

Week 4: Art and Conservation

Whether its artists, divers or families most people love the serenity and the view of a beautiful beach. Artists have photographed pristine beaches for years but what happens if those beaches are eroded? In these experiments, we will look at sand, waves, and vertical sorting.

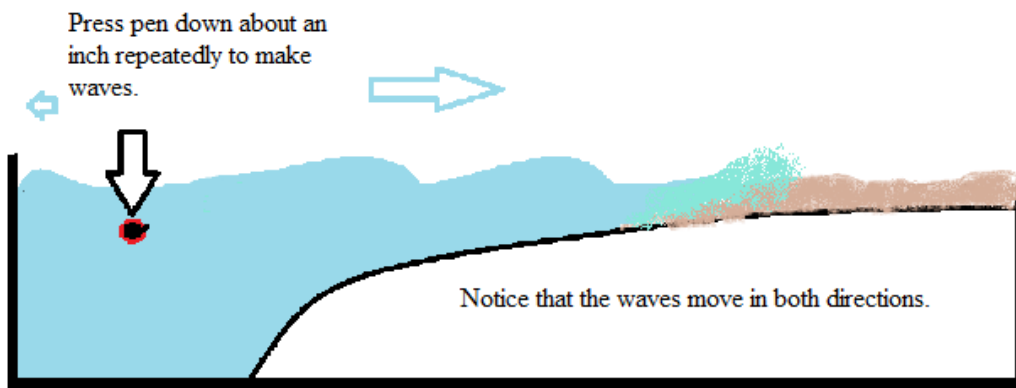
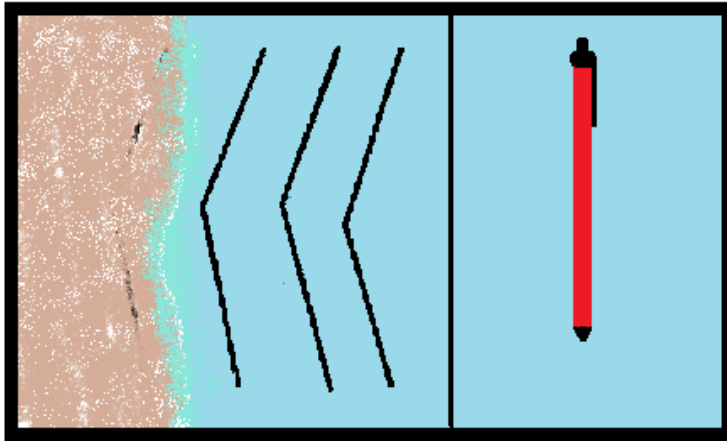
Exercise 1:

Shore Washout

Materials:

- paint pan
- water
- sand
- pencil

Cover the shallow part of a paint pan with sand building up a little beach area. Then pour water into the deep end of the pan filling up to the beach area. Now take a pencil or pen and make waves in the deep end of the pan by pushing the pencil up and down repeatedly. (Push the pencil about 1 inch down each time) What happens to the beach area after the waves hit it?



What is happening?

These waves represent disturbances in the water surface. When these waves hit the beach, they are moving the sand back towards the deep end of the pan. There are two main types of waves that the lab will focus on, the constructive wave and destructive wave. The constructive waves are waves that are low and carry material up onto the beach. The new material is deposited and the backwash slowly drains away or is soaked into the sand. The constructive waves are waves that build beaches. These types of waves are found typically in the summer. The other types of waves are the destructive waves. These waves are higher than the constructive waves and break with a greater force on the sand. The backwash has little to no time to soak into the sand due to the frequency of the waves. Therefore, there is more water running back towards the water carrying materials with it. This movement of sand is known as displacement and it is a form of erosion. The destructive waves are more common in the winter. In this demonstration, the pen was used to simulate the wind blowing across the surface of the water.

