Wavelength and Amplitude

4th Grade Sample Lesson

www.stemscopes.com/science

Scope (Unit) Wavelength and Amplitude

Explore (Lesson) Activity - Wave Challenge

The following pages introduce lesson resources that guide you through the STEMscopes NGSS 4th grade lesson. This sample lesson does not include all the elements and features of our digital and print science curriculum.

Resource List:

The following resources, as well as additional Scope resources not listed, can be found in the digital curriculum *4th Grade Scope, Wavelength and Amplitude.*

Home

- Standards Alignment
- Sample Lesson Plan
- Teacher Background
- CCC and SEP Scoring Rubric
- Answer Keys
- Materials List

Engage

- Investigative Phenomena – Introductory activity that facilitates a connection between the content and real-world phenomena and encourages students to ask why or how something happens.
- Graphic Organizer – Students fill this in as they work through the elements of this Scope.
- Accessing Prior Knowledge – A brief probing activity to gauge students' prior knowledge before engaging in the inquiry process.
- Hook – An engaging activity that includes instructor preparation, supplemental resources, and ready-made handouts for students.

Explore

- Explore 1: Activity – This lesson sample.
- Explore 2: Activity
- Explore 3: Engineering Solution

Explain

- Picture Vocabulary – Key terms explained through pictures and by definition.
- Linking Literacy – Strategies to help students comprehend difficult informational text.
- STEMscopedia – Reference materials that include parent connections, career connections, technology, and science news.
- Communicate Science – A class activity in which students use different forms of communication to discuss scientific topics connected to the content of this Scope.
- Concept Review Game – An interactive game that helps students review important concepts.
- Content Connections Video – A short video that supports student understanding of the content.

Elaborate

- Math Connections
- Reading Science
- Career Connections
- Scientist Spotlight
- PhET: Simulation Practice

Evaluate

- Claim-Evidence-Reasoning
- Open-Ended Response Assessment
- Multiple Choice Assessment

