

Amplitude and Frequency

Standard(s) Addressed: Next Generation Science Standards 4th Grade
4PS4 Waves and their applications in technologies for information transfer

Students who demonstrate understanding can explain:

- Waves of the same type can differ in amplitude (height of the wave) and frequency (how many waves are passing a point per second).

Lesson Objective: The children will be able to identify and explain amplitude, frequency and resonance while working with the model and make connections to real life examples for each.

Materials Used: base on wheels, 3 different color thick rods and 3 different colored thin rods

Student Talk Strategies Used:

Talk to your partner
 Think/pair/share

Classroom Management:

Conversation: quiet indoor voices

Activity: work with a partner, brainstorm/answer questions

Movement: students will stand at desk with partner

Participation: working well in groups, doing task, working cooperatively

ENGAGE: *Connect to Prior Knowledge and Experience, Create Emotionally Safe Learning Environment, Preview New Vocabulary* **Estimated time: 5 minutes**

Description of Engage: The students will share what they learned about amplitude and frequency at the assembly with their partner. Each pair will share with another pair. Teacher will chart their responses.

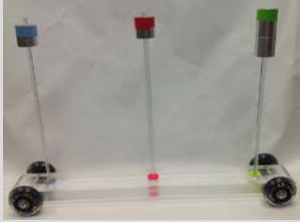
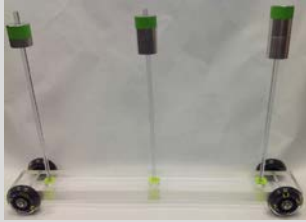
Teacher’s Role	Teacher Questions	Student’s Role
Teacher tells students that they are going to complete a scientific investigation about waves, specifically amplitude and frequency.	There are many different kinds of waves. Take a minute to think of different kinds of waves. (Think, Pair, Share) Turn to your partner and share your ideas. Today we are going to do an investigation like scientists. What does frequency mean? Using “numbered heads” join another	Students will collaborate using Think, Pair, Share with their partner Possible responses: <i>waves in the ocean</i> <i>sound waves</i> <i>radio waves</i> <i>light waves</i>

<p>After students come up with their definition, teacher asks the students to stand up and demonstrate what frequency and amplitude would look like using their hands and body. First low then high frequency (the number of vibrations per second). Low amplitude (size of the vibration) and high amplitude</p>	<p>pair (number off 1-4) Discuss with your group what frequency means and come up with a definition.</p> <p>Let's use our bodies to demonstrate both frequency and amplitude. Stand with your partner and take turns to demonstrate the amplitude and frequency. First let's use our hands as we did in the assembly to show frequency, first low and high frequency. Keeping the amplitude the same. Now demonstrate low amplitude, then high, keeping the frequency the same.</p> <p>Now demonstrate low frequency using your body. Now demonstrate high frequency.</p> <p>Describe frequency and amplitude to each other.</p>	<p>Answers will vary :</p> <p><i>the rate at which a vibration occurs that makes a wave, either in a material (as in sound waves), or in an electromagnetic field (as in radio waves and light), usually measured per second.</i></p> <p>Students will sway slowly back and forth</p> <p><i>Low frequency is when there are fewer vibrations per second</i></p> <p>Students will sway back and forth faster</p> <p><i>High frequency is when there are more vibrations per second.</i></p> <p><i>Low amplitude is when the vibrations are smaller</i></p> <p><i>High amplitude is when the vibrations are larger</i></p> <p><i>Students will sway first slowly, then faster.</i></p> <p><i>Students will describe frequency as the number of vibrations per second and</i></p>
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	<p>We are going to investigate the question: Does mass (weight or thickness) have an effect on frequency and amplitude.</p>	<p><i>amplitude as the size of the vibration.</i></p>
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EXPLORE: *Hands-On Learning, Contextualize Language, Use of Scaffolding (Graphic Organizers, Thinking Maps, Cooperative Learning), Use of Multiple Intelligences, Check for Understanding*
Estimated time: 30 minutes

Description of Explore: The students will make predictions and then conduct an investigation using a base on wheels with rods of different thicknesses and different weights. Moving the base side to side at different speeds the students will observe frequency



