

Grade 4 Science

Unit 2: Investigating Waves

15 lessons and a unit quiz. Use this pack with the **Investigating Waves Student Reader** (print it, or download it once from the course) to teach the whole unit without the internet.

What is in this pack

- A lesson plan for each chapter: the Big Question, words to know, which pages to read, questions to talk over and the activity pages.
- The unit quiz, ready to print.
- Answers for the teacher at the back: every discussion question and the quiz key.

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Lesson schedule

Two or three lessons a week, about 30 minutes each. Tick each one off as you go.

	Lesson	Reader pages	Activity pages
☐	Lesson 1: Investigating Water Waves	—	AP 1.1
☐	Lesson 2: Describing Water Waves	PDF pages 7–10	AP 2.1
☐	Lesson 3: Modeling Water Wave Features	—	AP 3.1, AP 3.2
☐	Lesson 4: Exploring Sound	—	AP 4.1, AP 4.2
☐	Lesson 5: Sound and Matter	—	AP 5.1
☐	Lesson 6: Sound, Energy, and Change	PDF pages 11–18	AP 6.1, AP 6.2
☐	Lesson 7: Investigating Sound	—	AP 7.1, AP 7.2, AP 7.3
☐	Lesson 8: Light	—	AP 8.1
☐	Lesson 9: Light Waves	PDF pages 19–28	AP 9.1
☐	Lesson 10: Investigating Light and Change	—	AP 10.1, AP 10.2
☐	Lesson 11: Invisible Energy	PDF pages 29–32	AP 11.1
☐	Lesson 12: Codes and Signals	PDF pages 33–38	AP 12.1
☐	Lesson 13: Investigating Transfer of Information	—	AP 13.1
☐	Lesson 14: Using Signals	PDF pages 39–46	AP 14.1
☐	Lesson 15: Waves and Information Transfer Game	—	—
☐	Unit review and assessment	—	AP UR.1, AP UR.2
☐	Words quiz	—	—

Page numbers are the PDF page numbers of the Student Reader file, so they match what your PDF reader shows.

Lesson 1: Investigating Water Waves

THE BIG QUESTION

How do waves move through water?

Words to know

- **wave** — a disturbance that transfers energy through matter or through space
- **wavelength** — the distance from one crest to the next crest of a wave
- **wave speed** — the pace at which wave crests in series pass a point of reference; frequency

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 24-29: the steps, materials and timing for this lesson.

Talk it over

1. Did they move up and down with the waves?
2. Did they move from one location to another on the waves?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do waves move through water?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 1.1: Making and Using a Wave Tank — Teacher Guide PDF pages 122-124

Lesson 2: Describing Water Waves

THE BIG QUESTION

How does the energy of water waves cause a change?

Words to know

- **wave** — a disturbance that transfers energy through matter or through space
- **wave height** — the vertical distance from the top of the crest to the bottom of the trough of a wave
- **wavelength** — the distance from one crest to the next crest of a wave
- **wave speed** — the pace at which wave crests in series pass a point of reference; frequency

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 30–35: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 1: “Describing Water Waves”: PDF pages 7–10. Look at the pictures and maps together.

Talk it over

1. What waves did you see in the video?
2. How was energy transferred to the waves?
3. What happened around the pebble when it went into the water?
4. What do the ripples, or waves, tell us about energy?
5. Which direction do the waves move?
6. Do you think this direction ever changes if you change how the rock is dropped or by dropping something else?
7. What changes would you expect to see if you drop a much larger rock into the water or if you drop the same small rock from a higher position?
8. What is the crest of the wave?
9. What is the trough of the wave?
10. What is the wavelength of the wave?
11. How is what you read in the Student Reader similar to what you saw in the video at the beginning of the lesson?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How does the energy of water waves cause a change?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 2.1: Wave Model — Teacher Guide PDF pages 125-126

Lesson 3: Modeling Water Wave Features

THE BIG QUESTION

What are the characteristics of water waves?

Words to know

- **wavelength** — the distance from one crest to the next crest of a wave
- **frequency** — the number of times a wave peaks over a period of time
- **amplitude** — the height or distance from the crest to either the mid-point or the trough of a wave

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 36-42: the steps, materials and timing for this lesson.

