

South Carolina Academic Standards and Performance Indicators for Science 2014



Instructional Unit Resource

4th Grade

South Carolina Academic Standards and Performance Indicators for Science 2014

Fourth Grade Science Instructional Unit Resource

As support for implementing the *South Carolina Academic Standards and Performance Indicators for Science 2014*, the standards for Fourth Grade have been grouped into possible units. In the Overview of Units below, the titles for those possible units are listed in columns. Refer to the Overview document to note these unit titles and how Standards, Conceptual Understandings, Performance Indicators, Science and Engineering Practices, and Crosscutting Concepts align. Following the Overview of Units, an Instructional Unit document is provided that delivers guidance and possible resources in teaching our new *South Carolina Academic Standards and Performance Indicators for Science 2014*. The purpose of this document is to provide guidance as to how all the standards in this grade may be grouped into units and how those units might look. Since this document is merely guidance, districts should implement the standards in a manner that addresses the district curriculum and the needs of students. This document is a living document and instructional leaders from around the state will continuously update and expand these resource documents. These documents will be released throughout the 2016-2017 school year with the intentionality of staying ahead of instruction. Teachers should also note that links to the Standards document, A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, the SEP Support Document, and the Support Document 2.0 are embedded throughout the Instructional Unit format for reference.

Acknowledgments

Jean Baptiste Massieu, famous deaf educator, made a statement that is now considered a French proverb. “Gratitude is the memory of the heart. Indeed, appreciation comes when you feel grateful from the depths of your heart. The head keeps an account of all the benefits you received and gave. But the heart records the feelings of appreciation, humility, and generosity that one feels when someone showers you with kindness.” It is with sincere appreciation that we humbly acknowledge the dedication, hard work and generosity of time provided by teachers and instructional leaders across the state that have made and are continuing to make the Instructional Unit Resources possible.

Grade 4 Overview of Units

Unit 1		Unit 2		Unit 3		Unit 4	
EARTH SCIENCE: WEATHER AND CLIMATE		EARTH SCIENCE: STARS AND THE SOLAR SYSTEM		PHYSICAL SCIENCE: FORMS OF ENERGY – LIGHT AND SOUND		LIFE SCIENCE: CHARACTERISTICS AND GROWTH OF ORGANISMS	
Standard		Standard		Standard		Standard	
4.E.2		4.E.3		4.P.4		4.L.5	
Conceptual Understanding		Conceptual Understanding		Conceptual Understanding		Conceptual Understanding	
4.E.2A	4.E.2B	4.E.3A	4.E.3B	4.P.4A	4.P.4B	4.L.5A	4.L.5B
Performance Indicators		Performance Indicators		Performance Indicators		Performance Indicators	
4.E.2A.1	4.E.2B.1	4.E.3A.1	4.E.3B.1	4.P.4A.1	4.P.4B.1	4.L.5A.1	4.L.5B.1
4.E.2A.2	4.E.2B.2	4.E.3A.2	4.E.3B.2	4.P.4A.2	4.P.4B.2	4.L.5A.2	4.L.5B.2
	4.E.2B.3	4.E.3A.3	4.E.3B.3	4.P.4A.3	4.P.4B.3	4.L.5A.3	4.L.5B.3
			4.E.3B.4	4.P.4A.4		4.L.5A.4	
				4.P.4A.5			
*Science and Engineering Practices		*Science and Engineering Practices		*Science and Engineering Practices		*Science and Engineering Practices	
4.S.1A.2		4.S.1A.2		4.S.1A.2		4.S.1A.2	
4.S.1A.4		A.S.1A.4		4.S.1A.3		4.S.1A.4	
A.S.1A.6		A.S.1A.6		4.S.1A.4		4.S.1A.6	
A.S.1A.8		4.S.1A.7		4.S.1A.7		4.S.1A.7	
		4.S.1A.8		4.S.1A.8		4.S.1A.8	
				4.S.1B.1			
*Crosscutting Concepts		*Crosscutting Concepts		*Crosscutting Concepts		*Crosscutting Concepts	
1,2,3,4,5,7		1,2,4,7		1,2,3,4,5		1,2,5,6	

**Teachers have the discretion to enhance the selected SEP's and CCCs.*

Unit Title
Physical Science: Forms of Energy-Light and Sound
Standard
http://ed.sc.gov/scdoe/assets/file/agency/ccr/Standards-Learning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf
4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A. Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object’s properties.

