In Search of … the Electromagnetic Spectrum

Description
Use the ‘Eagle Nebula (M16)’ lithograph as the initial source of information to engage your students in a Level One Inquiry Activity. Students will use the images and text on this lithograph to generate questions about why astronomers observe celestial objects in different regions of the electromagnetic spectrum. They will conduct research to answer their questions. This curriculum support tool is designed to be used as an introductory activity in a unit that incorporates scientific inquiry or that has an electromagnetic spectrum theme.

About Inquiry-based Learning
The inquiry process is driven by a student’s own curiosity, wonder, interest, or passion to understand an observation or to solve a problem. It involves a process of exploring the natural or material world. This exploration prompts students to ask questions and to make discoveries in the search for new insights. A Level One Inquiry Activity uses questions and problem-solving methods directed by the teacher. In this activity, teachers will use the lithograph images to help students formulate questions about why astronomers observe celestial objects in different regions of the electromagnetic spectrum. Teachers will suggest selected resources about the electromagnetic spectrum to help students answer their questions. Students will provide supporting evidence for their conclusions. This process can help prepare students to become more independent thinkers.

Grade Level
High school, grades 8-12

Prerequisites
Students should know that visible light is a small slice of the entire electromagnetic spectrum and that the majority of the spectrum is invisible to the human eye.

Misconceptions
Teachers should be aware of the following common misconceptions about the electromagnetic spectrum and determine whether their students harbor any of them. Students may think that all radiation is harmful, that filters change the color of light, or that red objects in space are hot and blue objects are cold.

Vocabulary
Electromagnetic spectrum: The entire range of wavelengths of electromagnetic radiation, including radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays.
Near-infrared light: The region of the infrared spectrum that is closest to visible light. Near-infrared light has slightly longer wavelengths and slightly lower frequencies and energies than visible light. Near-infrared light can penetrate the gas and dust of nebulae.

Purpose:
The purpose of this activity is to engage students in a Level One Inquiry Activity with astronomical images and information. Students will gain experience using the Internet to search for information. They will practice the process skills of observing and analyzing. Students also will organize their material, present their findings, and reflect on what they have learned.

Materials:
• The ‘Eagle Nebula (M16)’ lithograph
• Computer with Internet connection for conducting research

Instructions for Educators
Preparation
• Obtain copies of the lithograph for each student. The ‘Eagle Nebula (M16)’ lithograph can be found at: http://amazing-space.stsci.edu/capture/stars/preview-eagle-ir.php.
• Preview the Overview page at: http://amazing-space.stsci.edu/eds/overviews/print/lithos/eagle-ir.php. Use the ‘Related Materials’ section to become familiar with how astronomers use the electromagnetic spectrum to view celestial objects.
• Bookmark or identify as favorites the following suggested websites:
  - STScI: ‘Hubble Goes High Def to Revisit the Iconic Pillars of Creation’: http://hubblesite.org/newscenter/archive/releases/2015/01/
In Search of ... the Electromagnetic Spectrum (cont’d)


Procedure

Identify your students’ misconceptions about the electromagnetic spectrum by having them write down anything they know and understand about this topic. Use those statements to address any misconceptions. Have students volunteer their ideas about the electromagnetic spectrum. From those ideas, identify misconceptions and discuss them with the class. An alternative method is to collect your students’ written ideas about the electromagnetic spectrum. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to study the images on both the front and back of the lithograph. Then tell your students to write as many questions as they can about the features visible in the images. Collect the questions and group them by common themes. Ask students to read the information on the back of the lithograph. Then ask them if they found the answers to any of their questions. Tell students to use the Internet to research their questions. The Internet sites listed in the ‘Preparation’ section provide a starting point for their research. Tell students how to access other websites.

Ask students to prepare presentations that include the answers to their questions. Their presentations also should address how astronomers use the electromagnetic spectrum to view celestial objects and include specific examples of how the electromagnetic spectrum enhances astronomical knowledge. The presentation can be in the form of a skit, a story, a graphic organizer, a PowerPoint show, or a written report—any method that conveys a student’s understanding of the topic to another student, to a group of students, or to the entire class. Students may work individually or in groups. Ask students to check whether their original questions were answered during their research or from talking with other students. Then ask if they have any additional questions.

In Search of ... the Electromagnetic Spectrum (cont’d)

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Instructions for the Student

Your teacher will ask you to write down what you know and understand about the electromagnetic spectrum. You may be asked to share this information with the rest of the class. Study the images of the Eagle Nebula on the front and back of the lithograph. Write down as many questions as you can about what you see in the images. Read the back of the lithograph to find answers to your questions.

Conduct research on the Internet to find the answers to your questions. Your teacher will provide websites for your research and will ask you to create a presentation to demonstrate your understanding of the material you collected through your research. Your presentations also should address how astronomers use the electromagnetic spectrum to view celestial objects and include specific examples of how the electromagnetic spectrum enhances astronomical knowledge. The presentation could be a skit, a story, a graphic organizer, a PowerPoint show, or whatever format that will communicate the information you learned about how astronomers use the electromagnetic spectrum to view celestial objects. Your teacher will direct you to work individually or in small groups. You may be instructed to make your presentation to another student, to a group of students, or to the entire class.

Education Standards:

AAAS Benchmarks: Project 2061
http://www.project2061.org/publications/bsl/online/bolintro.htm

1. The Physical Setting

F. Motion

By the end of the 8th grade, students should know that:

- There are a great variety of electromagnetic waves: radio waves, microwaves, infrared waves, visible light, ultraviolet rays, X-rays, and gamma rays. These wavelengths vary from radio waves, the longest, to gamma rays, the shortest.

1. The Nature of Science

B. Scientific Inquiry

By the end of the 12th grade, students should know that:

- Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible for practical or ethical reasons, they try to observe as wide a range of natural occurrences as possible to be able to discern patterns.