Talk it over

1. What is the crest of the wave?
2. What is the trough of the wave?
3. What is the wavelength of the wave?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are the characteristics of water waves?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 3.1: Modeling a Water Wave — Teacher Guide PDF page 127
- Activity Page 3.2: Testing a Wave Model — Teacher Guide PDF pages 128-129

Lesson 4: Exploring Sound

THE BIG QUESTION

What is sound?

Words to know

- **wave** — a disturbance that transfers energy through matter or through space
- **wavelength** — the distance from one crest to the next crest of a wave

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 45–49: the steps, materials and timing for this lesson.

Talk it over

1. What are vibrations?
2. What is a sound?
3. How are sound waves created?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is sound?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 4.1: Making a Shoebox Guitar — Teacher Guide PDF page 130
- Activity Page 4.2: Investigating Sound Waves with a Shoebox Guitar — Teacher Guide PDF page 131

Lesson 5: Sound and Matter

THE BIG QUESTION

How do sound and matter interact?

Words to know

- **wave** — a disturbance that transfers energy through matter or through space
- **wavelength** — the distance from one crest to the next crest of a wave
- **sound wave** — a transfer of energy through a material as it is disturbed by vibrations
- **vibration** — the motion of an object or material that is vibrating
- **intensity** — the measurable strength or power of a vibration
- **pitch** — the quality of sound that is described as high or low and is related to a wave's frequency

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 50–55: the steps, materials and timing for this lesson.

Talk it over

1. How did the sound change between what you heard with air and what you heard with water?
2. How did the sound change between what you heard with water and the solid?
3. How did the sound change between what you heard with air and the solid?
4. In a thunderstorm, do you see, hear, or feel the thunder first? How does thunder as a phenomenon show that sound travels differently through different states of matter?
5. Which direction(s) do sound waves travel from their source?
6. How would the sound be different under and above the water?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do sound and matter interact?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 5.1: Sound Observations — Teacher Guide PDF page 132

Lesson 6: Sound, Energy, and Change

THE BIG QUESTION

What is the relationship among vibration, sound, and energy?

Words to know

- **sound wave** — a transfer of energy through a material as it is disturbed by vibrations
- **vibrate** — to move back and forth quickly
- **vibration** — the motion of an object or material that is vibrating
- **frequency** — the number of times a wave peaks over a period of time
- **intensity** — the measurable strength or power of a vibration
- **pitch** — the quality of sound that is described as high or low and is related to a wave's frequency
- **volume** — the way humans perceive loudness from the intensity of a sound wave

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 56–65: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 2: "Sound, Energy, and Change": PDF pages 11–18. Look at the pictures and maps together.

Talk it over

1. Activity Pages What Does It Sound Like?
2. What are examples of sounds?
3. How can sounds be different?
4. What causes/creates a sound?
5. Can sounds cause changes?
6. Has anyone ever heard a sound while they were underwater?
7. What did it sound like?
8. How was it different from hearing sounds in air?
9. What happens to the vibrations in the gas group?
10. What happens to the vibrations in the liquid group?
11. What happens to the vibrations in the solid group?
12. Does sound travel best through gas, liquid, or solid?
13. How do the properties of each state of matter affect how vibrations travel through them?

14. What is the best type of matter for sound to travel through?
15. What would happen without solid matter?
16. Did you write any observations on your Activity Page that are similar to the stereo hanger demonstration?
17. As students finish the Core Vocabulary task, collect their completed What Does It Sound Like?
18. Does it sound soothing or screeching?
19. Was it loud enough to make other objects vibrate?
20. How are these examples similar?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is the relationship among vibration, sound, and energy?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 6.1: What Does It Sound Like? — Teacher Guide PDF page 133
- Activity Page 6.2: Check — Teacher Guide PDF page 134

Lesson 7: Investigating Sound

THE BIG QUESTION

What are the characteristics of sound waves?

Words to know

- **wavelength** — the distance from one crest to the next crest of a wave
- **vibration** — the motion of an object or material that is vibrating
- **pitch** — the quality of sound that is described as high or low and is related to a wave's frequency
- **volume** — the way humans perceive loudness from the intensity of a sound wave

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 66–70: the steps, materials and timing for this lesson.

