1st Grade
Light and Sound

Teaching the Science and Engineering Education (SEEd) Standards

UVU College of Engineering & Technology
UTAH VALLEY UNIVERSITY

UVU CREATIVE LEARNING STUDIO

UVU School of EDUCATION
UTAH VALLEY UNIVERSITY

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SEEd Strand 1.3: Light and Sound

Sound can make matter vibrate, and vibrating matter can make sound. Objects can only be seen when light is available to illuminate them. Some objects five off their own light. Some materials allow light to pass through them, others allow only some light to pass through them, and still others block light and create a dark shadow on the surface beyond them where the light cannot reach. Mirrors can be used to redirect light. People use a variety of devices that may include sound and light to communicate over long distances

Standard 1.3.1 Plan and carry out an investigation to show the cause and effect relationship between sound and vibrating matter. Emphasize that vibrating matter can make sound and that sound can make matter vibrate. (PS4.A)

Standard 1.3.2 Use a model to show the effect of light on objects. Emphasize that objects can be seen when light is available to illuminate them or if they give off their own light. (PS4.B)

Standard 1.3.3 Plan and carry out an investigation to determine the effect of materials in the path of a beam of light. Emphasize that light can travel through some materials, can be reflected off some materials, and some materials block light causing shadows. Examples of materials could include clear plastic, wax paper, cardboard, or a mirror. (PS4.B)

Standard 1.3.4 Design a device in which the structure of the device uses light or sound to solve the problem of communicating over a distance. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs.* Examples of devices could include a light source to send signals, paper-cup-and-string telephones, or a pattern of drum beats. (PS4.C, ETS1.A, ETS1.B, ETS1.C)

1.3.1 - Good Vibrations

Grade: 1st **Time:** 30 -45 minutes

Lesson Topic: Sound and vibrations

Utah SEEd Standard:

Standard 1.3.1 Plan and carry out an investigation to show the cause and effect relationship between sound and vibrating matter. Emphasize that vibrating matter can make sound and that sound can make matter vibrate.

Lesson Performance Expectations:

- Obtain information through experiments about how sound causes items to vibrate.
- Use a model to show sound moving causing different objects to vibrate.

Phenomenon: I can sometimes feel different levels of sounds.

Gather

1. Students develop questions that guide a planned investigation inorder to gather evidence on how sound causes different materials to vibrate.

Class Discussion

2. Students plan and carry out their investigations to collect data on how vibrating materials can make sound and how sound can cause materials to vibrate.
3. Students gain information from reading information (reading is in appendix B) on how sound causes things to vibrate.

Reason

4. Students analyze data they got through their investigation to find patterns that can be used as evidence on how sound causes materials to vibrate.
5. Students will construct an explanation on how sounds can cause objects to vibrate.

Class Discussion:

Questions to initiate Discussion:

Q: What is sound?

Q: How do we hear a sound?

Q: How does putting more energy (how hard you hit the drum) into hitting the drum affect the sound?

Q: What caused things to move/vibrate?

Q: Was there a pattern in you hitting the drum and the movement of the object? What was it?

Q: What does it mean for things to vibrate?

Q: Why does it make you want to move that way?

Consider showing the What is sound? video located below in appendix B. *(vibrating matter can make sound and that sound can make matter vibrate)*
Communicate Reasoning 6. Students use a model to show sound moving causing different objects to vibrate.

Science and Engineering Practices Asking questions Planning and Carrying out investigations Developing Models	Develop questions to form an investigation to gain information. Use/make a model to show the sound vibration. Make observations from the investigations to gather evidence for the causes of phenomena.
Crosscutting Concepts Cause and Effect Patterns	Identify then describe the causes of phenomena. Use patterns seen/heard to make predictions. Explain and discuss why a specific order of events is necessary to cause some phenomena to occur.
Disciplinary Core Ideas Waves	Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

Lesson adapted from: Good Vibrations

Appendix A - Student Prompts for the Lesson

Phenomenon: I can sometimes feel different levels of sounds.

Group Performances:

1. What questions can we form that would help us investigate how sound causes things to vibrate.

***Class* Discussion - About Questions to Investigate**

2. Investigate how sound can cause things to vibrate and how vibrations cause sound.
3. Get information through reading about sound causing things to vibrate.
4. Make observations during the experiment to get evidence that sound causes things to vibrate.
5. Construct an explanation for how sound causes things to vibrate.