Definitions:

-Erosion: The gradual destruction or diminution of something

-Fetch: the distance a wave travels

-Swash: The rush of seawater up the beach after the breaking of a wave

-Backwash: The motion of receding waves

-Constructive waves: A low energy wave that deposits materials on a coast and, has a greater swash than backwash.

-Destructive waves: A high-energy wave that erodes a coast and, has a greater backwash than swash.

How this relates to Jessica and Bruce:

Jessica and Bruce are currently in a lagoon in Key Largo Florida. In Key Largo, there has been development over the past 50 years. With development came the destruction of acres of Mangroves. The Mangrove trees are ecologically important for many reasons. However, for today just focus of why they are important for waves. The Mangroves have a specialized type of root system called prop roots. These prop roots form tangled systems that can absorb high amounts of wave energy. It has been said that 75% of a waves' energy can be reduced in about 200 meters of mangroves (Massell 1999). This reduction in wave energy significantly helps reduce the amount of shore erosion compared to places that do not have mangroves. Mangroves also help filter some of the sedimentation and keep the sediment from traveling out to the coral reefs. In the Key Largo area, they are trying to re-establish mangroves along the shorelines to help with erosion and sedimentation.

Questions:

1. How did the waves affect the beach area?
2. How do you think the waves will affect the beaches over time?
3. What causes waves?
4. When are constructive waves more common?
5. What are some ways to help conserve the beach areas?

Related topics:

Building barriers for hurricanes that slope instead of a wall. This slope helps slow down the wave so that it does not cause that much damage like it would if there was a wall that the wave collide into.

Rebuilding our mangroves will save our shorelines :)

Ocean Geography: waves currents tides etc

Exercise 2: Sand Sorting

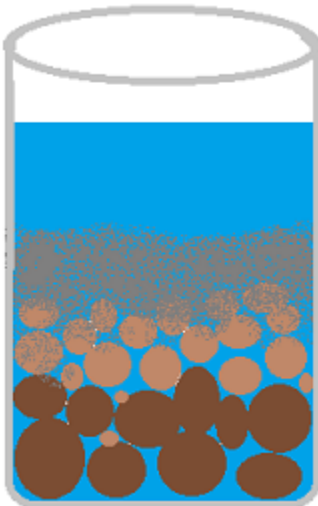
Materials:

- Glass Jar with a lid
- Sand
- Gravel
- Clay or fine dirt
- water

Fill the jar about halfway with water. Mix all the dry ingredients in a bowl. Ask the students if they could sort the different materials. Pour the mixed ingredients into the jar of water. You want to fill the jar almost completely and then secure the lid.

Carefully shake the jar to ensure the water mixes with the ingredients. Swirl the jar so the water can begin sorting the sediment. Set the jar down and allow a few minutes for the sediment to settle. Observe the different layers that can now be seen in the jar.

Will the layers become more distinct if the jar sits out longer?



What is happening?

When the water is moving quickly, it will carry all the particles around the jar. However, once the water slows down the heaviest pieces fall to the bottom. As the water continues to slow, the medium pieces will fall followed by the lightest pieces. The gravel is the heaviest and will be on the bottom of the jar. The sand will be the next layer followed by the clay or fine dirt. This is known as vertical sorting of sediments.

How this relates to Jessica and Bruce:

Moving water causes vertical and horizontal sorting. Our beaches experience it and our major waterways experience it. On our beaches, the largest particles are pushed up to the top of the beach by high-energy waves, while the little particles such as sand are

found at the base of the beaches. In streams, the water is moving too quickly to allow the smaller particles to settle so the bottom composition is typically composed of bigger cobbles and boulders that weight too much for the water to move. However, when the swift water meets a bigger body of water, the current slows down and the sediments settle to the bottom. The currents also fluctuate in the streams and areas can be seen where the sediments have collected. So look back at the mangroves, how do they sort the sediment from the water? When the fast water currents bring sediments toward the ocean the water is filtered though the mangroves, which slow the currents down allowing those sediments to fall and settle to the bottom. This plays an important role in keeping our corals healthy. If the sediments made it all the way to the corals, they could smother the corals, causing them to die.