Talk it over

1. What is the crest of the wave?
2. What is the trough of the wave?
3. What is the wavelength of the wave?
4. Does the volume (intensity) of a sound wave change depending on the amount of energy transferred into it?
5. How would you describe the vibrations that cause a lower-volume (intensity) sound?
6. Does the pitch of a sound wave change depending on the amount of energy transferred into it?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are the characteristics of sound waves?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 7.1: Sound Words — Teacher Guide PDF pages 135–136
- Activity Page 7.2: Modeling Sound Waves — Teacher Guide PDF pages 137–138
- Activity Page 7.3: Testing Sound Waves — Teacher Guide PDF pages 139–140

Lesson 8: Light

THE BIG QUESTION What is light?

Words to know

- **light** — a form of energy that can transfer through empty space and can and make things visible
- **light source** — an object that gives off its own light
- **light wave** — an energy disturbance that transfers, or radiates, light
- **reflect** — to bounce off of
- **transparency** — a property of matter that allows light to pass through it

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 72-77: the steps, materials and timing for this lesson.

Talk it over

1. What colors do you see in the light?
2. Is the light bright or dim?
3. How are we able to see this light?
4. Is this light? How do you know?
5. Look at objects next to the stickers. Do they give off light?
6. Is this an example of light?
7. Is this an example of light? Why or why not?
8. What colors do you see?
9. How else could you describe this light?
10. What is the light doing?
11. Why can the light go through the glass?
12. Why doesn't the light go through the wooden block?
13. How would you describe this light? Is it bright?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is light?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 8.1: Find the Light — Teacher Guide PDF page 141

Lesson 9: Light Waves

THE BIG QUESTION

How does light behave?

Words to know

- **light** — a form of energy that can transfer through empty space and can and make things visible
- **light source** — an object that gives off its own light
- **light wave** — an energy disturbance that transfers, or radiates, light
- **reflect** — to bounce off of
- **transparency** — a property of matter that allows light to pass through it
- **absorb** — to take something in and contain it
- **color** — an aspect of light that enables otherwise identical objects to be distinguished from each other through the sense of sight (vision)
- **emit** — to give off

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 78–86: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 3: “Light Waves”: PDF pages 19–28. Look at the pictures and maps together.

Talk it over

1. What is an example of a light source?
2. Why do we even see the light beam?
3. How did the light travel?
4. What would happen if an object gets in the way of the light?
5. What evidence is there that light transfers energy to the tree?
6. What happened when the sunlight passed between the tree's leaves and branches?
7. What sources of light might campers use to help light up the insides of their tents?
8. The image shows the moon shining down on campers. What is the actual light source for the moon?
9. Why are the moon and tent lit up?
10. What is the crest of the wave?
11. What is the trough of the wave?
12. What is wavelength?

13. How is what you read in the Student Reader similar to what you saw in the video at the beginning of the lesson?
14. How is what you read different from what you saw demonstrated in the previous lesson?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How does light behave?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 9.1: Light Behaviors — Teacher Guide PDF page 142

Lesson 10: Investigating Light and Change

THE BIG QUESTION

How does light cause change?

Words to know

- **light wave** — an energy disturbance that transfers, or radiates, light
- **reflect** — to bounce off of

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 87–95: the steps, materials and timing for this lesson.

Talk it over

1. Was your prediction correct?
2. What changed, and what stayed the same?
3. What caused the black balloon to pop?
4. What do you think will happen if we do the same activity with two clear balloons?
5. What caused the change?
6. How will the aluminum foil help light make a change?
7. How will the black construction paper help light make a change?
8. How does a solar oven work?
9. What do you think you can do with your solar oven?
10. What will happen to the pencil?
11. What changes do you expect to see in the crayon?
12. What will happen to the butter?
13. What changes do you expect to see in the rock?
14. How do water waves cause change?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How does light cause change?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 10.1: Build a Solar Oven (Day 1) — Teacher Guide PDF page 143
- Activity Page 10.2: Test Your Solar Oven (Day 2) — Teacher Guide PDF page 144

Lesson 11: Invisible Energy

THE BIG QUESTION

What are some different kinds of light waves?

Words to know

- **light wave** — an energy disturbance that transfers, or radiates, light
- **reflect** — to bounce off of
- **radiation** — the emission of energy as electromagnetic waves

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 96–99: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 4: “Invisible Energy”: PDF pages 29–32. Look at the pictures and maps together.

