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### Georgia Performance Standards Framework for Science – Grade 4

#### **Light and Sound Unit:** **(6 weeks)**

**OVERVIEW:** This unit is based on student observation of light and sound. They will use various tools to bend, reflect, and separate colors in light. They will investigate sound by making homemade instruments and changing pitch by varying the vibrations. This basic foundation will lay the groundwork for the study of waves in middle grades and high school.

#### **STANDARDS ADDRESSED IN THIS UNIT**

Focus Standards:

**S4P1 Students will investigate the nature of light using tools such as mirrors, lenses, and prisms.**

- a. Identify materials that are transparent, opaque, and translucent.
- b. Investigate the reflection of light using a mirror and a light source.
- c. Identify the physical attributes of a convex lens, a concave lens, and a prism and where each is used.

**S4P2 Students will demonstrate how sound is produced by vibrating objects and how can be varied by changing the rate of vibration.**

- a. Investigate how sound is produced.
- b. Recognize the conditions that cause pitch to vary.

#### **RELATED STANDARDS ADDRESSED IN THIS UNIT**

##### **Habits of the Mind**

**S5CS2. Students will have the computation and estimation skills necessary for analyzing data and following scientific explanations.**

- a. Add, subtract, multiply, and divide whole numbers mentally, on paper, and with a calculator.
- b. Use fractions and decimals, and translate between decimals and commonly encountered fractions – halves, thirds, fourths, fifths, tenths, and hundredths (but not sixths, sevenths, and so on) – in scientific calculations.
- c. Judge whether measurements and computations of quantities, such as length, area, volume, weight, or time, are reasonable answers to scientific problems by comparing them to typical values.

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**S5CS3. Students will use tools and instruments for observing, measuring, and manipulating objects in scientific activities.**

- a. Choose appropriate common materials for making simple mechanical constructions and repairing things.
- b. Measure and mix dry and liquid materials in prescribed amounts, exercising reasonable safety.
- c. Use computers, cameras and recording devices for capturing information.
- d. Identify and practice accepted safety procedures in manipulating science materials and equipment.

**S5CS4. Students will use ideas of system, model, change, and scale in exploring scientific and technological matters.**

- a. Observe and describe how parts influence one another in things with many parts.
- b. Use geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps, and stories to represent corresponding features of objects, events, and processes in the real world. Identify ways in which the representations do not match their original counterparts.
- c. Identify patterns of change in things—such as steady, repetitive, or irregular change—using records, tables, or graphs of measurements where appropriate.
- d. Identify the biggest and the smallest possible values of something.

**S5CS5. Students will communicate scientific ideas and activities clearly.**

- a. Write instructions that others can follow in carrying out a scientific procedure.
- b. Make sketches to aid in explaining scientific procedures or ideas.
- c. Use numerical data in describing and comparing objects and events.
- d. Locate scientific information in reference books, back issues of newspapers and magazines, CD-ROMs, and computer databases.

**S5CS6. Students will question scientific claims and arguments effectively.**

- a. Support statements with facts found in books, articles, and databases, and identify the sources used.
- b. Identify when comparisons might not be fair because some conditions are different.

**The Nature of Science**

**S5CS7. Students will be familiar with the character of scientific knowledge and how it is achieved.**

Students will recognize that:

- a. Similar scientific investigations seldom produce exactly the same results, which may differ due to unexpected differences in whatever is

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- being investigated, unrecognized differences in the methods or circumstances of the investigation, or observational uncertainties.
- b. Some scientific knowledge is very old and yet is still applicable today.

### **S5CS8. Students will understand important features of the process of scientific inquiry.**

Students will apply the following to inquiry learning practices:

- a. Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments.
- b. Clear and active communication is an essential part of doing science. It enables scientists to inform others about their work, expose their ideas to criticism by other scientists, and stay informed about scientific discoveries around the world.
- c. Scientists use technology to increase their power to observe things and to measure and compare things accurately.
- d. Science involves many different kinds of work and engages men and women of all ages and backgrounds.

### **ENDURING UNDERSTANDINGS**

- Light is a form of energy and light rays normally travel in straight lines.
- Light can reflect (bounce) off some objects like mirrors, refract (bend) through some objects like lenses, and be absorbed by some objects like soil.
- Some objects allow all the light to travel through them (transparent), some allow some of the light to travel through (translucent), and others prevent light from traveling through them (opaque).
- Lenses are used to bend light in useful ways. Convex lenses cause light to converge (bend in) after light passes through them and concave lenses cause light to diverge (bend out) after light passes through them. Lenses are used in many important tools such as microscopes, telescope, binoculars, and cameras.
- A prism bends light into different parts. Prisms can separate white light into the different colors that make it up because each color of light bends differently when it passes through a prism.
- Sound is produced by vibrating objects
- Vibrating objects produce sound waves that travel through the air (and other substances).
- The faster an object vibrates the more sound waves it produces per second and the higher the pitch of the sound.