Teacher's Role	Teacher Questions	Student's Role
<p>The first investigation involves having the students make a prediction on what order to place the rods (different thicknesses) from low frequency to high.</p> <p>The next investigation involves having the students make another prediction and explain their thinking to their partner. Will mass have an effect on natural frequency?</p>	<p>Now we are going to conduct our investigations about frequency.</p> <p>The first investigation involves placing the rods in order from low frequency to high frequency. How will you place them? Make a prediction and share it with your partner. Explain your thinking. Then complete your investigation. Look carefully at the rods. What happened? What makes the</p>	<p>Students share their predictions with their partner, explaining their reasoning. Then they organize the color rods placing them in the base, then roll the base side to side slowly.</p> <p>Students will find the thinner the tube the higher the frequency by observing the movement.</p>

<p>The last investigation demonstrates resonance. Students make their predictions and share them with their partner.</p> <p>Then they shake the base steadily at one frequency to give one of the rods a large amplitude.</p> <p>Now shake again at a different frequency to give the third tube a large amplitude.</p>	<p>frequencies different?</p> <p>In this next investigation, students will replace the red and blue rods with the green rods. Hold the base still, pull each rod to the side and watch it oscillate back and forth. Organize the colored tubes from low frequency to high. What makes the frequencies different? Then discuss your findings with your partner.</p> <p>Now you will do another investigation by making only one of the tubes shake from side to side. Try to shake the base so that only one tube shakes.</p> <p>Try moving the base from side to side to make a different tube shake. What did you have to do to make a different tube shake?</p>	<p>The students work with their partner, make predictions and complete the activity. Then discuss their finding with their partner.</p> <p>The students observe that the mass affects the frequency: the more mass the lower frequency.</p> <p><i>When we moved the base quickly from side to side, only one of the tubes shook. The shaking of the tube matched the shaking of the base.</i></p>
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EXPLAIN: *Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding* Estimated time: 10 minutes

Description of Explain: The students discuss amplitude and frequency sharing real life examples. Then they will discuss how they are different.

Teacher's Role	Teacher Questions	Student's Role
<p>Students will watch videos of buildings in an earthquake –students will identify the frequency and why the building didn't fall https://youtu.be/4Gm0FbsnY9c</p> <p>Watch the video and discuss why one building collapsed and the other remained standing on a resistant structures vs shake table: https://www.youtube.com/watch?v=NUzkh_2hS24 as an example.</p>	<p>Students will compare these buildings to their tubes. Explaining their thinking to their partner</p> <p>How are these structures similar or different from the tubes? Use evidence from the investigation to support your answers.</p>	<p><i>Students answer will vary.</i></p>

EVALUATE: *Thinking Maps, Summarize Lesson and Review Vocabulary, Variety of Assessment Tools, Games to Show Understanding* Estimated time: 5 minutes

Description of Evaluate:

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher will facilitate the discussion about frequency in terms of the shake table.</p>	<p>Explain why some buildings remained standing while others fell over.</p>	<p>Students' responses will vary.</p>

EXTEND/ELABORATE: *Group Projects, Plays, Murals, Songs, Connections to Real World, Connections to Other Curricular Areas* Estimated time: 5 minutes

Description of Extend/Elaborate: The children think of some examples of amplitude and frequency in their lives. Teacher reminds the children that they were acting like scientists by doing investigations by asking questions, drawing conclusions and communicating information.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher asks the students to think of objects around the room that might sway back and forth or fall down during an earthquake. Observe Japanese skyscrapers swaying during the 3-11-11 earthquake. Begin a class discussion about earthquake damage.</p>	<p>Look around the room. What objects might fall over during an earthquake?</p>	<p><i>Students will discuss With their partner and share out. (answers will vary)</i></p>

<p>https://www.youtube.com/watch?v=HB2jgJJG2is</p> <p>https://www.youtube.com/watch?v=g0cz-oDfUg0</p>	<p>How did you act like scientists today?</p> <p>What did you do?</p>	<p><i>Students will summarize what they learned and what connections they made.</i></p>
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