New Academic Vocabulary

Some students may need extra support with the following academic vocabulary in order to understand what they are being asked to understand and do. Teaching these terms in an instructional context is recommended rather than teaching the words in isolation. A great time to deliver explicit instruction for the terms would be during the modeling process. Ultimately, the student should be able to use the academic vocabulary in conversation with peers and teachers. These terms are pulled from the essential knowledge portion of the Support Doc 2.0 (<http://ed.sc.gov/instruction/standards-learning/science/support-documents-and-resources/>) and further inquiry into the terms can be found there.

Energy	Color	Prism	Spectrum	Brightness
Intensity	Visible	Reflection	Refraction	Absorption
Transparent	Translucent	Opaque		

Performance Indicators

Text highlighted below in **orange** and **italicized/underlined** shows connections to SEP’s

- 4.P.4A.1 Construct scientific arguments to support the claim that white light is made up of different colors.
- 4.P.4A.2 Analyze and interpret data from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.
- 4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.
- 4.P.4A.4 Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

4.P.4A.5 Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.

***Science and Engineering Practices**

Support for the guidance, overviews of learning progressions, and explicit details of each SEP can found in the Science and Engineering Support Doc (http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf). It is important that teachers realize that the nine science and engineering practices are not intended to be used in isolation. Even if a performance indicator for a given standard only lists one of the practices as a performance expectation, scientists and engineers do not use these practices in isolation, but rather as part of an overall sequence of practice. When educators design the learning for their students, it is important that they see how a given performance expectation fits into the broader context of the other science and engineering practices. This will allow teachers to provide comprehensive, authentic learning experiences through which students will develop and demonstrate a deep understanding of scientific concepts.

4.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

4S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation)

4.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

4.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language. n or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.

***Cross Cutting Concepts** (<http://www.nap.edu/read/13165/chapter/8>)

The link above provides support from the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) The text in blue and *italicized/underlined* below provides a brief explanation of how the specific content ties to the CCC's.

1. **Patterns:** The National Research Council (2012) states “observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them” (p. 84). *Similarities and differences can be found in objects that are transparent, translucent, or opaque.*

3. **Scale, Proportion, and Quantity:** The National Research Council (2012) states “In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance” (p. 84). *The distance from the light source, such as the sun, and intensity will affect the apparent brightness of the light.*

4. **Systems and System Models:** The National Research Council (2012) states “defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering” (p.84). [Models are used to show how light behaves when it strikes different objects made of different materials. To solve problems using sound, a model of the system is needed to be designed and tested.](#)

5. **Energy and Matter:** The National Research Council (2012) states “tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations” (p. 84). [Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.](#)

**Teachers have the discretion to enhance the selected SEP’s and CCC’s.*

Prior Knowledge

- 1.P.2A.1 – Light makes objects visible
- 1.P.2A.2 – Light behavior when shined on different objects
- 1.P.2A.5 – Light behavior when shined on a mirror

Subsequent Knowledge

- 8.P.3A.2 – Properties of waves
- 8.P.3A.3 –Behavior of waves
- 8.P.3A.5 – Color is a result of the properties of light waves as they strike an object.
- H.P.3F.1 – Light is made up of particles interacting as a wave
- H.P.3F.2 – Behavior of light waves

Possible Instructional Strategies/Lessons

Strategies and lessons that will enable students to master the standard and/or indicator.

- White Light (See Appendices) This activity allows students to support the claim that white light is made up of different colors.
- Prism (See Appendices) This activity allows students to support the claim that white light is made up of different colors.
- Light Intensity and Distance (See Appendices) This activity allows students to use observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.