Class Discussion

Individual Performances:

6. Use a model to show sound moving from the drum and causing the sequins in the bowl to vibrate.

Lesson Steps:

1. *Introduce the phenomenon "sometimes I can feel sound" by having students clap their hands, loud medium soft, what do you hear? What do you feel? Have them repeat this process while putting their hands on their throats (having students talk, loud medium soft, what do you hear? What do you feel?). Emphasize that engineers experiment with sounds and how they are created to know how to build some of their creations, etc. Discuss the following vocabulary words:*
    a. ***Sound:*** *Vibrations that you can hear*
    b. ***Vibrate:*** *Something you can feel that moves*
2. *Use the hand bells provided to show students what causes sound-the vibration moves and reaches your ears causing sound. You can show them the bell as it moves back and forth when it rings. Show them a few different bells as they ring and have them observe the vibration.*
    a. *Hold your hand on the bell to show what happens. What do they observe? Why didn't you hear anything when you held onto the bell? (the vibration is stopped by the hand)*
3. *Students will perform an investigation. Split them into pairs.*
    a. *Each pair will receive a hand drum and sequins.*
    b. *Let the students play with the drums for a minute, emphasise beforehand how to properly handle drums. Ask the students if they can see anything happening when the drum is struck.*
    c. *They will place the sequins on the drum and bang the drum in different ways (hard, soft, etc.) to observe what happens to the sequins.*
4. *After the students have observed and experimented with the drums and sequins, discuss as a class their observations and what they learned. Questions to initiate discussion can be found above in the "Reason" section. Emphasize with the class that because of the vibration that they can see, we are able to hear the sound of the drum.*
5. *Students will draw a picture to explain why the sequins moved on the drum and why this caused sound. This should be a simple drawing to show the movement of the vibrations from hitting the drum causes the sequins to move.*

Appendix B - Reading for Teacher or Parent to Read to Students Video and Materials list

Sound can cause things to vibrate *(discuss this word before moving on)*. Have you ever been close to a speaker and felt the sound? Yes! But can you see the sound?

A sound is a form of energy that travels in invisible waves through the air. Most of the sounds we hear have traveled to us through the air. Sound travels into our ear and our ear sends a message to our brain, and our brain knows how to recognize the sound. For example, if I ring a bell the waves travel through the air to your ear. If I speak, the sound of my voice travels through the air, but you know the difference between a bell and my voice. If I ring a big bell *or a little bell you know the difference. Both sounds travel the same way but sound different when we hear them.

*note the bells we have are all the same size but you can still facilitate this by ringing the bells c/1 and b/7 the red and purple bells.

(Stop at this point in the reading, ring two bells of different sizes, then hide the bells and ask students to identify which bell is ringing. Then have students act out the movement of vibrations from one place to another. Line students up and hold hands - then have one end send a wave through their hands.)

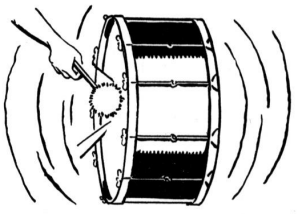
Sound can travel through different objects like water, wood, and metal and make other objects move. When sound waves strike an object, it can cause the object to vibrate. For example, when we hit the drum, the drum vibrates and makes little light things move. Objects like threads, sequins, salt crystals, or dust are caused to dance or move by sound.

Video: *What is sound?*

Student Reading

Sound

Sound causes things to vibrate. Sound causes air to vibrate.
Sound is made up of waves that move energy.
Sound waves can cause things to vibrate.
Vibrating things can cause a sound.



Materials Needed:

Provided Materials:

- Sequins
- Hand drums and sticks
- Bells of different sizes

- Boom Whackers

Classroom materials:

- Paper
- Pencils

Boom Whackers Procedures
Hand Bell Procedures
Drum Procedures

1.3.1 - Make a Splash and Musical Ruler

Grade: 1st grade **Time:** 2 days 30 minutes each

Lesson Topic: Sound and Vibrations

Utah SEEd Standard:
Standard 1.3.1 Plan and carry out an investigation to show the cause and effect relationship between sound and vibrating matter. Emphasize that vibrating matter can make sound and that sound can make matter Vibrate.