Talk it over

1. What do you think will happen to the food or liquid placed in the microwave oven?
2. How do you know?
3. What do you think causes the changes to the food or liquid?
4. What does wavelength have to do with whether light waves are visible or invisible?
5. Can light of any wavelength cause a change?
6. Which type of waves are most often used for communicating?
7. What are some of the ways that waves can be helpful?
8. What are some of the ways that waves can be harmful?
9. If so, which ones?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are some different kinds of light waves?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 11.1: Invisible Energy — Teacher Guide PDF page 145

Lesson 12: Codes and Signals

THE BIG QUESTION

What is a code?

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 101–105: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 5: “Codes and Signals”: PDF pages 33–38. Look at the pictures and maps together.

Check for understanding

- Answer the Big Question in a sentence or two: What is a code?

Activity pages

- Activity Page 12.1: Decoding — Teacher Guide PDF page 146

Lesson 13: Investigating Transfer of Information

THE BIG QUESTION

How can signals transfer information?

Words to know

- **code** — a pattern of symbols that can be used to communicate a message
- **pattern** — a regular or repeated way in which something occurs
- **information** — types of data such as pictures, sounds, and messages
- **transfer** — to move from one place to another
- **digital** — describing signals sent as separate bits and not continuous

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 106–111: the steps, materials and timing for this lesson.

Talk it over

1. What do you think makes a coded system “good”?
2. How can we measure or tell whether a signal works or doesn’t work?
3. Why is it important to follow the criteria and constraints?
4. How are these signaling methods similar?
5. How are these signaling methods different?
6. Which signaling method do you think is best? Why?
7. How do you think the other signaling methods could be improved?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How can signals transfer information?
- Use one of today’s words in a sentence of your own.

Activity pages

- Activity Page 13.1: Sending Coded Messages — Teacher Guide PDF pages 147–149

Lesson 14: Using Signals

THE BIG QUESTION

How are waves used to send signals?

Words to know

- **pattern** — a regular or repeated way in which something occurs
- **information** — types of data such as pictures, sounds, and messages
- **transfer** — to move from one place to another
- **digital** — describing signals sent as separate bits and not continuous

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 112–116: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 6: “Using Signals”: PDF pages 39–46. Look at the pictures and maps together.

Talk it over

1. What will happen if I call someone?
2. What will happen if I send a text message?
3. How do you think cell phones and other devices send and receive information?
4. How might these be similar to using a code?
5. What is happening when you receive this message?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How are waves used to send signals?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 14.1: Develop Models of Signals — Teacher Guide PDF page 150

Lesson 15: Waves and Information Transfer Game

THE BIG QUESTION

What have I learned about waves?

Words to know

- **wave** — a disturbance that transfers energy through matter or through space
- **wave height** — the vertical distance from the top of the crest to the bottom of the trough of a wave
- **wavelength** — the distance from one crest to the next crest of a wave
- **vibrate** — to move back and forth quickly
- **vibration** — the motion of an object or material that is vibrating
- **volume** — the way humans perceive loudness from the intensity of a sound wave

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 117–119: the steps, materials and timing for this lesson.

Check for understanding

- Answer the Big Question in a sentence or two: What have I learned about waves?
- Use one of today's words in a sentence of your own.

UNIT REVIEW

Unit review and assessment

- Unit Assessment (print for your student): Teacher Guide PDF pages 154–161
- How to mark it (for the teacher): Teacher Guide PDF pages 165–167
- Activity page answer key (for the teacher): Teacher Guide PDF pages 162–164
- Activity Page UR.1: Race the Board — Teacher Guide PDF page 151
- Activity Page UR.2: Vocabulary Crossword Puzzle — Teacher Guide PDF page 152

WORDS QUIZ

Investigating Waves

Name: _____ Date: _____

Circle the letter of the best answer.

1. Which word means “types of data such as pictures, sounds, and messages”?
 - a) information
 - b) crest
 - c) wave
 - d) pitch
2. Which word means “a property of matter that allows light to pass through it”?
 - a) absorb
 - b) light
 - c) reflect
 - d) transparency
3. Which word means “an energy disturbance that transfers, or radiates, light”?
 - a) wave height
 - b) volume
 - c) light wave
 - d) code
4. Which word means “the motion of an object or material that is vibrating”?
 - a) vibration
 - b) light wave
 - c) wave
 - d) code
5. Which word means “describing signals sent as continuous waves”?
 - a) analog
 - b) light source
 - c) signal
 - d) light
6. Which word means “a regular or repeated way in which something occurs”?
 - a) wavelength
 - b) information
 - c) pattern
 - d) color
7. Which word means “the quality of sound that is described as high or low and is related to a wave’s frequency”?
 - a) pitch
 - b) digital
 - c) light source
 - d) sound wave

