Diffraction Grating Activity Lesson Plan

Beckman Center Collection Area: Spectrophotometer
Grade: Middle School (recommended 6th grade)
Subject Area: Science, English Language Arts
Duration: 45 minutes

Objectives:
Goals:

1. Students will be able to investigate different types of light sources including incandescent and fluorescent light and their properties when transmitted through diffraction grating
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 electromagnetic spectrum and identify where visible light is located

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. Each student group will have 3 light sources with one electricity source (Electrical outlet or battery) to investigate:
    - Incandescent light bulb
    - Fluorescent light bulb
    - One light source of their choice (laser pointer, birthday candle, flashlight, camping lantern, etc.)
2. Each student group will have one Diffraction Grating Slide
3. Crayons or colored pencils
4. White paper
5. Ruler (optional)
6. Diffraction Grating Student Handout

Classroom Activities:

1. Warm-up Discussion: Make a list of different types of lights you see in a day. What type of light bulbs do you use at home versus school? Have you heard of incandescent or fluorescent light bulbs? What is the difference between an incandescent and a fluorescent light bulb?
2. Pass out the Diffraction Grating Student Handout and read as a whole class or in pairs. Suggested comprehension questions:
    - *What is diffraction grating?*
    - *Describe the electromagnetic spectrum and what role does ROYGBIV play in relation to this spectrum?*
    - *What color is associated with short frequently occurring waves on the electromagnetic visible spectrum?*
    - *What is a spectrophotometer and who uses one?*
    - *Which light bulb is more energy efficient- incandescent or fluorescent light bulbs?*
3. Demonstrate how to shine light sources through the diffraction grating slide. Have students share with their partners what they think each light bulb's different wavelengths will look like when using the diffraction grating.
4. In groups, have students follow the instructions and complete the diffraction grating 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:

- Students bring in 3D glasses to class and experiment with different light sources when wearing 3D glasses and compare these results with the diffraction grating slides. 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:

"Electromagnetic Spectrum: Media." *Encyclopedia Britannica*, Encyclopedia Britannica, Inc., www.britannica.com/science/electromagnetic-spectrum/images-videos#/media/1/183297/106806.

"Light Bulbs." *NASA*, NASA, climatekids.nasa.gov/light-bulbs/.

"The Visual Spectrum - Activity." *TeachEngineering.org*, 30 Apr. 2021, www.teachengineering.org/activities/view/cub_soundandlight_lesson7_activity1.