Lesson Performance Expectations:

- Conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
- Students will observe simple objects, patterns and events and report their observations in a simple graph.

Phenomenon: *Sound can make matter move.*

Gather

1. Students will experiment with a musical tool called a tuning fork.
2. Students will practice using tuning forks and rulers in an appropriate way.
3. Students will observe patterns as they strike tuning forks and place them in water.
4. Students will make observations about the difference in sounds when the ruler is extended.

Reason

5. Students will elaborate as they compare their observations with a classmate.
6. Students evaluate information by participating in a class discussion.

Class Discussion:
Questions to initiate " Make a splash"Discussion:
Q:What did you observe when you would put a tuning fork in the bowl of water?
Q: Are there some similarities that you noticed with the different tuning forks in the water? What are they?
Q: Are there some differences that you noticed with the different tuning forks in the water? What are they?
Q: Did you think there were changes between the tuning forks? Was there?
Q: How does the tuning fork make sound and cause water to splash?
Q: What conclusions can you make about this exploration?

Questions to initiate " Musical Ruler" Discussion:
Q: What did you observe each time you moved the ruler?
Q: Were there any similarities in sound that you noticed? What were they?
Q: Were there any differences in sound that you noticed? What were they?
Q: Why do you think there were changes in sound/vibration each time you moved the ruler?
Q: What conclusions can you make about this exploration?

Communicate Reasoning
6. Students communicate why the observations they gathered in the investigation are evidence that objects vibrating causes sound and sound can cause things to vibrate.
7. Students will fill out a graphic organizer throughout the lesson to evaluate their thinking.

Science and Engineering Practices	Use the model given to observe sound vibrations Make observations to gather evidence Gather information from investigations to form explanations
Asking Questions and defining problems Constructing Explanations	
Crosscutting Concepts	Identify and describe the cause of sound and water splashing Observe patterns you noticed during explorations
Patterns Cause and effect	
Disciplinary Core Ideas	Sound can make matter vibrate, and vibrating matter can make sound.(1-PS4-1)
Waves	

Lesson Adapted from: Light and sound

Appendix A - Student Prompts for the Lesson

Phenomenon: *Sound can cause matter to move.*

Group Performances:

1. investigate how sound can cause things to vibrate.
2. Make observations to get evidence that sound causes things to vibrate.
3. Use a model to show that sound causes things to vibrate

Class Discussion

Individual Performances:

4. Construct an explanation for how sound causes things to vibrate.

Lesson Steps:

1. *Introduce the lesson by reviewing concepts from the previous lesson, Sound, vibration, sound can make things move. Have students feel their throat again if they need a reminder. Have the students comment on how they think lower sounds travel/vibrate and how higher sounds travel/vibrate. Emphasize that engineers experiment with sounds and vibrations and need to know about the science behind it for the creations they make, etc. Review the following vocabulary words.*
    a. ***Sound:*** *vibrations that you can hear*
    b. ***Vibrate:*** *Something you can feel that moves*
2. *Show a tuning fork, demonstrate hitting it with the mallet on the side of the table or on the floor (Gently!). Make sure that you hold the tuning fork at the bottom of the lesson. Ask the students what they can hear and if they can see anything. (answer should be no). Ask them how they saw the sound moving in the previous lesson, explain that they are going to see sound move again today.*
3. *Split students into groups of 2-3 pass out tuning forks after giving and demonstrating instructions on how to use them. Let the students experiment with the forks.*
    a. *Have each student hit the tuning fork and hold it by their ears, ask the students what they notice. (vibration should make a buzzing sound by their ears.)*

Make A Splash Activity:

4. *Put the bowl or cup of water on a surface where students will be able to make observations. With one of the tuning forks, hit it so it vibrates. Quickly put it in the water and observe what it does. Model this action a couple of times and then let the students try it out in their groups. After a couple of minutes have the students switch tuning forks with someone who has a different size or try using a cup and repeat this experiment. How far did the water splash? Using the Making a Splash (student journal page) observe patterns, cause and effect and record observations. The longer forks you can place closer to your ear to hear the vibration.*
5. *Class discussion - have the students share what they observed from the experiment, relate them to the discussion questions found above.*
6. *Have students draw a picture detailing what happened, what made the water move?*

Teaching suggestions - for the demonstration you can place a colored piece of paper underneath the bowl to help students see what is happening. To challenge students, have them put an object that floats such as a paperclip in the cup and watch what happens as the vibrations move the water.