- Visibility (See Appendices) This activity allows students to explain how the visibility of an object is related to light.
- Reflection, Refraction, and Absorption (See Appendices) This activity allows students to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.
- Transparent, Translucent, and Opaque (See Appendices) This activity allows students to explain how light behaves when it strikes transparent, translucent, and opaque materials.

Resources

- ROY G BIV (song) This is a song the students can learn to remember the colors of the visible light spectrum. This resource can be found at: <https://youtu.be/Gf33ueRXMzQ>
- How We See This activity is an interactive game that students can play to see how light is reflected using a mirror. This resource can be found at: <http://www.sciencekids.co.nz/gamesactivities/howweseesee.html>
- Investigation: Lesson 4 Bending Light This website gives several activities to use with students about light. This resource can be found at: <http://learning-in-action.williams.edu/opportunities/elementary-outreach/science-lessons/4th-grade-waves-unit/>
- Light in a Straight Line This activity shows how light travels in a straight line. This resource can be found at: <http://www.wikihow.com/Prove-That-Light-Travels-in-a-Straight-Path>
- Light Energy This resource can be adapted to fit the 4th grade light standards. This resource can be found at: https://www.wallingford.k12.ct.us/uploaded/Curriculum/SCIENCE_K-8/SCI GRADE 5/Light_gr 5 curr guide for web w out article all sections.pdf

Sample Formative Assessment Tasks/Questions

Additional sample formative assessment tasks/questions for grade bands are located at the end of each of the SEP Support Doc

(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

- Students will observe how various sources of white light behave when it passes through a prism and construct an argument that supports the idea that white light is made of different colors. They will support their argument with evidence.
- Provide students with different data tables. One showing how the intensity of light changes as the distance of the light source changes and one comparing the intensity of light from varying sources. Students will draw conclusions to determine the optimal conditions for light intensity (distance and light source) citing evidence from the data provided.
- Students will design a room in a fun house that will demonstrate concepts about visible light including the way that light travels and reacts as it strikes objects.

Conceptual Understanding

4.P.4B Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various form of technology.

New Academic Vocabulary

Some students may need extra support with the following academic vocabulary in order to understand what they are being asked to understand and do. Teaching these terms in an instructional context is recommended rather than teaching the words in isolation. A great time to deliver explicit instruction for the terms would be during the modeling process. Ultimately, the student should be able to use the academic vocabulary in conversation with peers and teachers. These terms are pulled from the essential knowledge portion of the Support Doc 2.0 (<http://ed.sc.gov/instruction/standards-learning/science/support-documents-and-resources/>) and further inquiry into the terms can be found there.

Vibration	Pitch	Thickness	Length	Tension
Volume	Force	Distance		

Performance Indicators

Text highlighted below in *orange* and *italicized/underlined* shows connections to SEP's

4.P.4B.1 *Plan and conduct scientific investigations* to test how different variables affect the properties of sound (including pitch and volume).

4. P.4B.2: *Analyze and interpret data* from observations and measurements to describe how change in vibration affects the pitch and volume of sound.

4. P.4B.3: *Define problems* related to the communication of information over a distance and *design devices* or solutions that use sound to solve the problem.

*Science and Engineering Practices

Support for the guidance, overviews of learning progressions, and explicit details of each SEP can found in the Science and Engineering Support Doc

(http://ed.sc.gov/scdoe/assets/File/Instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf). It is important that teachers realize that the nine science and engineering practices are not intended to be used in isolation. Even if a performance indicator for a given standard only lists one of the practices as a performance expectation, scientists and engineers do not use these practices in isolation, but rather as part of an overall sequence of practice. When educators design the learning for their students, it is important that they see how a given performance expectation fits into the broader context of the other science and engineering practices. This will allow teachers to provide comprehensive, authentic learning experiences through which students will develop and demonstrate a deep understanding of scientific concepts.

4S.1A.3 *Plan and conduct scientific investigations* to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

4.S.1A.4 *Analyze and interpret data* from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation.

5.S.1B.1 *Construct devices or design solutions* to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

*Cross Cutting Concepts (<http://www.nap.edu/read/13165/chapter/8>)

The link above provides support from the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) The text in *blue* and *italicized/underlined* below provides a brief explanation of how the specific content ties to the CCC's.

