It's Not all Visible

Based on The Electromagnetic Spectrum

Focus on Inquiry

The student will investigate and describe the uses and applications of the electromagnetic spectrum.

Lesson Content Overview

Students will investigate the various types of electromagnetic radiation with the use of a graphic organizer and create a foldable to represent the EM spectrum, including the types, uses, and applications.

Duration	Setting	Grouping	PTI Inquiry Subskills
115 minutes	Classroom	3-4 Students, Individual	**3.3,3.4,3.6,4.2, 5.7,5.8, 7.3**

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	10 min	5.8	none	3	Students will use a tethered rope to simulate waves. Then use this simulation to discuss different aspects of a wave such as amplitude, wavelength, crest, and trough. (These build prior knowledge and are concepts that the student will find helpful later in the lesson)
Explore	40 min	3.3,	none	3	Students will use a card sort to determine the different parts of the EM spectrum and will use their graphic organizer to explain the differences within the spectrum.
Explain	10-15 min	7.3	none	2	Through a series of guided questions students will describe the electromagnetic spectrum
Expand/Elaborate	35 minutes	3.4, 4.2, 5.7, 5.8	none	3	Students will complete an electromagnetic spectrum foldable
Evaluate	15 min	3.3, 3.6	none	1	Students will complete a short quiz to check for understanding

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 3: Planning and Carrying Out Investigations
NGSS Practice 4: Analyzing and Interpreting Data
NGSS Practice 6: Constructing explanations
NGSS Practice 8: Obtaining, Evaluating and Communicating Information

Next Generation Science Standards – Content

MS-PS4-2.Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Florida Science Standards – Nature of Science

SC.8.N.3.1 Select models useful in relating the results of their own investigations.

Florida Science Standards – Content

SC.8.E.5.11 Identify and compare characteristics of the electromagnetic spectrum, such as wavelength, frequency, use, and hazards, and recognize its application to an understanding of planetary images and satellite photographs.

Materials and Advance Preparation

Materials List

Class set:

- Scissors (one per student)
- Coloring pencils, crayons or markers
- Ruler (one per group)

Student materials:

- One piece of copy paper per student
- Blackline Master # 1 (one set per group of 3-4)
- Blackline Master # 2 (one per student)
- Blackline Master # 3 (one per student)

Blackline Masters

1. Electromagnetic Spectrum Card Sort
2. Electromagnetic Spectrum Graphic Organizer
3. Electromagnetic Spectrum Card Sort ANSWER KEY
4. Electromagnetic Spectrum Graphic Organizer ANSWER KEY
5. Check For Understanding: The Electromagnetic Spectrum

Advance Preparation

1. Tie a length of rope (6ft - 10ft) to a stationary object such as a doorknob, chair, drawer handle, etc. 1 rope per each group of 4 - 6 students.
2. Copies of blackline Masters

Lesson Information

Learning Objectives

1. The student will be able to compare, and/or contrast the variety of types of radiation present in radiation from the Sun.
2. The student will be able to identify and/or compare characteristics of the electromagnetic spectrum including relative wavelengths, frequencies and energy levels.
3. The student will be able to identify common uses and/or applications of electromagnetic waves.

Prior Knowledge Needed by the Students

- Basic understanding of the types of radiations from the Electromagnetic Spectrum.
- Visible light and its color spectrum.

Background Information

Electromagnetic Spectrum is a range of different types of radiations that includes radio waves, microwaves, infrared, visible light, ultraviolet, x-rays and gamma rays. Each range of the EMS

(Electromagnetic Spectrum) has several applications and uses in everyday life. All the radiation types are distinguished by its own wavelength and frequency; radio wave having the longest wavelength and lowest frequency while gamma rays have the shortest wavelength and highest frequency. The visible light is the only radiation visible and when it pass through a prism it separate into different colors. The colors of the rainbow are in a specific order based on their wavelength (red, orange, yellow, green, blue, indigo, and violet).

Lesson Procedure

Engage

Include guiding questions you might ask to help students. If you use a video (include the URL in your lesson plan instructions) or a book (the author, title and publication date), and include questions that you would ask before, during or after the video/book reading selection.