Intervention

- Guided Practice
- Independent Practice
- Concept Attainment Quiz

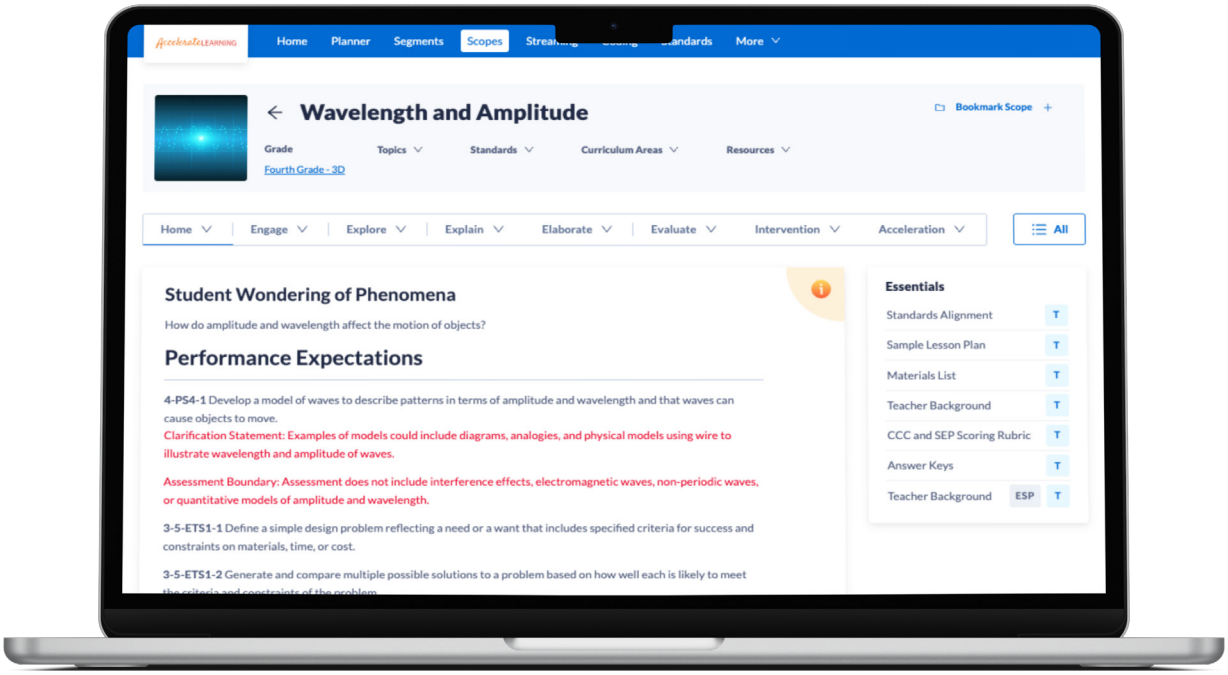
Acceleration

- Extensions
- Science Art
- Books on Topic

Table of Contents

Scope (Unit) Overview

Scope (Unit) Wavelength and Amplitude



Student Wondering of Phenomena

How do amplitude and wavelength affect the motion of objects?

Performance Expectations

4-PS4-1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.
Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Scope (Unit) Overview

Scope (Unit) Wavelength and Amplitude

Three-Dimensional Focus

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and Using Models Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) Connection to Nature of Science Scientific Knowledge is Based on Empirical Evidence Science findings are based on recognizing patterns. (4-PS4-1)	PS4.A (3) Wave Properties Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between the wave peaks).	Patterns Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)

Wavelength and Amplitude

Explore 1: Activity - Wave Challenge

Everyday Phenomena

Can you see patterns in waves?

Description

(SEP) Students will use a model to observe amplitude and wavelength.

Materials

Printed Material
1 Wave Challenge (per student)
1 Student CER (per student)

Reusable
1 Large jump rope (per pair of students)
1 Pencil (per student)

Preparation

- Plan or reserve an area with space for jump ropes to be stretched out and moved.
- Print out a Wave Challenge and Student CER for each student.
- Place students in groups of two.

STEMcoach in Action

An essential aspect of facilitating student understanding is insight into student thinking. This insight is best provided by observing how students are able to communicate their understanding. When we say "facilitating questioning and discourse", we are describing the effective questioning and meaningful communication that the teacher uses to establish what students know and are able to do. For further information on Facilitating Questioning and Discourse, please click on the provided link.
Site

Procedure and Facilitation Points

Part I

1. Tell students they will be "seeing" a wave.
2. As students work through the activity, look for teachable moments to introduce students to the following vocabulary terms. Try to point out examples of the terms as students are working so that they can connect the meaning of the word with their experiences. Encourage students to use the following words as they record and discuss their findings.
    a. **Amplitude**: the height of a wave measured from midway between the highest and lowest points
    b. **Wave peak**: the highest point on a wave
    c. **Wavelength**: the distance between the same two points on a wave (i.e., crest to crest)
    d. **Wave**: a disturbance that transfers energy from place to place
    e. **Motion**: describes change in an object's position with respect to time and in comparison to other objects
    f. **Pattern**: a design or sequence that is repeated
3. Give each group a jump rope. Discuss:
    a. What are some safety rules we need to keep in mind when using jump ropes? Make sure there is plenty of space.
4. Have two students hold the ends of the rope. There should be a little slack in the rope. Students can be holding each end of the rope while standing, or they can have the rope on the ground on a flat, smooth surface.
5. Students should have one partner slowly flick the rope in an up-and-down motion from one end while the partner holds the other end.
6. Have students observe and record their observations on their Wave Challenge.
7. Discuss:
    a. What happened when the rope was slowly flicked up and down? It made a long wave from one end to the other end.
8. Now students should have one partner quickly flick the rope in an up-and-down motion from one end while the partner holds the other end.
9. Have students observe and record their observations on their Wave Challenge.
10. Discuss:
    a. What happened when the rope was quickly flicked up and down? It made short waves from one end to the other end.
11. Tell students that the distance from one peak to the next is called the wavelength, and the height from midway between the highest and lowest points is called the amplitude. You may want to have the picture vocabulary (found in Explain) available for these terms.
12. Have students label the wavelength and the amplitude on each of their drawings.