8. Which word means “a form of energy that can transfer through empty space and can and make things visible”?

- a) digital
- b) light
- c) pitch
- d) intensity

9. Which word means “a symbol sent over a distance”?

- a) reflect
- b) signal
- c) light
- d) pitch

10. Which word means “the vertical distance from the top of the crest to the bottom of the trough of a wave”?

- a) light wave
- b) signal
- c) vibrate
- d) wave height

11. Which word means “the way humans perceive loudness from the intensity of a sound wave”?

- a) wave
- b) transfer
- c) volume
- d) analog

12. Which word means “the highest part of a wave”?

- a) sound wave
- b) crest
- c) wave
- d) transfer

Answers

Lesson 1: Investigating Water Waves

1. **Did they move up and down with the waves?**
Yes, the waves make the boat move up and down.
2. **Did they move from one location to another on the waves?**
It did not seem like the boat moved to a different location.

Lesson 2: Describing Water Waves

1. **What waves did you see in the video?**
Water waves
2. **How was energy transferred to the waves?**
By wind and gravitational forces
3. **What happened around the pebble when it went into the water?**
Ripples, or waves, formed.
4. **What do the ripples, or waves, tell us about energy?**
Energy causes the water to change, and energy is transferred from the moving pebble or rock to cause the water to start moving in a pattern.
5. **Which direction do the waves move?**
The waves move in circles, away from the rock.
6. **Do you think this direction ever changes if you change how the rock is dropped or by dropping something else?**
If you skip a rock across the water, the waves move away from the rock to make a trail.
7. **What changes would you expect to see if you drop a much larger rock into the water or if you drop the same small rock from a higher position?**
The waves will still be in circles, but the size and force will be larger.
8. **What is the crest of the wave?**
The highest part of a wave
9. **What is the trough of the wave?**
The lowest part of a wave
10. **What is the wavelength of the wave?**
The distance from one crest to the next crest of a wave
11. **How is what you read in the Student Reader similar to what you saw in the video at the beginning of the lesson?**
» How is what you read in the Student Reader different from what you saw in the video at the beginning of the lesson?

Lesson 3: Modeling Water Wave Features

1. **What is the crest of the wave?**
The highest part of a wave

2. **What is the trough of the wave?**

The lowest part of a wave

3. **What is the wavelength of the wave?**

The distance from one crest to the next crest of a wave

Lesson 4: Exploring Sound

1. **What are vibrations?**

Quick back-and-forth or side-to-side motions

2. **What is a sound?**

Invisible energy vibrations

3. **How are sound waves created?**

When a sound is made, waves form to carry the sound. When it reaches an ear, the sound can be heard.

Lesson 5: Sound and Matter

1. **How did the sound change between what you heard with air and what you heard with water?**

The tapping sound is louder through the bottle filled with water than the bottle with air.

2. **How did the sound change between what you heard with water and the solid?**

The sound is louder through the solid than through the bottle of water.

3. **How did the sound change between what you heard with air and the solid?**

The sound through the solid is louder than the sound through the bottle of air.

4. **In a thunderstorm, do you see, hear, or feel the thunder first? How does thunder as a phenomenon show that sound travels differently through different states of matter?**

You may feel a vibration around you or under your feet because sound travels faster through the ground than through the air; you hear the thunder after this vibration because sound travels more slowly through air.

5. **Which direction(s) do sound waves travel from their source?**

Sound waves spread out from the source that is vibrating, like the ripples from a pebble dropped in water.

6. **How would the sound be different under and above the water?**

» Which direction(s) do sound waves travel from their source? (Sound waves spread out from the source that is vibrating, like the ripples from a pebble dropped in water.)

