you make one without rain?
2. Pass out the Create Your Own Spectroscope Student Handout and read as a whole class or in pairs. Suggested comprehension questions:
    i. *What natural diffraction gratings can be used to make rainbows?*
    ii. *Describe the electromagnetic spectrum and what role does ROYGBIV play in relation to this spectrum?*
    iii. *What color is associated with short frequently occurring waves on the electromagnetic visible spectrum?*
    iv. *What is a spectrophotometer and who uses one?*
    v. *Which light bulb is more energy efficient- incandescent or fluorescent light bulbs?*
3. Discuss which light sources the students would like to observe. Have students share with their partners what they think each light bulb's different wavelengths will look like when using the spectroscope.
4. In groups, have students follow the instructions and complete the spectroscope activity sketching their observations in the table and answering the questions.
5. As a whole class, discuss results and share as a class:
    - *What surprised you today?*
    - *What is something new you learned?*

Extension Activities:

- These videos explain how astronomers and chemists use spectra to determine the makeup of stars:
    - https://www.youtube.com/watch?v=n_KyYFYNvpI
    - https://www.youtube.com/watch?v=-ob7foUzXaY (first 3 mins are relevant to this lesson)
- Students bring in 3D glasses or diffraction grating slides to class and experiment with different light sources and compare these results with the spectroscope. Students can research and sketch a drawing of how 3D glasses work with light waves to explain how movies utilize this phenomenon to make special effects come to life.
- Students divide into groups and explore careers such as an oceanographer, x-ray technician, electronic engineer, and seismologist. Students will report back how these jobs depend on their knowledge of invisible waves to best serve their customers.

Additional Beckman Center Resources:

- Arnold & Mabel Beckman Foundation Spectrophotometer Reading https://www.beckman-foundation.org/about-foundation/inventions/spectrophotometer/
- Success Stories 1950s TV Series Beckman Instruments Video https://youtu.be/TRdYEczK3Ns
- Ultraviolet Spectrophotometer Video https://youtu.be/uaMhxG3mHrI
- Infrared Spectrophotometer Video https://youtu.be/41LDdym7gmQ

Sources:

Redd, N. T. (2013, November 27). *Make Your Own Spectroscope | Spectroscopy Science Fair Project*. LiveScience. https://www.livescience.com/41548-spectroscopy-science-fair-project.html.

Image Sources:

Electromagnetic Spectrum - Principles of Structural Chemistry. Principles of Structural Chemistry. (n.d.). https://sites.google.com/a/coe.edu/principles-of-structural-chemistry/relationship-between-light-and-matter/electromagnetic-spectrum.

Why absorption spectum is not identical to emission spectrum? Physics Stack Exchange. (1964, October 1). https://physics.stackexchange.com/questions/238236/why-absorption-spectum-is-not-identical-to-emission-spectrum.