Part II

1. Challenge students to create a wave with a very large amplitude. Have students observe and record their observations on their Wave Challenge.
2. Discuss:
    a. What did you have to do to make a wave with a large amplitude? I moved my arm up and down as high and low as I could, and it made the wave in our jump rope have a really large amplitude.
3. Challenge students to create a wave with a very small amplitude. Have students observe and record their observations on their Wave Challenge.
4. Discuss:
    a. What did you have to do to make a wave with a small amplitude? I barely moved my arm up and down, so the wave had a small amplitude.

5. Challenge students to create a wave with a very short wavelength. Have students observe and record their observations on their Wave Challenge.
6. Discuss:
    a. What did you have to do to make short wavelengths? I had to move the rope up and down really fast so the tops of the waves were really close together.
7. Challenge students to create a wave with a very long wavelength. Have students observe and record their observations on their Wave Challenge.
8. Discuss:
    a. What did you have to do to make long wavelengths? I had to move the rope up and down slowly so the tops of the waves were farther apart.
9. Have students complete the Student CER.
10. Discuss:
    a. **(CCC)** What did all these waves have in common? They all moved up and down. Their shapes were similar.
    b. **(CCC)** What was different about these waves? Some had larger and smaller amplitudes, and others had longer and shorter wavelengths. We had to use different force and motion to create the different types of waves.
    c. **(CCC)** Did you notice any patterns when making waves? The higher I shook the rope, the larger the amplitude of the wave was. The more force I applied when I shook the rope, the shorter the wavelength was.
        i. Record this example of a pattern on the class crosscutting concept chart. Discuss other examples of patterns that the students have previously explored. Charts can be found in the teacher toolbox.
11. Add new learning to the Graphic Organizer.

Connection to the Investigative Phenomena

Once students have completed the activity, have them refer to the Investigative Phenomena question, anchor their learning, and revise their thinking.

Math Moment

This learning task connects to math standard *4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.*

After students draw their waves in their Student Journal, ask them whether or not they see parallel and perpendicular lines. Be sure to have them justify their answer!

Check out this module's Math Connections for further practice!

Explore

Wavelength ar

Explore Lesson

Name: _____ Date: _____

Wave Challenge

Part I
Drawing of a **Slow** Rope Flick

Drawing of a **Quick** Rope Flick:

From one peak to the next is called the wavelength, and the height from midway between the highest and lowest points is called the amplitude. Label the wavelength and the amplitude on each of your drawings.

Explore

Part II

1. Drawing of a Wave with a **Large** Amplitude

2. Drawing of a Wave with a **Small** Amplitude

3. Drawing of Wave with **Short** Wavelengths

4. Drawing of Wave with **Long** Wavelengths

Explore

What did these waves have in common?

_____
_____
_____

What was different about these waves?

_____
_____
_____

Did you notice any patterns that occurred when making waves?