2. *Cause and Effect*: The National Research Council (2012) states that “events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts” (p. 84). *Pitch and volume will change due to the changes in vibration.*

5. **Energy and Matter:** The National Research Council (2012) states “tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations” (p. 84). [Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.](#)

**Teachers have the discretion to enhance the selected SEP’s and CCC’s.*

Prior Knowledge

- N/A

Subsequent Knowledge

- 8.P.3A.2 – Wave properties (frequency, amplitude, wavelength, speed)
- 8.P.3A.6 – Technological instruments extend human senses by transmitting and detecting waves.
- H.P.3D.2 – Resonance
- H.P.3D.3 – Doppler effect
- H.P.3D.4 – Wave properties (including period, velocity, and energy)
- H.P.3F.6 – Waves are used to produce and transmit signals, and store and interpret information in technological devices.

Possible Instructional Strategies/Lessons

- **Properties of Sound** This activity allows students to test how different variables affect the properties of sound (including pitch and volume). This resource can be found at: <http://rpsec.usca.edu/Workshops/SISSI/SISSI3-5AikenAugust2015/lessons/Gr4SoundsLessonSISSI.pdf>
- **Pitch and Frequency** This activity allows students to make observations and measurements to describe how change in vibration affects the pitch and volume of sound. This resource can be found at: https://www.teachengineering.org/activities/view/cub_energy2_lesson05_activity3
- **Pitch and Frequency** This activity allows students to make observations and measurements to describe how change in vibration affects the pitch and volume of sound. This resource can be found at: <http://www.scholastic.com/teachers/lesson-plan/science-sound>
- **Cup A Phone** This activity allows students to define problems related to the communication of information over distances and design devices or solutions that use sound to solve the problem. This resource can be found at: https://www.teachengineering.org/activities/view/cub_sound_lesson02_activity1

Resources

- Sound This website gives several activities to use with students about sound. This resource can be found at: <http://www.kathimitchell.com/sound.htm>
- Experiments on Sound Students have fun experimenting more with sound. This resource can be found at: http://homepage.eircom.net/~kogrango/sound_experiments.html
- Changing Sounds Students learn about changing sounds and music as they experiment with different musical instruments in this fun, interactive activity. This resource can be found at: <http://www.sciencekids.co.nz/gamesactivities/changingsounds.html>
- Sound Vibrations Students learn that sound vibrations can travel through different mediums. This resource can be found at: http://www.pbslearningmedia.org/resource/phy03.sci.phys.howmove.lp_sound/sound-vibrations/
- Understanding Vibration and Pitch This video segment includes sounds that many of us hear every day. This resource can be found at: <http://www.pbslearningmedia.org/resource/phy03.sci.phys.howmove.collage/understanding-vibration-and-pitch/>
- Frequency and Pitch Teacher Resources This is website detailing ideas and activities with a focus on frequency and pitch. This resource can be found at: <http://www.lessonplanet.com/lesson-plans/frequency-and-pitch/all>
- Waves of Sound This is a unit to show students how sound vibrates. This resource can be found at: <https://mysteryscience.com/waves/sound-waves-communication>
- Sound: Listen Up This website gives several activities to use with students about sound. This resource can be found at: <http://pbskids.org/zoom/activities/sci/#sound>

Sample Formative Assessment Tasks/Questions

Additional sample formative assessment tasks/questions for grade bands are located at the end of each of the SEP Support Doc

(http://ed.sc.gov/scdoe/assets/File/instruction/standards/Science/Support%20Documents/Complete_2014SEPsGuide_SupportDoc2_0.pdf)

- Design a device that will create the clearest transmission of sound over a given distance. They should also prepare a persuasive presentation to convince the audience that their device is the best created citing concepts learned throughout the unit.
- Students will create a stringed instrument (using rubber bands, string, or fishing line, etc.). They will design and conduct experiments using their instrument. Students will analyze and draw conclusions about the variable selected (length, tightness, thickness etc.). They will then present their conclusions citing evidence from their data.
- Pitch and Frequency Worksheet: This resource can be found at:
http://content.teachengineering.org/content/cub/_activities/cub_energy2/cub_energy2_lesson05_activity3_worksheet.pdf
- Vibrations, Pitch, Transmitting Sound: This resource can be found at:
<http://www.nsta.org/elementaryschool/connections/201010ActivityQuestionsAndRubric.pdf>

