What Is a Wave? Lesson 5

New Direction

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Grade Level	9th – 10th Grade	**Time Frame**	90 minutes
Subject	Social Studies	**Duration**	2 class periods
Course	Physical Science		

Essential Question

What are waves? How do waves behave differently from particles?

Summary

In this fifth and final lesson of the "What Is a Wave?" unit, students will observe two demonstrations of waves interacting with different types of matter and form conclusions to understand how light travels through matter. Students will complete a Concept Card Map activity to demonstrate their understanding of the unit's content and concepts.

Snapshot

Engage

Students generate key concepts based on the previous lessons.

Explore

Students make observations and develop claims about light traveling through matter.

Explain

Students observe a laser demonstration and form conclusions about light frequency.

Extend

Students brainstorm other forms of radiation.

Evaluate

Students create a Concept Card Map to summarize their understanding of the unit.

Standards

Oklahoma Academic Standards (Physical Science)

PS.PS4.1 : Use mathematical representations to explain both qualitative and quantitative relationships among frequency, wavelength, and speed of waves traveling in various media.
PS.PS4.4 : Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
PS.PS4.4.1: When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).
PS.PS4.4.2: Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
PS.PS4.4.3: Photoelectric materials emit electrons when they absorb light of high enough frequency.

Attachments

- CERTIfy Your Thinking Activity—New Direction - Spanish.docx
- CERTIfy Your Thinking Activity—New Direction - Spanish.pdf
- CERTIfy Your Thinking Activity—New Direction.docx
- CERTIfy Your Thinking Activity—New Direction.pdf
- Concept Card Packet Waves—New Direction - Spanish.docx
- Concept Card Packet Waves—New Direction - Spanish.pdf
- Concept Card Packet Waves—New Direction.docx
- Concept Card Packet Waves—New Direction.pdf
- Lesson Slides—New Direction.pptx
- Wave Vocabulary Packet—New Direction - Spanish.docx
- Wave Vocabulary Packet—New Direction - Spanish.pdf
- Wave Vocabulary Packet—New Direction.docx
- Wave Vocabulary Packet—New Direction.pdf
- Wave Vocabulary Teacher Guide—New Direction.docx
- Wave Vocabulary Teacher Guide—New Direction.pdf

Materials

- Lesson Slides (attached)
- Concept Card Packet (attached; one per group of 3-4 students)
- C.E.R.T.I.fy Your Thinking Activity (attached; one per student)
- Wave Unit Vocabulary Packet (attached; one per student)
- Wave Unit Vocabulary Teacher's Guide (attached)
- Yellow highlighter
- Pliers
- Jar with lid
- Two liter clear plastic bottle
- Drinking glass
- Pencil
- Water
- 650nm red laser pointer
- 405nm blue/violet laser pointer
- Poster board or large paper
- Glue sticks

15 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson.

Show **slides 3 and 4**. Review the essential questions and lesson objectives with students. Place students into groups of three or four.

Show **slide 5**. Using the Strike Out strategy:

1. Ask students to generate a list of key ideas or themes from the past two lessons in this unit.
2. When the lists are complete, have each group pass their list to another group for review.
3. Instruct each group to strike out the least important key concept from the lists they review.
4. Have the students pass to another group and repeat step 3.
5. When each group receives its original list, ask students look it over and choose one concept to reclaim.
6. Instruct groups to add the reclaimed concept back to their original list.

Show **slide 6.** Ask students to combine their lists of important themes and concepts gleaned from the past two lessons. Have them add these concepts to the Strike Out Board created in Lesson 2.

Show **slide 7**. Refer to the Driving Question Board created in Lesson 1. Ask students to determine if any of their questions can be answered at this time and include any questions that should be added at this time.

20 minutes

Explore

Teacher's Note: Activity Preparation

Get a clear glass, a bottle of water, and a pencil.

Show **slide 8.** Pass out the attached **C.E.R.T.I.fy Your Thinking Activity** handout to each student. Introduce them to the C.E.R.T.I.fy Your Thinking strategy.

1. Show students the empty glass with the pencil inside the glass.
2. Ask students to think about how adding water to the glass will affect the way they see the pencil.
3. Have students write a response on their handout. This response is their *claim*.
4. Invite them to consider what they have learned about waves so far.
5. Based on what they already know, have students write a sentence with *evidence* for their response.
6. Have students write their *reasoning* for their claim.
7. Ask for volunteers to share their *claims*, *evidence* and *reasoning*.

Show **slide 9** after students have written a *claim*, *evidence*, and *reasoning* on their activity sheet. Add water to the glass and tell students to observe the pencil.