1. Instruct students to hold the end of the rope with their hand at their waist.
2. Ask students to back up so that the drooping rope just touches the floor.
3. Discuss the characteristics of the hanging rope.
    - Question: What does the shape of the rope look like in a resting position?
    - Question: How much energy do you need to use to keep the rope in this resting position?
4. Ask students to slowly and gently move the hand holding the rope up and down (about one foot between top and bottom).
5. Discuss the characteristics of the rope.
    - Question: What is the shape of the rope now?
    - Question: How has it changed?
    - Question: How has the energy needed to move the rope changed?
6. Ask the students to increase the distance between the top and bottom but to keep the same speed.
7. Discuss changes in the characteristics of the rope
    - Question: What is the shape of the rope now?
    - Question: How has it changed?
    - Question: How has the energy needed to move the rope changed?
8. Ask the students to increase the speed of the rope.
9. Discuss the characteristics of the rope.
    - Question: What is the shape of the rope now?
    - Question: How has it changed?
    - Question: How has the energy needed to move the rope changed?

Explore

This should be a student-centered, hands-on activity that teaches your students about science. No lectures or direct teaching allowed. Please be as hands-on as possible. Also, please provide enough detail so that Dr. Blanchard could teach your lesson based on what you have included in these steps.

1. Each group of students will receive 1 envelope. Inside the envelope are the different types of Electromagnetic waves and pictures that correspond to each energy type. **Blackline Master #1.** *See sheet below for answers.*
2. Allow students to match the pictures to the definition of the type of Electromagnetic wave they belong to (based on prior knowledge). Instruct students to keep the cards on their desk once they have them matched.
3. Once students have all pictures and Electromagnetic wave types matched, have them raise their hands for you to come to check their work. Instruct students to keep the cards together once they have the order correct.
4. If there are wrong matches, silently un-match those words and have students correct them until all pairs are correctly matched.
5. Have students write a working definition and draw a picture(s) in the space provided on **Blackline Master #2.** *See sheet below for answers.*
6. Have students highlight words within the definition that help them remember what each type of Electromagnetic wave is.

Explain

*Include guiding questions you might ask students during the EXPLORE activity. You should have at least **10-15 questions** to guide student discussion and learning.*

Some questions you might ask students include,

1. Where does the radiation of the electromagnetic spectrum originate from?
2. Are all wavelengths and frequencies the same? Explain your reasoning.
3. Are there different types of waves in the spectrum? Are they in a specific order? How is that order determined? What would that order be?
4. Which electromagnetic wave has the longest wavelength?
5. Which electromagnetic wave has the shortest wavelength?
6. What wave property increased as the wavelength decreased?
7. What happens to the energy as the wavelength decreases?
8. What is the order the colors in the visible light spectrum? Where would the infrared and ultraviolet fit in the electromagnetic spectrum?

Expand

Include a similar student centered activity that will allow students to practice or connect what they have just learned in Explore. This is not an opportunity to introduce a new topic, but to provide enrichment on the topic of this lesson.

1. Take a piece of paper and fold it in half (hot dog). Lay a ruler down along the top of the folded side and fold it back up over the ruler, make six even cuts to make seven even flaps. (see example at http://www.conejousd.org/portals/36/TEACHERS/rgonzales/Science7/Electromagnetic%20Spectrum%20Example%201.JPG
2. After discussing the instructions for the foldable, have the students cut and label all the parts of the foldable.
3. When students have their foldable cut and labeled discuss with the students each part of the electromagnetic spectrum, as each wavelength is discussed the students will fill up each section of the foldable.
4. Parts of the foldable:
    a. Name of wavelength
    b. Definition and world applications for the specific wavelength
    c. Nonlinguistic representation for each wavelength.

Evaluate

FORMAL EVALUTION

a. Attach a FORMAL EVALUATION (1-3 questions) on a separate sheet of paper that you have developed to use as your evaluation tool.
b. For each question, identify in parentheses at the end of the criteria the GLE (GLE#___) and/or Learning Objective (LO#___) you are assessing for your lesson. If you use an Inquiry GLE, please note it as INQ GLE #___.