Lesson 6: Sound, Energy, and Change

1. **Activity Pages What Does It Sound Like?**

AP 6.1

2. **What are examples of sounds?**

Clock ticking, talking, siren

3. **How can sounds be different?**
High, low, loud, soft
4. **What causes/creates a sound?**
Vibration
5. **Can sounds cause changes?**
Sound waves cause changes in ears that allow you to hear sounds.
6. **Has anyone ever heard a sound while they were underwater?**
Possible sounds may include sloshing, the motor of a boat, or sounds that are above the water.
7. **What did it sound like?**
Fuzzy, muffled, not very loud
8. **How was it different from hearing sounds in air?**
It is difficult to hear what is being said by someone above the water, but the boat motor sounded very loud.
9. **What happens to the vibrations in the gas group?**
The sound vibrations are far apart and take longer to bump together.
10. **What happens to the vibrations in the liquid group?**
There should be more collisions than modeled for the gas.
11. **What happens to the vibrations in the solid group?**
The solid molecules are much closer together and bump into one another quickly.
12. **Does sound travel best through gas, liquid, or solid?**
Solid
13. **How do the properties of each state of matter affect how vibrations travel through them?**
The sound vibrations travel slowly if they are far apart and fast if they are close together.
14. **What is the best type of matter for sound to travel through?**
A solid
15. **What would happen without solid matter?**
Sound would not be as loud
16. **Did you write any observations on your Activity Page that are similar to the stereo hanger demonstration?**
Students should be able to draw conclusions about sounds traveling slower through air, faster through liquids, and even faster through solids. Sounds are louder through liquids than air and louder through solids than liquids.
17. **As students finish the Core Vocabulary task, collect their completed What Does It Sound Like?**
AP 6.1
18. **Does it sound soothing or screeching?**
» Does it hurt my ears?

19. **Was it loud enough to make other objects vibrate?**
» Could you hear it from across the room?
20. **How are these examples similar?**
» Encourage students to ask their own questions and answer others' questions during the discussion.

Lesson 7: Investigating Sound

1. **What is the crest of the wave?**
The highest part of a wave
2. **What is the trough of the wave?**
The lowest part of a wave
3. **What is the wavelength of the wave?**
The distance from one crest to the next crest of a wave
4. **Does the volume (intensity) of a sound wave change depending on the amount of energy transferred into it?**
Yes, it is louder when there is more energy.
5. **How would you describe the vibrations that cause a lower-volume (intensity) sound?**
Softer/less intense sounds are often the result of slower vibrations; less motion energy of the object that vibrates creates less intense sound waves.
6. **Does the pitch of a sound wave change depending on the amount of energy transferred into it?**
No, it is dependent on the frequency of the sound waves and wavelength, not the amplitude of the sound waves.

Lesson 8: Light

1. **What colors do you see in the light?**
Answers will vary but will likely include yellow, orange, and possibly blue.
2. **Is the light bright or dim?**
Dim compared, for example, to daylight
3. **How are we able to see this light?**
Light energy transfers to our eyes.
4. **Is this light? How do you know?**
Yes. I know because it is visible.
5. **Look at objects next to the stickers. Do they give off light?**
Little, if any
6. **Is this an example of light?**
Yes
7. **Is this an example of light? Why or why not?**
Students should indicate that the source of light is the flashlight, not the prism.
8. **What colors do you see?**
The full spectrum should be visible.

9. **How else could you describe this light?**
Colored, rainbow
10. **What is the light doing?**
It passes through the glass but is blocked by the block.
11. **Why can the light go through the glass?**
The glass is transparent.
12. **Why doesn't the light go through the wooden block?**
The wood is not transparent. It is opaque.
13. **How would you describe this light? Is it bright?**
Answers will vary depending on the lamp and bulb.

Lesson 9: Light Waves

1. **What is an example of a light source?**
Lighthouse, flashlight, sun, laser
2. **Why do we even see the light beam?**
Because light energy reflects off of some material to reach our eyes
3. **How did the light travel?**
A straight path
4. **What would happen if an object gets in the way of the light?**
The light may be blocked from our sight, but the object will be lit at some place.
5. **What evidence is there that light transfers energy to the tree?**
The tree's leaves and branches are lit by light, and shadows are cast behind them.
6. **What happened when the sunlight passed between the tree's leaves and branches?**
The light continued and was not interrupted.
7. **What sources of light might campers use to help light up the insides of their tents?**
Lamps, flashlights
8. **The image shows the moon shining down on campers. What is the actual light source for the moon?**
The sun
9. **Why are the moon and tent lit up?**
The moon is reflecting sunlight. The tents have light sources inside that are visible through their material.
10. **What is the crest of the wave?**
The highest part of a wave
11. **What is the trough of the wave?**
The lowest part of a wave
12. **What is wavelength?**
The distance from crest to crest

13. **How is what you read in the Student Reader similar to what you saw in the video at the beginning of the lesson?**

Sample answer: It shows that light travels in a straight line.