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4th grade- Forms of Energy-Light and Sound

White Light Lesson

Materials:

- White Cardstock
- CD
- Scissors
- String
- Hole punch

Procedures:

1. Trace the outside edge of a CD on a sheet of cardstock.
2. Divide the circle into 6 equal parts.
3. Make a copy for each student.
4. The students will cut the circle out and color each section: red, orange, yellow, green, blue, and violet.
5. Fold the circle in half and use the hole punch to punch a hole near the center edge of the half circle. When you unfold the circle you will have 2 holes.
6. Cut a piece of string about 2 feet long for each student.
7. Put the 2 ends of the string through the 2 holes and tie a knot.
8. Slide the circle to the middle of the string.
9. Have one student hold the string at the ends and another student turn the circle until the string is twisted a lot.
10. Then the student will let go of the circle. The circle will spin and the colors will mix together and look white.

4th grade- Forms of Energy-Light and Sound

White Light and Prism Assessment

The students should use the activity to construct an argument to show white light is made up of colors. The students' arguments should be detailed and based on the evidence from the activities. Give the following sentences starters. White light is made up of _____. I know this because _____.

The following rubric will be used to grade your scientific argument:

	1	2	3	4
Content	Answers are partial or incomplete. Details are not clear. Question not adequately answered.	Answers are not accurate or complete. Details are addressed, but not well supported.	Answers are accurate and complete. Details are stated and supported.	Answers are accurate, and complete. Details are clearly stated, explained and well supported.
Organization	Organization and structure detract from the answer.	Inadequate organization or development. Structure of the answer is not easy to follow.	Organization is mostly clear and easy to follow.	Well organized, coherently developed, and easy to follow.

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators

4.P.4A.1 [Construct scientific arguments](#) to support the claim that white light is made up of different colors.

Science and Engineering Practices

4.S.1A.7 [Construct scientific arguments](#) to support claims, explanations, or designs using evidence from observations, data, or informational texts.

Cross Cutting Concepts:

5. [Energy and Matter](#): The National Research Council (2012) states "tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations" (p. 84). [Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.](#)

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4th grade- Forms of Energy-Light and Sound

Prism Activity

Materials:

- Prisms for students to use
- A window where a lot of light comes in

Procedures:

1. Give each pair of students a prism.
2. Let the students use the prism to try to bend the light coming in the window.
3. When the students have successfully formed a rainbow on a wall in the classroom, have them draw what they see.

White Light and Prism Assessment

The students should use the activity to construct an argument to show white light is made up of colors. The students' arguments should be detailed and based on the evidence from the activities. Give the following sentences starters. White light is made up of _____. I know this because _____.

The following rubric will be used to grade your scientific argument:

	1	2	3	4
Content	Answers are partial or incomplete. Details are not clear. Question not adequately answered.	Answers are not accurate or complete. Details are addressed, but not well supported.	Answers are accurate and complete. Details are stated and supported.	Answers are accurate, and complete. Details are clearly stated, explained and well supported.
Organization	Organization and structure detract from the answer.	Inadequate organization or development. Structure of the answer is not easy to follow.	Organization is mostly clear and easy to follow.	Well organized, coherently developed, and easy to follow.

4th grade- Forms of Energy-Light and Sound

Prism Activity

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators

4.P.4A.1 *Construct scientific arguments* to support the claim that white light is made up of different colors.