INFORMAL or OPTIONAL EVALUTIONS

1.

WRAP UP.

Bring the lesson to a conclusion by watching the Electromagnetic Spectrum Song Mr. Parr video which summarizes the lesson.
https://www.youtube.com/watch?v=P_PVz8HrrCI

You can include an exit ticket referencing the video.

Supplementary Resources

Include links to resources that the teachers and students might find useful in learning more about this topic.

Each resource should be in APA citation style and be followed with a one sentence annotation that notes appropriate age or grade level.

Teachers

An alternative foldable activity is available at https://www.teacherspayteachers.com/Product/Electromagnetic-Spectrum-Foldable-1801476

Students

Students can use http://chromoscope.net/ to view a visual representation of 8 different wavelengths.

CITATION OF SOURCES.

Where did you get the idea/materials for this lesson?(Put the author/date/book name or the Name of the website and the complete URL). I/We used the following resources to build our lesson:

Based on (APA format please)

Sources Sort Card Pictures:

Antenna and Radio Waves -
http://www.wpclipart.com/signs_symbol/assorted/assorted_3/antenna_and_radio_waves.png
Microwaves –
http://www.goldcoasthireall.com.au/wp-content/uploads/2014/06/microwave.jpg
Infrared Waves –
www.livescience.com/50260-infrared-radiation.html
http://www.livescience.com/images/i/000/074/901/original/earth-map-wildfire-20130827c.jpg?interpolation=lanczos-none&fit=around%7C300:200&crop=300:200;*,*
Visible Light –
http://www.livescience.com/images/i/000/059/748/original/Spectrum-Prism-sm.jpg?interpolation=lanczos-none&fit=around%7C300:200&crop=300:200;*,*
Ultraviolet Waves –
http://blog.stgaynor.com/wp-content/uploads/blog.stgaynor.com/2011/06/20110629-105458.jpg
Xray Waves –
http://www.davidlnelson.md/images/Xray_normal_hand_PA.jpg
Gamma Waves -
http://4.bp.blogspot.com/-HJmTdVMY58w/T7PTaXWA20I/AAAAAAAABGc/eyXzUvKAsig/s1600/pet+scan+pictures+3.jpg

Electromagnetic spectrum foldable:

http://www.conejousd.org/portals/36/TEACHERS/rgonzales/Science7/Electromagnetic%20Spectrum%20Example%201.JPG

http://worksheets.hobby-smart.com/electromagnetic-spectrum-worksheet-middle-school-answers/

__✓__ Yes, I cited all materials and resources used in this lesson.

Candace Bailey
Lesson author signature

Blackline Master # 1 Electromagnetic Spectrum Card Sort

Radio Waves :

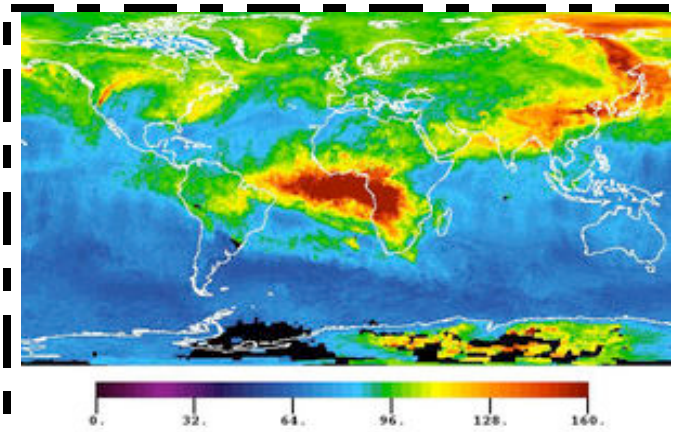
This is part of the EM spectrum that emits the longest wavelengths and lowest frequency of radiation waves.

Examples of radio waves include long distance communication, television transmission, satellites, walkie talkies, and listening to the radio.