_____
_____
_____

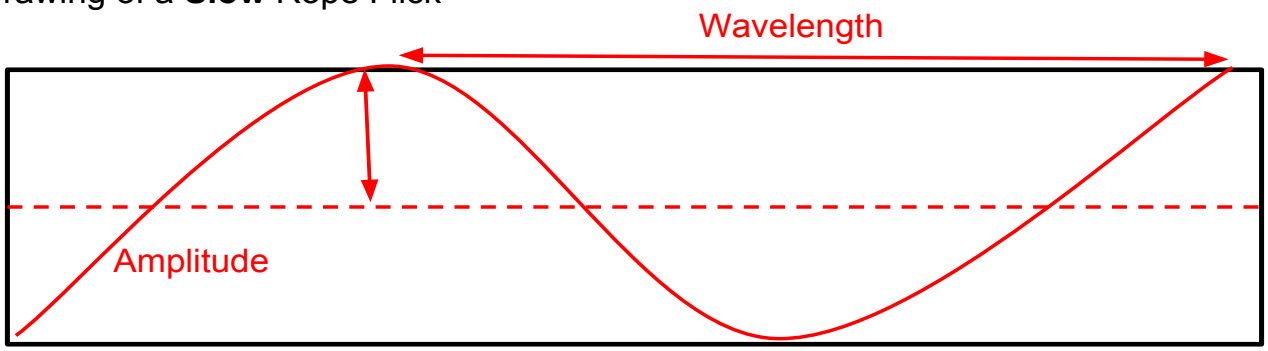
Explore

Name: _____ Date: _____

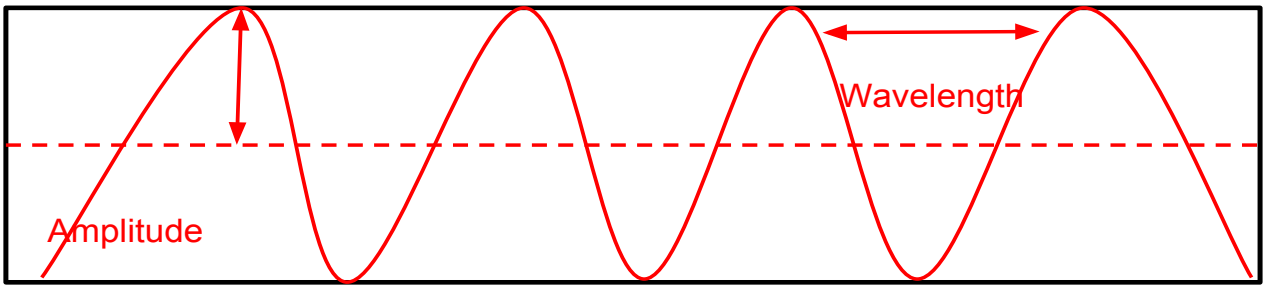
Wave Challenge

Part I

Drawing of a **Slow** Rope Flick



Drawing of a **Quick** Rope Flick:

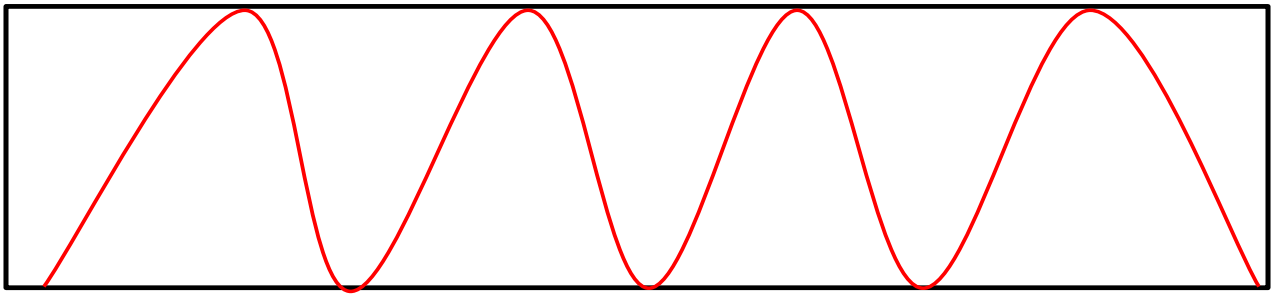


From one peak to the next is called the wavelength, and the height from midway between the highest and lowest points is called the amplitude. Label the wavelength and the amplitude on each of your drawings.