Definitions:

-Sediment: matter that settles to the bottom of a liquid; dregs

-Sedimentation: the natural process in which material (such as stones and sand) is carried to the bottom of a body of water and forms a solid layer

-Silt: fine sand, clay or other material carried by running water and deposited as a sediment, especially in a channel or harbor.

-Vertical sorting: the alignment of sediments in vertical position

Questions:

1. What particles are on the bottom of the jar?
2. What particles are on the top layer in the jar?
3. What causes these different layers to form?
4. What is vertical sorting?
5. What is sediment?
6. Jessica and Bruce are living in a lagoon which does not get much water movement what type of bottom composition would you expect to see?

Related topics:

Formation of sedimentary rocks

Bottom composition of rivers, lakes, oceans, lagoons etc does it have something to do with how much the water moves?

Are there any areas near you that have heavy sedimentation due to construction or development?

Exercise 3:

Sand Under the Microscope

Materials:

- microscopes
- sand (preferably multiple samples from different beaches)
- black paper
- vinegar

Teachers:

If the students have a sand sample from a family vacation they can bring it in to look at the differences, if not, play sand will work.

Spread out a thin layer of sand on black paper. Have the students identify individual grains of sand and look at them under a microscope. Note size, shape color etc. Now add a small amount of vinegar on the sand.

What is happening?

Sand can give us clues to what kind of environment can be found nearby the beach areas. Black sand can be from Basalt. Basalt is typically found near volcanic activity. The Hawaiian Islands, for example, have sand that has high amounts of Basalt sand. All white sand or sand with hints of pink may have come from corals and shells. This type of sand is common from coral atoll islands. Sand from the Maldives, the Marshall Islands, and Bermuda, for example, are all white with hints of pink. Sand in North America is typically quartz mixed with other minerals. The samples may contain jewel colored pieces, which are broken glass pieces that have been smoothed out by the water. Some pieces that bubble when the vinegar is added were once part of a living organism such as coral shells or bones. Have the students look at the shapes of the sand. In places where there are rough destructive currents, the sand may be very smooth and round.

How this relates to Jessica and Bruce:

The Florida Keys are Limestone islands. The upper keys were formed from exposed coral reefs from when the sea levels dropped in the last ice age. When the coral reefs were exposed, they became fossilized and formed the limestone islands that people know today. This means that the sand that is found in the Keys is mainly white from the calcareous algae, calcium carbonate skeleton, or coral. If students had sand from the Keys and vinegar was added vinegar the sand would most likely bubble.

Questions:

1. Where do you think your sand is from (if you did not know already)?
2. Did your sand have any pieces from coral?
3. What was the overall shape of your pieces of sand?
4. What does this tell you about how the sand was formed?

5. Did your sand have any pieces of glass in it?

Related topics:

How does glass end up in our sand?

How do parrotfish help our beaches?

How are islands formed?

Links:

Shore washout

http://www.education.com/science-fair/article/earth-science_wash/

Watercolors:

http://www.ioccg.org/training/BossOPN_Light_demos.pdf

Fishing

<http://www.uli-beyer.com/en/monster-technology/lures/102-farben-unter-wasser>

<http://lifestyle.howstuffworks.com/crafts/other-arts-crafts/science-projects-for-kids-spectrum-of-colors.htm>

Sand

http://www.sciencekidsathome.com/science_experiments/sand_1.html

<http://www.science-projects.com/Beach.htm>

http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvSci_p034.shtml

<http://oimb.uoregon.edu/k-6/curricula/sandy-beaches-second-grade/>

<http://floridakeys.noaa.gov/ocean/limestone.html>

Answers:

1. How did the waves affect the beach area?
 - a. Constructive waves bring materials up on the beaches and Destructive waves bring materials away from the beaches.
2. How do you think the waves will affect the beaches over time?
 - a. Answers will vary. Waves can construct the beach landscape but in times of bad weather, they can also drastically alter the landscape.
3. What causes waves?
 - a. Wind blowing across the surface of the water
4. When are constructive waves more common?
 - a. Summer
5. What are some ways to help conserve the beach areas?
 - a. Answers will vary
1. What particles are on the bottom of the jar?
 - a. The heaviest particles
2. What particles are on the top layer in the jar?
 - a. The lightest particles
3. What causes these different layers to form?
 - a. The different weights of the particles along with the movement of the water
4. What is vertical sorting?
 - a. The alignment of sediments in vertical a position
5. What is sediment?
 - a. Matter that settles to the bottom of a liquid; dregs
6. Jessica and Bruce are living in a lagoon which does not get much water movement what type of bottom composition would you expect to see?
 - a. Silt
1. Where do you think your sand is from (if you did not know already)?
 - a. Answers will vary based on your sand samples
2. Did your sand have any pieces from coral?
 - a. Answers will vary
3. What was the overall shape of your pieces of sand?
 - a. Answers will vary
4. What does this tell you about how the sand was formed?
 - a. Answers will vary
5. Did your sand have any pieces of glass in it?
 - a. Answers will vary

Tennessee State Standards:

Grade 6 :Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Grade Level Expectations

GLE 0607.Inq.1 Design and conduct open- ended scientific investigations.

GLE 0607.Inq.2 Use appropriate tools and techniques to gather, organize, analyze, and interpret data.

GLE 0607.Inq.3 Synthesize information to determine cause and effect relationships between evidence and explanations.

GLE 0607.Inq.4 Recognize possible sources of bias and error, alternative explanations, and questions for further exploration.

GLE 0607.Inq.5 Communicate scientific understanding using descriptions, explanations, and models.

Checks for Understanding

0607.Inq.1 Design and conduct an open-ended scientific investigation to answer a question that includes a control and appropriate variables.

0607.Inq.2 Identify tools and techniques needed to gather, organize, analyze, and interpret data collected from a moderately complex scientific investigation.

0607.Inq.3 Use evidence from a dataset to determine cause and effect relationships that explain a phenomenon.

0607.Inq.4 Review an experimental design to determine possible sources of bias or error, state alternative explanations, and identify Questions for further investigations.

0607.Inq.S Design a method to explain the results of an investigation using descriptions, explanations, or models.

State Performance Indicators

SPI 0607.Inq.1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0607.Inq.2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0607.Inq.3 Interpret and translate data in a table, graph, or diagram.

SPI 0607.Inq.4 Draw a conclusion that establishes a cause and effect

relationship supported by evidence.

SPI 0607.Inq.5 Identify a faulty interpretation of data that is due to bias or experimental error.

Grade 6 : Embedded Technology & Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

How do science concepts, engineering skills, and applications of technology improve the quality of life?

Grade Level Expectations

GLE 0607.T/E.1 Explore how technology responds to social, political, and economic needs.

GLE 0607.T/E.2 Know that the engineering design process involves an ongoing series of events that incorporate design constraints, model building, testing, evaluating, modifying, and retesting.

GLE 0607.T/E.3 Compare the intended benefits with the unintended consequences of a new

GLE 0607.T/E.4 Describe and explain adaptive and assistive bioengineered products.

Checks for Understanding

0607.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.

0607.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

0607.T/E.3 Explore how the unintended consequences of new technologies can impact society.

0607.T/E.4 Research bioengineering technologies that advance health and contribute to improvements in our daily lives.

0607.T/E.5 Develop an adaptive design and test its effectiveness.

State Performance Indicators

SPI 0607.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.

SPI 0607.T/E.2 Evaluate a protocol to determine if the engineering design process was successfully applied.

SPI 0607.T/E.3 Distinguish between the intended benefits and the unintended consequences of a new technology.
technology.