Microwaves :

This is part of the EM spectrum that is basically a high frequency radio wave which is easily focused into narrow beams.

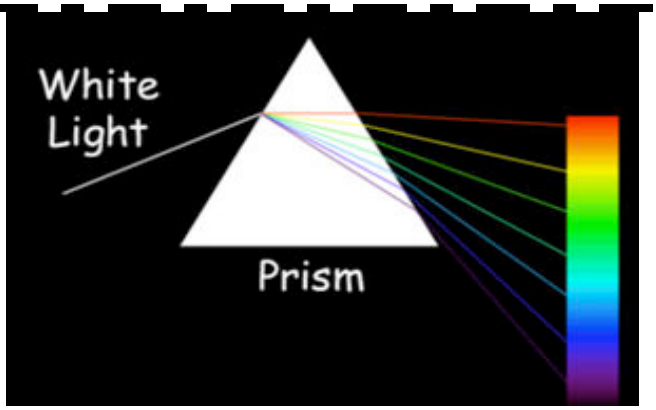
Examples of microwaves include cell phone transmission, blue tooth, wifi, xbox, cooking, and radar.



Infrared Waves :

This is part of the EM spectrum we are most often exposed to. It is invisible to humans, but we feel it as heat.

Examples of Infrared waves include changing the channels on our televisions, thermal imaging for weather reporting, remote controls, room heaters, and night vision goggles.



Visible Light Waves:

This is part of the EM spectrum that humans can see (ROY-G-BIV – Red, Orange, Yellow – Green – Blue, Indigo, Violet)., and visible light falls in the middle of the spectrum.

Examples of visible light waves include rainbows.

Ultraviolet Waves :

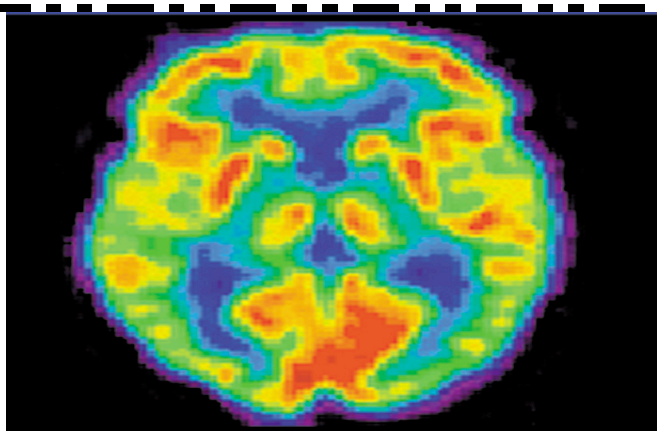
This is part of the EM spectrum that is invisible to humans, yet many insects use this.

Examples of ultraviolet waves include the auroras, sunburn, a cause of skin cancer, and black lights.

X-ray Waves :

This is part of the EM spectrum that is invisible to humans and is known to affect cell division.

Examples of x-rays include medical diagnosis, radiation therapy, measuring construction integrity, laser refinement, archeology, and TSA monitoring.



Gamma Waves :

This is part of the EM spectrum that has the shortest wavelength and highest frequency of radiation waves.

Examples of gamma waves include medical radiation treatment, CT scans, and sterilizing medical tools.

Blackline Master #2

Electromagnetic Spectrum Graphic Organizer

Radio	**Microwave**
Infrared	**Visible**
Ultraviolet	**X-ray**
Gamma	

Blackline Master # 3 Answer Key

Radio Waves :

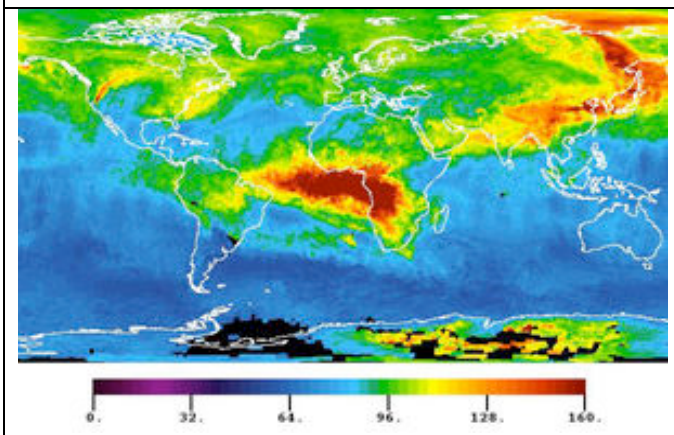
This is part of the EM spectrum that emits the longest wavelengths and lowest frequency of radiation waves.