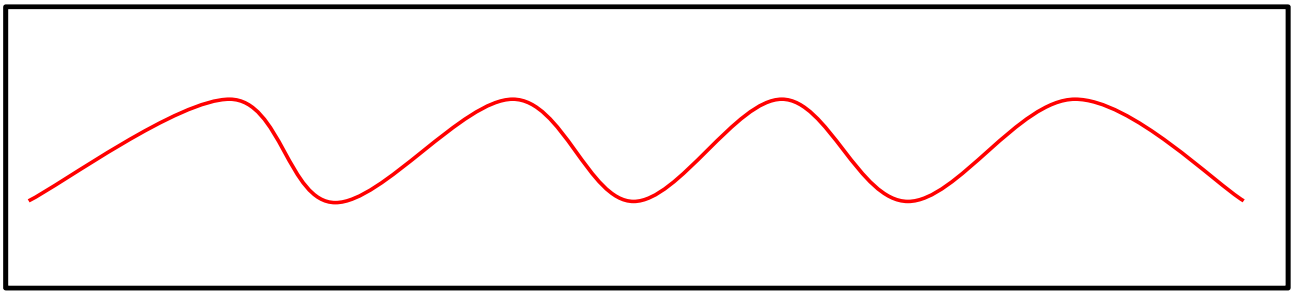
Explore

Part II

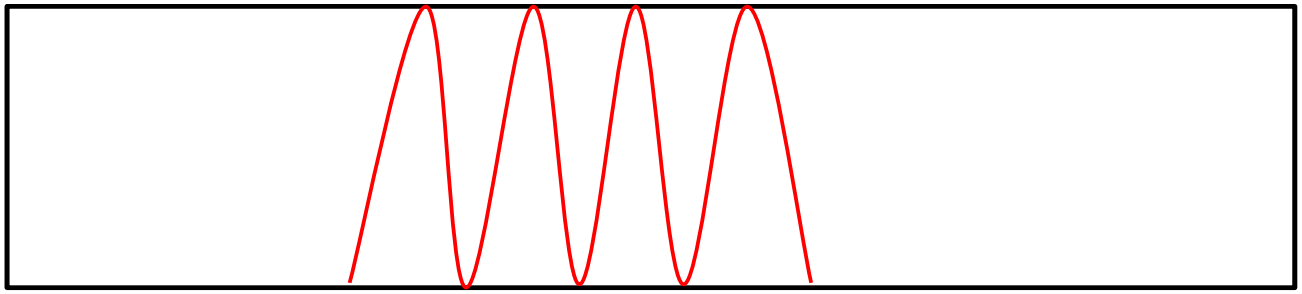
1. Drawing of a Wave with a **Large** Amplitude



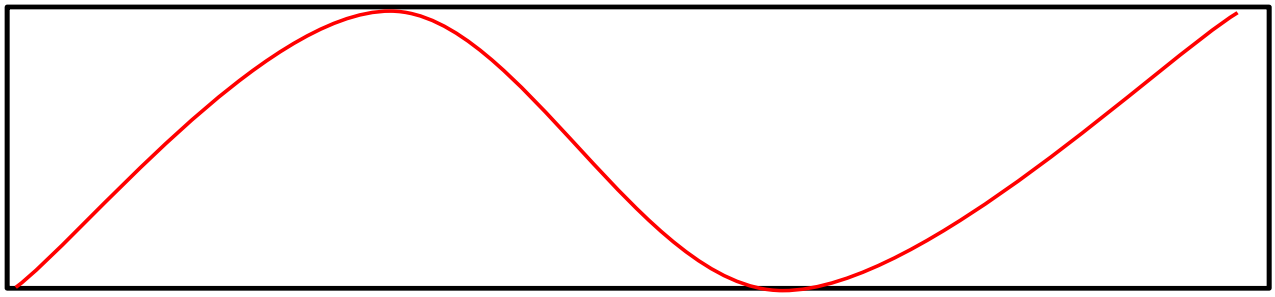
2. Drawing of a Wave with a **Small** Amplitude



3. Drawing of Wave with **Short** Wavelengths



4. Drawing of Wave with **Long** Wavelengths



Explore

What did these waves have in common?