Show **slide 10.**

1. Ask students if their claim has changed after viewing the pencil with water in the glass.
2. Have students write a new claim in the next box on their handout.
3. If their evidence has changed based on observing the pencil in the water, have students provide a new piece of evidence as well as a new reasoning.
4. Ask for volunteers to share their revised claims, evidence, and reasoning.

Explain to students that the pencil appears to be crooked because light cannot travel as quickly in water as it does in the air; therefore, the light bends around the pencil and makes it appear crooked.

Tell students that this is an example of "refraction" and that they will learn more about refraction during this lesson.

20 minutes

Explain

Teacher's Note: Use Caution While Preparing the Lasers

Dim the lights in the classroom. Ensure that lasers are pointed away from observers and that there are no reflections back into the eyes of observers.

Teacher's Note: Activity Preparation

Watch this video, titled "How to Make Fluorescent Water (UV Reactive)."

Embedded video
https://youtube.com/watch?v=ULgTrw63Tn4

After the video, discuss the remaining vocabulary words on each of the upcoming slides.

Show **slide 18** and share the definition of Absorption. You'll want to make sure and share the following information with your students as well.

- Absorption occurs when matter absorbs the energy contained in EM waves. Total absorption results in all of the energy being transferred to the matter, with the EM wave vanishing.

Show **slide 19** and share the definition of Emission. You'll want to make sure and share the following information with your students as well.

- Emission is a special property of some materials that is observed when they absorb EM waves.
- Fluorescent materials absorb energy from EM waves. This excess energy causes the material to emit new EM waves with a lower energy and different color than what was absorbed.
- In our demonstration the light from the red laser did not have enough energy to trigger emission. It passed right through the dye. The light from the blue laser has much higher energy and triggered the emission of bright yellow/green light. All of the blue light was absorbed in this process.
- Materials react differently to EM radiation depending on how much energy it contains.

15 minutes

Extend

Show **slide 20**.

Assign students to work in groups of 3-4 to develop a list of other types of electromagnetic radiation that have not been discussed so far. Have them write their notes on notebook paper. Ask each group to share one type of electromagnetic radiation they have discussed in their groups.

Possible Student Responses

Students might share that radiation is used to treat cancer. Students might discuss how radiation is sometimes leaked from nuclear power plants, such as Fukushima Daiichi in Japan or in Chernobyl, Ukraine, when it was part of the Soviet Union.

30 minutes

Evaluate

Teacher's Note: Activity Preparation

Students will need glue sticks and either poster board or large pieces of butcher paper to complete this activity.

Show **slide 21.** Introduce the Concept Card Mapping strategy to students. Ask students to return to their groups of 3-4. Pass out the attached **Concept Card Packet** to each group.

Provide time for students to sort the concept cards and to decide how the cards should be connected to each other. Encourage students to use their vocabulary packets to assist with grouping the concept cards. Have students glue or paste their concept cards to the poster board and draw lines to show connections among the cards.

Collect the completed mapping poster to assess students' understanding of the unit content.

Optional Unit Evaluate

Use a resource, such as released work from the OSTP (Oklahoma State Testing Program) or The Wonder of Science, to help prepare your students for the end-of-the-year assessment.

Resources

- Electronics Projects - Stephano91ste. (n.d.). How to make fluorescent water (UV reactive) [Video]. YouTube. https://www.youtube.com/watch?v=ULgTrw63Tn4
- Fehrmann. (n.d.). The fluorescent lamp [Digital Image]. https://fehrmann.com.br/site/noticias/detalhes/a-lampada-fluorescente
- Kamenícek, J. (2014, March 31). London Millennium Bridge from Saint Paul's [Image]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:London_Millennium_Bridge_from_Saint_Paul%27s.jpg
- K20 Center. (n.d.). Driving Question Board. Strategies. https://learn.k20center.ou.edu/strategy/1511
- K20 Center. (n.d.). Strike out!. Strategies. https://learn.k20center.ou.edu/strategy/136
- K20 Center. (n.d.).C.E.R.T.I.fy Your Thinking. Strategies. https://learn.k20center.ou.edu/strategy/827
- K20 Center. (n.d.). Concept Card Mapping. Strategies. https://learn.k20center.ou.edu/strategy/123
- North Carolina State University. (n.d.). Adventures of the agronauts [Digital Image]. https://projects.ncsu.edu/project/agronauts/mission4_6.htm
- Pxleyes.com (n.d.). Light refraction [Digital Image]. http://www.pxleyes.com/photography-picture/500ab33be9af2/Light-refraction.html
- Science Sauce. (2019, October 29). Refraction explained [Video]. YouTube. https://www.youtube.com/watch?v=zarxpu43-ls