Science and Engineering Practices

4S.1A.3 *Plan and conduct scientific investigations* to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

Cross Cutting Concepts

5. *Energy and Matter*: The National Research Council (2012) states "tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations" (p. 84). *Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.*

References

South Carolina Department of Education. (2015). South Carolina Academic Standards and Performance Indicators for Science 2014. Retrieved from http://ed.sc.gov/scdoe/assets/file/agency/ccr/StandardsLearning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

4th grade- Forms of Energy-Light and Sound

Light Intensity and Distance

Materials:

- Small flashlight
- New batteries
- 1 sheet of graph paper
- Meter stick
- Heavy books
- Tape
- Notebook
- Pencil

Procedures:

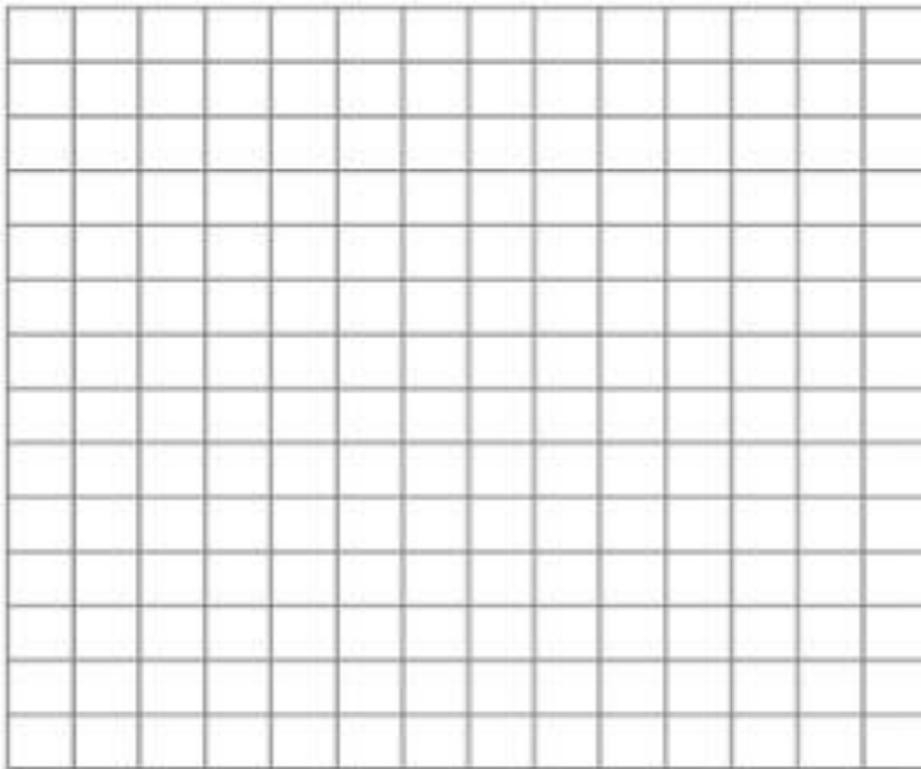
1. Tape 1 sheet of graph paper close to the ground on the wall.
2. Put new batteries into the flashlight.
3. Make a stack of heavy books and place the flashlight on top of the books. It should be the height do the light hits the middle of the graph paper.
4. Turn off the lights.
5. Measure the area the light covered by counting the squares on the graph paper.
6. Move the light source back at $\frac{1}{2}$ meter increments and repeat the steps.
7. Leave the flashlight on for 1 hour and repeat the steps.

4th grade- Forms of Energy-Light and Sound

Light Intensity and Distance Assessment

Make a line graph showing the results of the number of squares the light covered on the graph paper from the flashlight.

Distance from the graph paper	Number of Squares Covered



As the light source moves away from the wall, the number of squares lit by the light (increases/decreases).

4th grade- Forms of Energy-Light and Sound

Light Intensity and Distance

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators

4.P.4A.2 *Analyze and interpret data* from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.