They all moved up and down. Their shapes were similar.

What was different about these waves?

Some had larger and smaller amplitudes, and others had longer and shorter wavelengths. We had to use different force and motion to create the different types of waves.

Did you notice any patterns that occurred when making waves?

The higher I shook the rope, the larger the amplitude of the wave was. The more force I applied when I shook the rope, the shorter the wavelength was.

Explore

Name: _____ Date: _____

Wave Challenge
Claim-Evidence-Reasoning

Prompt

Write a scientific explanation for what wave conditions you think would be the most difficult to drive through in a boat. Make sure you use the words amplitude and wavelength in your reasoning.

Claim:

_____
_____
_____

Evidence:

_____
_____
_____
_____
_____

Reasoning:

_____
_____
_____
_____
_____
_____
_____

Explore

Points Awarded	2	1	0
Claim	Student makes an accurate and complete claim.	Student makes a claim that is inaccurate or incomplete.	Student does not make a claim.
Evidence	Student provides two or more accurate pieces of evidence, uses labels, and addresses variables.	Student provides one to two accurate pieces of evidence.	Student does not provide evidence or only provides inappropriate or vague evidence.
Reasoning	Evidence is connected to the claim and includes scientific principles and vocabulary.	Student cites a reason, but it is inaccurate or does not support the claim. Student's reasoning does not use scientific terminology or uses it inaccurately.	Student does not connect the evidence to the claim.

Explore

Name: _____ Date: _____

Wave Challenge
Claim-Evidence-Reasoning

Prompt

Write a scientific explanation for what wave conditions you think would be the most difficult to drive through in a boat. Make sure you use the words amplitude and wavelength in your reasoning.

Claim:

A boat would have a very hard time driving in waves that have a high amplitude and short wavelength.

Evidence:

When I moved my arm up and down as high and as low as I could, it made a wave with a large amplitude. When I moved my arm up and down just a little, it made a wave with a small amplitude. When I moved my rope up and down quickly, the waves were close together. When I barely moved my arm up and down slowly, the waves were farther apart.

Reasoning:

The amplitude is the height of a wave from its midpoint to the top or bottom of the wave. A higher amplitude would be very hard to drive a boat in. The waves would carry the boat very high and then drop the boat down. Water would get into the boat. The motor wouldn't help when you were going up and down. The wavelength is the distance between waves. If there were wavelengths that were short, the motor would have even more difficulty powering through those waves with higher amplitudes, because there would be shorter distances between waves.

Explore

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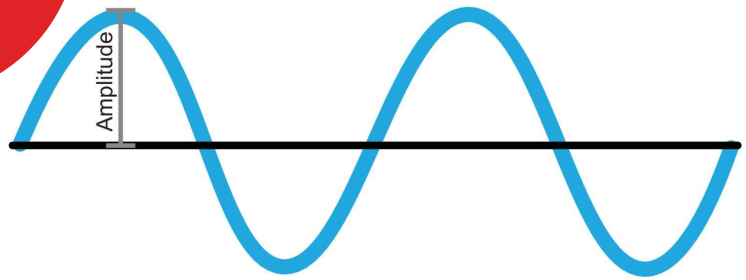
Picture Vocabulary