SPI 0607.T/E.4 Differentiate between adaptive and assistive engineered products (e.g., food, biofuels, medicines, integrated pest management).

Grade 6 :Standard 6 - The Universe

Conceptual Strand 6

The cosmos is vast and explored well enough to know its basic structure and operational principles.

Guiding Question 6

What big ideas guide human understanding about the origin and structure of the universe, Earth's place in the cosmos, and observable motions and patterns in the sky?

Grade Level Expectations

GLE 0607.6.4 Describe the different stages in the lunar cycle.

GLE 0607.6.5 Produce a model to demonstrate how the moon produces tides.

Checks for Understanding

0607.6.5 Illustrate the positions of the earth, moon, and sun during specific tidal conditions.

0607.6.6 Diagram the relationship of the earth and sun that accounts for the seasons.

State Performance Indicators

SPI 0607.6.5 Predict the types of tides that occur when the earth and moon occupy various positions.

Grade 6 :Standard 8 - The Atmosphere

Conceptual Strand 8

The earth is surrounded by an active atmosphere and an energy system that controls the distribution life, local weather, climate, and global temperature.

Guiding Question 8

How do the physical characteristics and the chemical makeup of the atmosphere influence surface processes and life on Earth?

Grade Level Expectations

GLE 0607.8.3 Investigate the relationship between currents and oceanic temperature differences.

Checks for Understanding

0607.8.3 Design an experiment to demonstrate how ocean currents are

associated with the sun's energy.

State Performance Indicators

SPI 0607.8.3 Describe how temperature differences in the ocean account for currents.

Grade 7 : Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Grade Level Expectations

GLE 0707.Inq.1 Design and conduct open- ended scientific investigations.

GLE 0707.Inq.2 Use appropriate tools and techniques to gather, organize, analyze, and interpret data.

GLE 0707.Inq.3 Synthesize information to determine cause and effect relationships between evidence and explanations.

GLE 0707.Inq.4 Recognize possible sources of bias and error, alternative explanations, and questions for further exploration.

GLE 0707.Inq.5 Communicate scientific understanding using descriptions, explanations, and models.

Checks for Understanding

0707.Inq.1 Design and conduct an open-ended scientific investigation to answer a question that includes a control and appropriate variables.

0707.Inq.2 Identify tools and techniques needed to gather, organize, analyze, and interpret data collected from a moderately complex scientific investigation.

0707.Inq.3 Use evidence from a dataset to determine cause and effect relationships that explain a phenomenon.

0707.Inq.4 Review an experimental design to determine possible sources of bias or error, state alternative explanations, and identify questions for further investigation.

0707.Inq.5 Design a method to explain the results of an investigation using descriptions, explanations, or models.

State Performance Indicators

SPI 0707.Inq.1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0707.Inq.2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0707.Inq.3 Interpret and translate data in a table, graph, or diagram.

SPI 0707.Inq.4 Draw a conclusion that establishes a cause and effect relationship supported by evidence.

SPI 0707.Inq.5 Identify a faulty interpretation of data that is due to bias or experimental error.

Grade 7 : Embedded Technology & Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

How do science concepts, engineering skills, and applications of technology improve the quality of life?

Grade Level Expectations

GLE 0707.T/E.1 Explore how technology responds to social, political, and economic needs.

GLE 0707.T/E.2 Know that the engineering design process involves an ongoing series of events that incorporate design constraints, model building, testing, evaluating, modifying, and retesting.

GLE 0707.T/E.3 Compare the intended benefits with the unintended consequences of a new technology.

GLE 0707.T/E.4 Describe and explain adaptive and assistive bioengineered products.

Checks for Understanding

0707.T/E.1 Use appropriate tools to test for strength, hardness, and flexibility of materials.

0707.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.

0707.T/E.3 Explore how the unintended consequences of new technologies can impact society.

0707.T/E.4 Research bioengineering technologies that advance health and contribute to improvements in our daily lives.