Science and Engineering Practices:

4.S.1A.4 *Analyze and interpret data* from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation)

Cross Cutting Concepts:

3. *Scale, Proportion, and Quantity*: The National Research Council (2012) states "In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance" (p. 84). *The distance from the light source such as the sun and intensity will affect the apparent brightness of the light.*

5. *Energy and Matter*: The National Research Council (2012) states "tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations" (p. 84). *Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.*

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Bjornsson, E. (2013). Light Intensity and Distance. Retrieved from <http://www.education.com/science-fair/article/relationship-between-distance-light-intensity/>

South Carolina Department of Education. (2015). South Carolina Academic Standards and Performance Indicators for Science 2014. Retrieved from http://ed.sc.gov/scdoe/assets/file/agency/ccr/StandardsLearning/documents/South_Carolina_Academic_Standards_and_Performance_Indicators_for_Science_2014.pdf

4th grade- Forms of Energy-Light and Sound

Visibility

Materials:

- 1 pen light
- 2 mirrors
- 2 binder clips
- 1 object to use as a target

Procedures:

1. Take all of the students into a room with no windows. Turn off the lights and ask students, “What do you see?”
2. Turn the lights back on and ask the same question.
3. Ask the student, “Why do you think you can see all the objects in the room when the lights are on?”
4. Next list all of the sources of light students can think of (sun, flashlight, candle, moon, ect.)
5. Discuss with students why we can see the moon. Reflection is a way for an object to give off light.
6. Divide the class into groups.
7. Give each group the materials listed above.
8. Ask the students to place the target object on the table and use 1 mirror to try to reflect the light from the pen light on the object.
9. After the groups complete the activity with 1 mirror, have them try it with 2 mirrors.

4th grade- Forms of Energy-Light and Sound

Visibility Assessment

Write an email to your friend who is planning to go to the beach at night with you to catch ghost crabs. In the email you need to ask your friend to bring a flashlight and explain why it will be needed. Your explanation should include the words light source, visibility, and reflection. Make sure your email gives detailed information, so your friend has a clear idea of how visibility of an object is related to light.

The following rubric will be used to grade your email:

	1	2	3	4
Content	Answers are partial or incomplete. Details are not clear. Question not adequately answered.	Answers are not accurate or complete. Details are addressed, but not well supported.	Answers are accurate and complete. Details are stated and supported.	Answers are accurate, and complete. Details are clearly stated, explained and well supported.
Organization	Organization and structure detract from the answer.	Inadequate organization or development. Structure of the answer is not easy to follow.	Organization is mostly clear and easy to follow.	Well organized, coherently developed, and easy to follow.

4th grade- Forms of Energy-Light and Sound

Visibility

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators

4.P.4A.3 *Obtain and communicate* information to explain how the visibility of an object is related to light.

Science and Engineering Practices

4.S.1A.8 *Obtain and evaluate* informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language. n or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.

Cross Cutting Concepts

4. **Systems and System Models:** The National Research Council (2012) states “defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering” (p.84). *Models are used to show how light behaves when it strikes different objects made of different materials. To solve problems using sound a model of the system are needed to be designed and tested.*

5. **Energy and Matter:** The National Research Council (2012) states “tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations” (p. 84). *Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.*

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4th grade- Forms of Energy-Light and Sound

Reflection, Refraction, and Absorption

Materials:

- 1 laser pointer
- Chalk dust or powder
- 8 X 10 Piece of glass
- 2 candles
- Matches
- Modeling clay
- Rectangular table
- Mirror for each group
- Binder clip for each group
- Pen light for each group
- Piece of white paper for each group
- Clear plastic cup for each group
- Water
- Pencil for each group
- An index card covered with black material for each group
- An index card covered in aluminum foil for each group
- Gummy bears of different colors for each group

Procedures:

1. Use a laser pointer and focus on a point on a wall. Sprinkle chalk dust or powder in the path of the laser so student can see the light travels in a straight line.
2. Attach modeling clay to the bottom of the glass to get it to stand up in the middle of the table. Also put clay on the bottom of 2 candles that are the same size and color. Place 1 of the candle a foot behind the glass and the other a foot in front of the glass. Make sure the candles are in a straight line with each other. Light the candle in front of the glass. Have the students look through the glass and the candle in the back will look like it is lit. This will also show how light travels in a straight line.
3. Have the students look around the room to see what type of objects show their reflection. Look for patterns in those objects to see what is similar in each.
4. Divide the class into groups and give each group a mirror, binder clip, pen light, and piece of white paper.
5. Have the students place the mirror in the binder clip and put it on the piece of white paper. Shine the penlight on the mirror and have the students trace the light hitting the mirror and where it bounces back.