Day 2

7. *Start with a quick review of the activity from the previous day. Madel the next step for the students.*

Musical Ruler:

8. *Using a 12 inch plastic ruler, observe the difference in the sounds when the ruler is extended over the table at different lengths. Put the ruler at the edge of the table so half of it hangs over the edge. Hold the ruler down with the palm of one hand on the table. With your other hand push the end of the ruler down and let it go. Observe the vibrations of your ruler and the sound it makes. Draw a picture of what happened when the ruler was long, and when it was short, or when they could hear the sound the best.*
9. *Group discussion should focus on how sound can make matter vibrate, and vibrating matter can make sound. Talk about the vibrations. Define what a vibration is. Compare your observations with a classmate. Whole group discussion to determine if students have understood the concept that vibrations cause sound waves that our ears convert into noise or voices. Use attached discussion questions to lead and review the similarities and differences that were observed with each experiment.*
10. *After the discussion students should record in their science journals that vibrating objects make sound and that sound causes things to vibrate. They can use pictures or words to help them make their explanation.*

Appendix B - Phenomenon video, discussion questions list, Journal pages, and materials list.

Discussion Questions- pg. 15

Making a splash Journal page- pg. 16

Musical Ruler journal page - pg. 17

Materials:

Provided Materials:

- Tuning forks
- Plastic reusable cups
- Large plastic bowl
- 12 in plastic rulers

Classroom Materials:

- Water
- Paper Towels (to clean up spilled water)
- Paper clips (if needed)
- Colored paper (if needed)
- Student journal pages (Print)

Tuning fork Procedures

1.3.2 - In the Dark

Grade: 1st **Time:** 35 minutes

Lesson Topic: Light

Utah SEEd Standard:
Standard 1.3.2 Use a model to show the effect of light on objects. Emphasize that objects can be seen when light is available to illuminate them or if they give off their own light. (PS4.B)

Lesson Performance Expectations:

- Students observe objects in the dark to determine how light causes the object to be visible.
- Students explain verbally that light causes an object to be visible.

Phenomenon: *In a very dark place I cannot see my hand in front of me.*

Gather

1. Students observe objects in the dark to determine how light causes the object to be visible.
2. Students investigate looking at paper of various colors in a darkened room and lighted room to describe what causes the colors to be different.
3. Students explore with colored paper down a long dark box or tube or in a dark room.

Reason

4. Students discuss their findings related to the paths of light.
5. Students obtain information about how light causes us to see.
6. Students develop a model to show the path of light and that light causes objects to be visible.

Class Discussion:
Questions to initiate Discussion:
Q: Where did the light come from?
Q: Why do you shine a flashlight on something?
Q: Why were parts of the video completely dark?
Q: Why can we only see things when there is light?
Q: What caused objects to be seen only when the light was shining on them?
Q: Why does the object look like they are a different color in the dark?

Read the book All About Light aloud to the class.

Communicate Reasoning

1. Students construct an explanation that light causes an object to be visible and communicate it verbally and with assistance from the teacher. *record the explanation.*

(Teaching Suggestions: The teacher writes down student responses in her journal. The students copy it in their journal.)

Science and Engineering Practices	Use representations to describe phenomena. Explain science observations using evidence.
Developing and using models Constructing explanations	
Crosscutting Concepts	Describe the conditions necessary for visibility to occur.
Cause and effect	
Disciplinary Core Ideas	Objects can be seen if the light is available to illuminate them or if they give off their own light.
PS4B: Electromagnetic Radiation	

Lesson Adapted from: Light and Sound

Appendix A - Student Prompts for the Lesson

Phenomenon: In a very dark room I cannot see my hand in front of me.

Group Performances:

1. Observe things in the dark and then with the light on to see what ***causes*** things to be visible.
2. Investigate how colors look different in the dark and in the light.