Wavelength and Amplitude

Picture Vocabulary

Amplitude

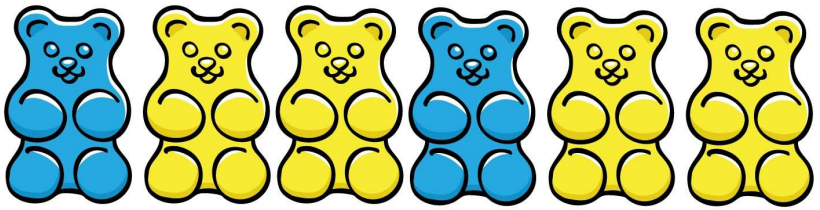


The height of a wave measured from midway between the highest and lowest points

Motion

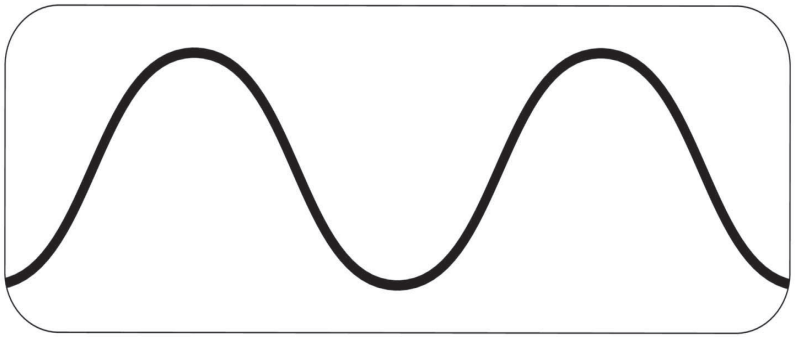
How an object moves from one place to another

Pattern



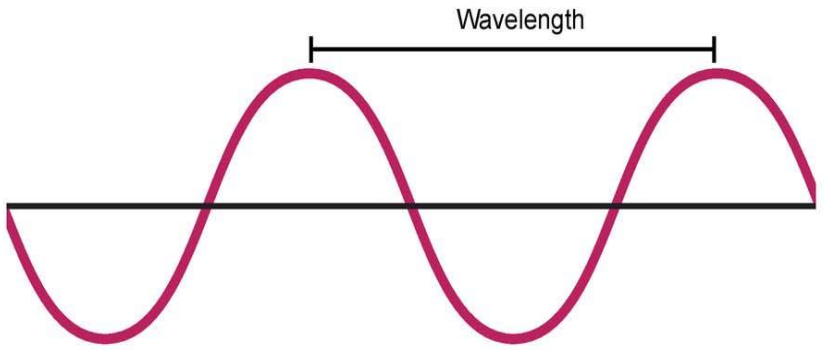
A design or sequence that is repeated

Wave



A disturbance that transfers energy from place to place

Wavelength



The distance between the same two points on a wave, such as crest to crest

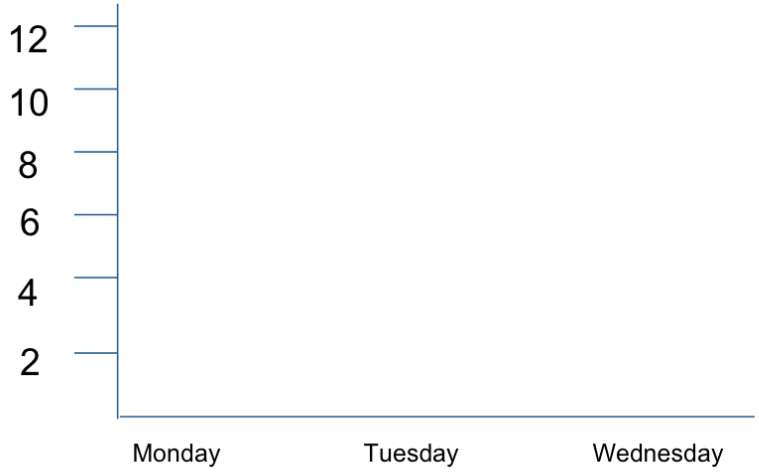
Math Connections

Math Connections

Name: _____ Date: _____

A scientist recorded the wave amplitude for ocean waves for next week in Santa Monica, California. Wave amplitude is from the midpoint of the wave to either the crest or the trough. On Monday, the amplitude was 5 feet. On Tuesday, the amplitude was 8 feet, and on Wednesday, the amplitude was 3 feet.