### **ESSENTIAL QUESTIONS**

- What are the characteristics of light and how does it normally behave?
- How can we describe the movement of light as it passes through different substances?

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<ul style="list-style-type: none"> <li>• How do lenses bend light in specific ways in order to do accomplish useful jobs?</li> <li>• How to different organisms and objects vibrate in order to produce sounds?</li> <li>• What is the relationship between the speed at which an object vibrates and the pitch of the sound that is produced?</li> </ul>	
<b>MISCONCEPTIONS</b>	<b>PROPER CONCEPTIONS</b>
<p>With respect to their understanding of light, students often associate it only with a source and they tend to consider only the instantaneous effects of light. Light sources are often considered only in respect to the objects or areas that they illuminate. There is frequently no recognition that light must move - between the source, the object, and the observer’s eye. As students experiment with mirrors, lenses, and prisms, their understandings of light can gain depth.</p> <p>Students often assume that sounds can be produced with using any material objects. They frequently believe that the sounds of the human voice are produced by a large number of vocal chords, each producing their own distinct sounds. Finally, they may think that you can alter the pitch of a sound by hitting the vibrating object harder or softer. As students, experiment with tuning forks, rubber band guitars, drums, and other instruments, their understanding of sound deepens.</p>	<p>Light and sound are both forms of energy. Light rays normally travel in straight lines and they can reflect (bounce) off some objects, refract (bend) through some, and be absorbed by others. Some objects allow all the light that hits them to travel through them (transparent); some allow some of the light to travel through (translucent), while others prevent any light from traveling through them (opaque). Lenses are used in tools such as microscopes, telescope, binoculars, and cameras. They bend light in useful ways. Convex lenses cause light to converge after light passes through them while concave lenses cause light to diverge after light passes through them. Prisms can separate white light into the different colors that make it up because each color of light bends differently when it passes through a prism.</p> <p>Sound is produced by vibrating objects. As an object vibrates, it produces sound waves that travel through the air (and other substances). The faster an object vibrates the more sound waves it produces per second and the higher the pitch of the sound.</p>
<b>LANGUAGE</b>	
<p>Light, transparent, translucent, opaque, reflection, refraction, convex lens, concave lens, prism, spectrum, color, ROY G BIV, rainbow, vibration, sound wave, pitch, loud, soft.</p>	

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**EVIDENCE OF LEARNING**

**By the conclusion of this unit, students should be able to demonstrate the following competencies:**

**Culminating Activity for Light:**

**GRASPS**

**Goal:** You are explaining the many ways light can maneuver using various tools.

**Role:** You are a member of the Light Transportation System.

**Audience:** A multimedia display of the different ways light can change with the use of lenses, mirrors, and various materials.

**Scenario:** Create a display to show how light bends with different lenses, how light is reflected off of shiny surfaces, and how light can go through some materials and not others.

**Product:** The display will explain

- How light bends when using a convex or concave lens and where each are used in society.
- How light is reflected using various materials, a light source such as sunlight or flashlight and the characteristics of materials that reflect light.
- How light is reflected using a mirror and block letters, numbers, and symbols such as heart, triangle, etc. Show how lines of symmetry are found by placing the mirror in the middle horizontally, vertically, and diagonally on various letters, numbers, and symbols.
- How light is broken up into a spectrum using a prism.

**Culminating Activity for Sound:**

**GRASPS**

**Goal:** You are demonstrating how vibration produces sound and how pitch varies according to vibrations.

**Role:** You are producing a sound recording of various objects that make sound by vibration.

**Audience:** The recordings will be compiled into a class CD and archived in the media center.

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**Scenario:** You have received a grant to produce a recording of objects found in the classroom that make various sounds when vibrated. You will write a narrative explaining the regular function of the object and how you discovered its sound potential. The recording will explain the object, how it makes sound, and how you are able to vary its sound.

**Product:** Give your portion of the CD a catchy title. After each group has recorded the various objects and their sounds, combine various groups of objects together to create a class musical.

Teacher Hint: You may wish to acquaint students with percussion musical productions such as STOMP.