0707.T/E.5 Develop an adaptive design and test its effectiveness.

State Performance Indicators

SPI 0707.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.

SPI 0707.T/E.2 Evaluate a protocol to determine if the engineering design process was successfully applied.

SPI 0707.T/E.3 Distinguish between the intended benefits and the unintended consequences of a new technology.

SPI 0707.T/E.4 Differentiate between adaptive and assistive engineered products (e.g., food, biofuels, medicines, integrated pest management).

Grade 7 : Standard 7 – The Earth

Conceptual Strand 7

Major geologic events that occur over eons or brief moments in time continually shape and reshape the surface of the Earth, resulting in continuous global change.

Guiding Question 7

How is the earth affected by long-term and short term geological cycles and the influence of man?

Grade Level Expectations

GLE 0707.7.3 Analyze the characteristics of the earth's layers and the location of the major plates.

GLE 0707.7.4 Explain how earthquakes, mountain building, volcanoes, and sea floor spreading are associated with movements of the earth's major plates.

GLE 0707.7.6 Evaluate how human activities affect the earth's land, oceans, and atmosphere.

Checks for Understanding

0707.7.7 Analyze the relationship between plate movements, volcanoes, and sea floor spreading.

0707.7.8 Determine the impact of man's use of renewable and nonrenewable resources on future supplies.

0707.7.9 Evaluate how human activities affect the condition of the earth's land, water, and atmosphere.

State Performance Indicators

SPI 0707.7.6 Describe the relationship between plate movements and earthquakes, mountain building, volcanoes, and sea floor spreading.

SPI 0707.7.7 Analyze and evaluate the impact of man's use of earth's land, water, and atmospheric resources.

Grade 8 : Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Grade Level Expectations

GLE 0807.Inq.1 Design and conduct open- ended scientific investigations.

GLE 0807.Inq.2 Use appropriate tools and techniques to gather, organize, analyze, and interpret data.

GLE 0807.Inq.3 Synthesize information to determine cause and effect relationships between evidence and explanations.

GLE 0807.Inq.4 Recognize possible sources of bias and error, alternative explanations, and questions for further exploration.

GLE 0807.Inq.5 Communicate scientific understanding using descriptions, explanations, and models.

Checks for Understanding

0807.Inq.1 Design and conduct an open-ended scientific investigation to answer a question that includes a control and appropriate variables.

0807.Inq.2 Identify tools and techniques needed to gather, organize, analyze, and interpret data collected from a moderately complex scientific investigation.

0807.Inq.3 Use evidence from a dataset to determine cause and effect relationships that explain a phenomenon.

0807.Inq.4 Review an experimental design to determine possible sources of bias or error, state alternative explanations, and identify questions for further investigation.

0807.Inq.5 Design a method to explain the results of an investigation using descriptions, explanations, or models.

State Performance Indicators

SPI 0807.Inq.1 Design a simple experimental procedure with an identified control and appropriate variables.

SPI 0807.Inq.2 Select tools and procedures needed to conduct a moderately complex experiment.

SPI 0807.Inq.3 Interpret and translate data into a table, graph, or diagram.

SPI 0807.Inq.4 Draw a conclusion that establishes a cause and effect relationship supported by evidence.

SPI 0807.Inq.5 Identify a faulty interpretation of data that is due to bias or experimental error.

Grade 8 : Embedded Technology & Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

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GLE 0807.T/E.1 Explore how technology responds to social, political, and economic needs.

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SPI 0807.T/E.4 Differentiate between adaptive and assistive engineered products (e.g., food, biofuels, medicines, integrated pest management).

National Standards:

Middle school Earth and Space Science:

Human Impacts:

1. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-3
 - a. Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).
 - b. Assessment Boundary: none

Middle School Physical Science

Waves and Electromagnetic Radiation:

2. 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. MS-PS4-1
 - a. Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.
 - b. Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.
3. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS-PS4-2
 - a. Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.

- b. Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.