Hint: The vertical axis is counting by 2s. In order to find an odd number, you need to go halfway between the 2 lines.



1. Create a bar on the graph to represent the amplitude of Monday.

2. Create a bar on the graph to represent the amplitude of Tuesday.

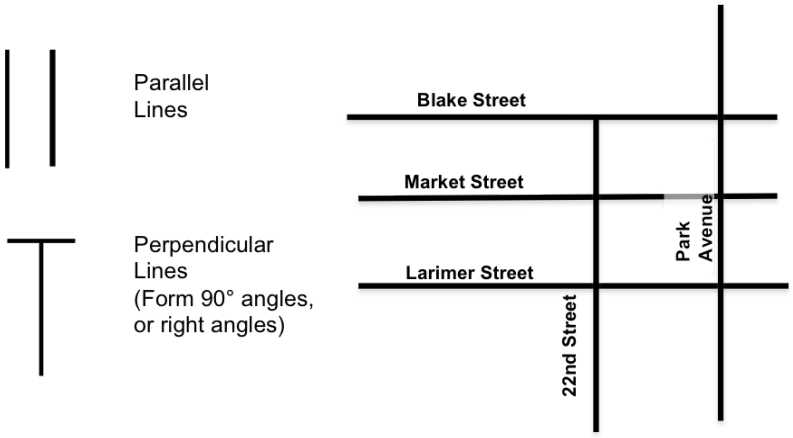
3. Create a bar on the graph to represent the amplitude of Wednesday.

4. If the amplitude on each day were doubled, what would the difference be between the amplitude on Tuesday and the amplitude on Wednesday? (Hint: this is a 2-step problem.)

_____

Math Connections

Use the map of a few streets in Denver, Colorado, to answer questions 5–8.



5. Which street is parallel to Park Avenue? _____

6. Name a street that is perpendicular to Market Street. _____

7. What best describes the relationship between Larimer Street and 22nd Street?

   A. Parallel

   B. Obtuse

   C. Perpendicular

   D. Acute

8. What angle is formed between Blake Street and Park Avenue?

   A. Right angle

   B. Obtuse angle

   C. Acute angle

   D. Perpendicular angle

Claim-Evidence-Reasoning

Wavelengt

CER Assessment

Name: _____ Date: ____

Scenario

Elizabeth was watching the news about an earthquake that had occurred in California. On the news, she saw the following picture and decided to start a collection at school to help the children in a highly affected area. Elizabeth wants to send the donations to the city that most likely received the most damage. Each line on the map below shows a peak of the waves sent out by the earthquake, and the center of the circles is the epicenter. The thicker the line, the higher the amplitude.

Prompt

Using scientific reasoning, explain which of the cities on the map Elizabeth should send her donations to.

Claim:

_____

_____

Evidence:

_____

_____

_____

Reasoning:

_____

_____

_____

_____

_____

Claim-Evidence-Reasoning

Wavelength and Amplitude CER

Rubric for Writing a Scientific Explanation

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Claim-Evidence-Reasoning

Name: _____ Date: _____

Scenario

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Prompt

Using scientific reasoning, explain which of the cities on the map Elizabeth should send her donations to.

Claim:

Elizabeth should send her donations to Barstow.

Evidence:

The waves near Barstow have a higher amplitude. Pasadena and Glendale are experiencing waves with lower amplitudes.

Reasoning:

The wavelength is the space between the waves, and amplitude is how high or low the waves go. The higher-amplitude waves that hit Barstow would have caused more up-and-down motion, which would have caused the most damage to buildings and other structures. The other cities were not hit by waves with as high of an amplitude, so they most likely had less damage.

Claim-Evidence-Reasoning

Wavelength and Amplitude CER

Rubric for Writing a Scientific Explanation

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