14. **How is what you read different from what you saw demonstrated in the previous lesson?**

Answers will vary.

Lesson 10: Investigating Light and Change

1. **Was your prediction correct?**

Yes, no, or partially correct

2. **What changed, and what stayed the same?**

The black balloon got bigger, but the clear balloon did not change much.

3. **What caused the black balloon to pop?**

The black balloon absorbs more light and heat energy than the clear balloon, so the black balloon swells faster and pops from the heat.

4. **What do you think will happen if we do the same activity with two clear balloons?**

The inside balloon probably will not pop, because it will not absorb more heat.

5. **What caused the change?**

Energy

6. **How will the aluminum foil help light make a change?**

The foil is a smooth surface, so it will bend the light and direct it to the oven.

7. **How will the black construction paper help light make a change?**

The black paper will absorb the light and increase the heat.

8. **How does a solar oven work?**

It is heated by the sun.

9. **What do you think you can do with your solar oven?**

I can use solar light and foil to direct the light waves and heat the solar oven.

10. **What will happen to the pencil?**

It may get a little warm, but it won't get hot enough to burn.

11. **What changes do you expect to see in the crayon?**

The crayon will slowly melt.

12. **What will happen to the butter?**

The butter will melt quickly.

13. **What changes do you expect to see in the rock?**

The rock will get too hot to touch, but it will not change form.

14. **How do water waves cause change?**

» How do sound waves cause change?

Lesson 11: Invisible Energy

1. **What do you think will happen to the food or liquid placed in the microwave oven?**

It will heat up. If it heats too long, it may burn or boil.

2. **How do you know?**

That's what happens at home when I use the microwave.

3. **What do you think causes the changes to the food or liquid?**

It must use some kind of waves because it is called a microwave. A few students may understand that it uses radio waves that generate heat when applied to an object.

4. **What does wavelength have to do with whether light waves are visible or invisible?**

The human eye can only see light that is within a certain range of wavelengths.

5. **Can light of any wavelength cause a change?**

Yes, because all are forms of energy

6. **Which type of waves are most often used for communicating?**

Radio waves

7. **What are some of the ways that waves can be helpful?**

Waves can supply heat, light, and radio signals.

8. **What are some of the ways that waves can be harmful?**

Waves that are too powerful can cause problems such as too much heat and radiation burns.

9. **If so, which ones?**

» How do you use them and why? SUPPORT—As a result of the reading so far, some students may come away believing that all electromagnetic radiation is helpful. Be sure to point them to the last paragraph on the page as well as to the example on page 24 of how too much ultraviolet light can cause sunburn. Have them name other ways that electromagnetic radiation can be harmful, but be aware of any issues that students may have and keep the conversation light.

Lesson 13: Investigating Transfer of Information

1. **What do you think makes a coded system “good”?**

It should be complete enough to solve a problem or to make something usable.

2. **How can we measure or tell whether a signal works or doesn't work?**

If a code works, the receiver will be able to decode the message.

3. **Why is it important to follow the criteria and constraints?**

The criteria and constraints help make sure that the code can be used for the use that is intended.

4. **How are these signaling methods similar?**

They communicate a message.

5. **How are these signaling methods different?**

Possible answer: Some methods use light, some use color, and some use sound.

6. **Which signaling method do you think is best? Why?**

Students should explain their rationales for stated preferences.

7. **How do you think the other signaling methods could be improved?**

Students may point out ways to make the messages or instructions more clear.

Lesson 14: Using Signals

1. **What will happen if I call someone?**

The voice message is turned into a digital signal and then turned back into a voice message for the message receiver to be able to hear.

2. **What will happen if I send a text message?**

The text message is turned into a digital signal and then is converted back to a visual display.

3. **How do you think cell phones and other devices send and receive information?**

Radio waves

4. **How might these be similar to using a code?**

Both forms of messages use coding and decoding.

5. **What is happening when you receive this message?**

The phone is using GPS to record where the picture is being taken.

Unit quiz key

1. a 2. d 3. c 4. a 5. a 6. c 7. a 8. b 9. b 10. d 11. c 12. b