Examples of radio waves include long distance communication, television transmission, satellites, walkie talkies, and listening to the radio.

Microwaves :

This is part of the EM spectrum that is basically a high frequency radio wave which is easily focused into narrow beams.

Examples of microwaves include cell phone transmission, blue tooth, wifi, xbox, cooking, and radar.



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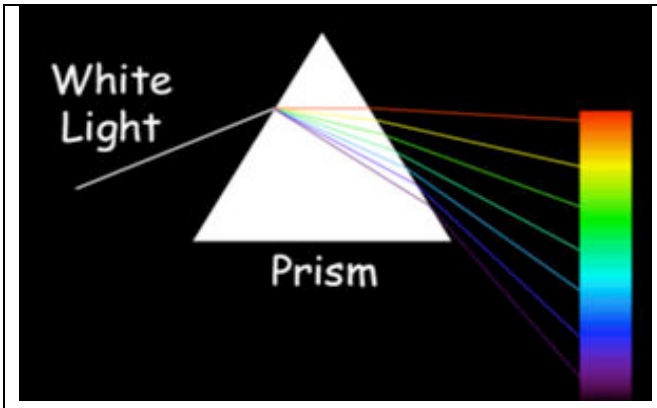

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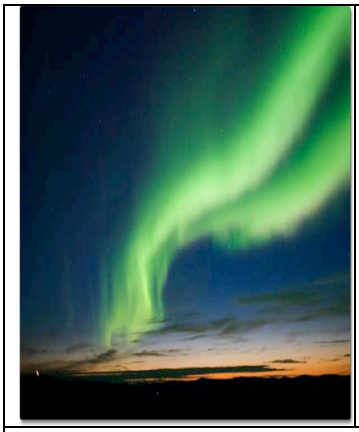


Ultraviolet Waves :

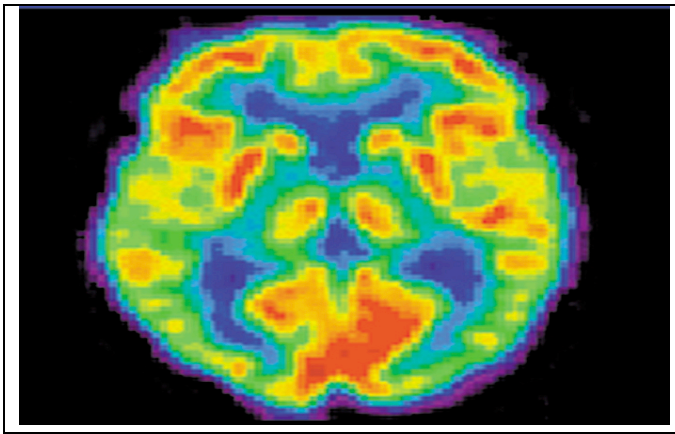
This is part of the EM spectrum that is invisible to humans, yet many insects use this.

Examples of ultraviolet waves include the auroras, sunburn, a cause of skin cancer, and black lights.

X-ray Waves :

This is part of the EM spectrum that is invisible to humans and is known to affect cell division.

Examples of x-rays include medical diagnosis, radiation therapy, measuring construction integrity, laser refinement, archeology, and TSA monitoring.



Gamma Waves :

This is part of the EM spectrum that has the shortest wavelength and highest frequency of radiation waves.

Examples of gamma waves include medical radiation treatment, CT scans, and sterilizing medical tools.