4th grade- Forms of Energy-Light and Sound

Reflection, Refraction, and Absorption

6. Give each group a clear plastic cup filled $\frac{2}{3}$ with water. Have the students place a pencil in the water. They will observe the cup at eye level and draw a model of what they see. This activity will show how light bends or refracts.
7. Have each group point a pen light at the index card covered with aluminum foil and they will see a lot of the light reflects. Now have them shine the pen light on the card covered with black material. They will compare how much light reflects compared to the first card. Students should see that most of the light is absorbed in the card with the black material.
8. Have the students use a pen light to shine through a red gummy bear. They will notice only the red light will pass through all the other colors are absorbed. Next try it with a green gummy bear. Only green light will be reflected. They can continue the activity with the remaining gummy bears.

4th grade- Forms of Energy-Light and Sound

Reflection, Refraction, and Absorption Assessment

4.P.4A.4 Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

1. Draw a model and explain how light is reflected when it hits a shiny, smooth surface.

2. Draw a model and explain how light is refracted when it passes through a transparent object.

4th grade- Forms of Energy-Light and Sound

Reflection, Refraction, and Absorption Assessment

3. Draw a model and explain why a red object looks red.

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators:

4.P.4A.4 *Develop and use models* to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

Science and Engineering Practices

4.S.1A.2 *Develop, use, and refine models* to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

Cross Cutting Concepts

4. *Systems and System Models*: The National Research Council (2012) states “defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering” (p.84). *Models are used to show how light behaves when it strikes different objects made of different materials. To solve problems using sound a model of the system are needed to be designed and tested.*

5. *Energy and Matter*: The National Research Council (2012) states “tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations” (p. 84). *Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.*

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4th grade- Forms of Energy-Light and Sound

Transparent, Translucent, and Opaque

Materials:

- Plastic wrap
- Plastic water bottle
- Water in clear plastic cup
- Tissue paper
- Waxed paper
- Sheet of white paper
- Aluminum foil
- Cardboard
- Styrofoam cup
- flashlight

Procedures:

1. The students should write the focus question for the lesson in their notebooks. “How does light behave when it strikes a transparent, translucent, and opaque material?”
2. Pass out all of the materials to the groups except the flashlights.
3. Give students time to talk with their group members to predict what will happen when light shines through the various materials. They should write their predictions in their notebook.
4. Now pass out the flashlights.
5. The students should now test the materials to see what happens. They should be making qualitative observations and adding them in their notebooks.
6. The students should also make drawing of what happens to the light when you hold the object up to the flashlight.
7. Next have the students sort the materials into groups of transparent, translucent, and opaque objects.
8. Have a classroom discussion on their findings and make sure the students are in agreement of what items are transparent, translucent, and opaque.
9. The students should now answer the focus question in their notebooks.
10. Check their answers to make sure they have a clear understanding.

4th grade- Forms of Energy-Light and Sound

Transparent, Translucent, and Opaque Assessment

Answer the focus question and explain what you did in the investigation to come to your conclusion.

“How does light behave when it strikes a transparent, translucent, and opaque material?”

Standard

4.P.4 The student will demonstrate an understanding of the properties of light and sound as forms of energy.

Conceptual Understanding

4.P.4A Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object’s properties.

Performance Indicators

4.P.4A.5 [Plan and conduct scientific investigations](#) to explain how light behaves when it strikes transparent, translucent, and opaque materials.

Science and Engineering Practices

4S.1A.3 [Plan and conduct scientific investigations](#) to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

Cross Cutting Concepts

1. **Patterns:** The National Research Council (2012) states “observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them” (p. 84). [Similarities and differences can be found in objects that are either transparent, translucent, or opaque.](#)
5. **Energy and Matter:** The National Research Council (2012) states “tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations” (p. 84). [Light and sound are both forms of energy that behave in different ways depending on the variables that are involved.](#)

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