Blackline Master #4

Electromagnetic Spectrum Graphic Organizer ANSWER KEY

Radio This is part of the EM spectrum that emits the longest wavelengths and lowest frequency of radiation waves. Examples of radio waves include long distance communication, television transmission, satellites, walkie talkies, and listening to the radio.	**Microwave** This is part of the EM spectrum that is basically a high frequency radio wave which is easily focused into narrow beams. Examples of microwaves include cell phone transmission, blue tooth, wifi, xbox, cooking, and radar.
Infrared This is part of the EM spectrum we are most often exposed to. It is invisible to humans, but we feel it as heat. Examples of Infrared waves include changing the channels on our televisions, thermal imaging for weather reporting, remote controls, room heaters, and night vision goggles.	**Visible** This is part of the EM spectrum that humans can see (ROY-G-BIV – Red, Orange, Yellow – Green – Blue, Indigo, Violet)., and visible light falls in the middle of the spectrum. Examples of visible light waves include rainbows.
Ultraviolet This is part of the EM spectrum that is invisible to humans, yet many insects use this. Examples of ultraviolet waves include the auroras, sunburn, a cause of skin cancer, and black lights.	**X-ray** This is part of the EM spectrum that is invisible to humans and is known to affect cell division. Examples of x-rays include medical diagnosis, radiation therapy, measuring construction integrity, laser refinement, archeology, and TSA monitoring.
Gamma This is part of the EM spectrum that has the shortest wavelength and highest frequency of radiation waves. Examples of gamma waves include medical radiation treatment, CT scans, and sterilizing medical tools.	

Blackline Master # 5

Check For Understanding: The Electromagnetic Spectrum

1. If Rick is talking on his cellphone what type of electromagnetic waves is his cellphone using to connect and communicate? (LO #3)

a. gamma rays
b. microwaves
c. radio waves
d. visible light

2. A thunderstorm has just passed and the sun is coming out. Maria is at the school track field and she observes a rainbow at a distance. What type of electromagnetic wave is causing this phenomena? (LO #2)

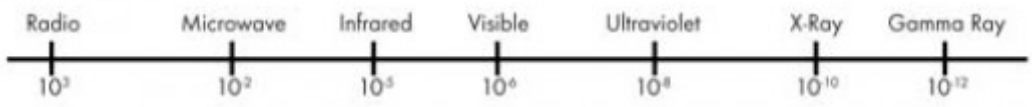
a. infrared rays
b. ultraviolet waves
c. x-rays
d. visible light

3. You are going on vacation during summer to Hawaii and you pack some sunscreen to protect your skin from a sunburn. The sunscreen is protecting your skin from which wavelength? (LO #3)

a. radio waves
b. x-rays
c. ultraviolet light
d. gamma rays

4. Jimmy is doing a poster of the electromagnetic spectrum and he needs to show the relationship between the frequency and wavelength of the EMS waves. Which statement best describes that relationship? (INQ GLE 3.6) (LO #2)

a. The wavelength decreases as the frequency decreases.
b. The wavelength increases as the frequency increases.
c. The wavelength decreases as the frequency increases.
d. The wavelength and frequency remains constant.



Using the diagram above answer the following questions.

5. When you are sick the doctor gives you a treatment or order some medicines. He has to assign you several tests and make you go through a process of examination to help you get better. Identify one region of the electromagnetic spectrum used by medicine and explain how is used. (LO #3)

6. Choose one of the following to answer.
a. Select between radio waves and infrared and give one useful application of this spectral region.(LO #3)

b. Explain how visible light is different from other parts of the spectrum.(INQ GLE 3.3) (LO #1)

Answer Key:

1. b- microwaves
2. d- visible light
3. c-ultraviolet light
4. c- The wavelength decreases as the frequency increases.
5. a- x-rays =broken bone scanning, gamma rays= cancer treatment/ chemotherapy
6 a. - radio waves= listening music, watch TV, long distance communication, walky-talkies
infrared rays = remote controls, room heater, weather report, toaster, night vision goggles
b.- Visible light is the only type of radiation that you can see. When the visible light hits a prism it will separate
into the rainbow colors (red, orange, yellow, green, blue indigo, violet) because of the different wavelength that each color has.