Class Discussion

3. Develop a model to show the path of light bouncing off the things we see.

Individual Performances: Speaking

4. Construct an explanation for why light is needed to see things.

Lesson Steps:

1. *Start the lesson by introducing the phenomenon, it's hard to see when it's dark. Ask the students if they have ever been in a really dark room, like if they wake up in the middle of the night. Are they able to see easily? Discuss this briefly as a class. Emphasize that engineers work to solve problems, such as seeing easier in a dark place. Review the vocab words:*
    a. ***Light:*** *something that makes things visible*
    b. ***Iris:*** *The black part of your eyes*
    c. ***Dark:*** *the absence of light*
2. *Parts of the all about light book could be shared before the investigation is done to help the students understand the concept.*
3. *Show the video* [*How the Human eye works*]

After the video: Extension Activity - Observing the Iris at Work

1. *Have the students get into pairs and face each other.*
2. *Tell them to stare at each other's eyes.*
3. *Turn the lights off for a minute.*
4. *Turn the lights back on.*
5. *Repeat several times.*
6. *Discuss:*

   Why do you think the iris is moving?
   What do you think the iris does when you go into a dark room or cave?
   Why is it opening when it is dark?
   What do you think the iris does when you go outside on a sunny day?
   Why is it closing when it is sunny?
4. *Complete the investigation:*
    a. *The investigation is done by using a box and a jacket to create a dark environment. Have the student put the box on their head like a teepee and cover it with your coat/jacket. Help students to block out as much light as possible by making sure there are as few areas where light can get in.*
    b. *Have their partner ask them what they can see or describe what they can see. After a few minutes have the students switch places. Make sure to have the students look at each other's eyes when they come out of the box and note what they see (they should see the iris's change as they adjust to the light again).*
5. After the investigation, students will discuss what they observed with their partner. Questions to initiate discussion can be found above in the "Reason" section.
6. Read the article, "How we see things" in Appendix B as a class and discuss what they learn from the article.
7. Students will draw a picture or write something to explain what happens when there is no light and how the human eye works.

Appendix B -

How we see things

We see things because the light is reflected off the things we see. Some of the reflected light comes to our eyes and we can see that light.

Light travels in straight lines. Light bounces off an object and enters our eyes. This is how we see the object.

Objects of different colors reflect the color of light we see. A blue shirt reflects blue light. A green shirt reflects green light.

Home extension: Go into the bathroom at home when it is really dark. Look in the mirror. Turn on the light. Watch your iris. Repeat.

Materials:

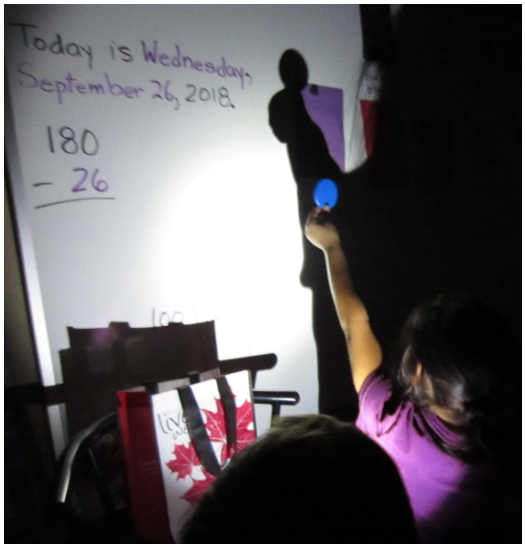
Provided Materials:

- Boxes
- All about light by Lisa Trumbauer

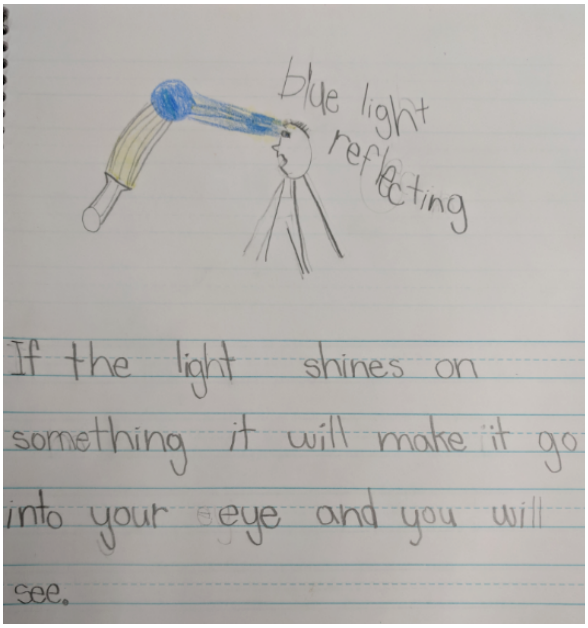
Classroom Materials:

- Students Jackets

This is a picture of a light shining on an object and a person seeing the object.



Example of a student model



1.3.3 - Experimenting with Light

Grade: 1st 30 min

Lesson Topic: Light

Utah SEEd Standard:
Standard 1.3.3 Plan and carry out an investigation to determine the effect of materials in the path of a beam of light. Emphasize that light can travel through some materials, can be reflected off some materials, and some materials block light causing shadows. Examples of materials could

- Planning and carrying out investigations to gather evidence that light is affected differently by different materials.

Construct an explanation for the causes of light changing include clear plastic, wax paper, cardboard, or a mirror. (PS4.B)

Lesson Performance Expectations: when it interacts with different materials.

Phenomenon: *What if there were no windows?*

Gather

1. Students ask questions about how light is affected by different clothing materials. Students develop questions and make predictions by exploring shining a flashlight through different things.
2. Students investigate (explore) changes in the light when it shines on types of materials: (*opaque (not see-through - solid construction paper), translucent (kind of see-through wax paper), transparent (see-through colored cellophane, acetate overhead film, or sheet protector), and reflective (aluminum foil) materials.*)
3. Students use a model (appendix B) to record their data with different materials.

Reason

4. Students analyze data *(sort materials by a similar effect on light)* to find patterns in the types of materials that affect light in similar ways.

Class Discussion - Discussion

1. Students as a class construct an explanation that different materials affect light differently.

(Teaching Suggestions: (Whole class charting with partner brainstorming of answers to our initial questions) What's the difference between the block and cellophane - (thicker) and if you layered the cellophane and made that thick would it make a difference? Whole class charting with partner brainstorming of answers to our initial questions)

Class Discussion:
Questions to initiate Discussion:
Q: How does light change when it encounters different materials?
Q: What evidence do you have that materials might affect light in different ways?
Q: How does light behave differently with the block, cellophane, wax paper, mirror, or soda bottle?
Q: How can I see through things that light goes through?
Q: What happens when we shine light through these objects?

Communicate Reasoning

5. Students construct an explanation for the causes of light behaving differently with different materials.

Science and Engineering Practices Planning and Carrying Out Investigations Construct Explanations Analyze data	Plan and carry out investigations that generate evidence. Compare data and use comparisons as evidence. Make careful observations to generate evidence. Construct explanations for the causes of phenomena. Construct explanations supported by evidence from investigations.
Crosscutting Concepts Cause and Effect Change	Develop explanations for the causes of phenomena. Explain the causes of changes.
Disciplinary Core Ideas Light	PS4.B: Electromagnetic Radiation Some materials allow light to pass through them, others allow only some light through and others block all the light. Mirrors can be used to redirect a light beam. (1- PS4-3)

Appendix A - Student Prompts for the Lesson

Phenomenon: **What if there were no windows?**

Group Performances:
1. Develop questions about how light is changed by different materials.
2. Investigate how shining a flashlight through different materials affects the light.
3. Use a model (table) to record data for how different materials affect light.

Group Discussion
4. Sort the materials by how they affect light. (patterns)
5. Construct an explanation that different materials affect light differently.

Individual Performances:

6. Construct an explanation that different materials affect light differently.

Lesson Steps:

1. *Introduce the lesson by watching the "What if there were no windows?" video. Talk about what they noticed. Introduce the following vocabulary words:*
    a. ***Transparent:*** *light can go through material, you can see through it*
    b. ***Semi transparent:*** *light partially passes through, you can kind of see through it*
    c. ***Reflective:*** *Light bounces off a object*
    d. Refracted: *Light changes direction after hitting an object*
2. *Start the investigation. Split the class into groups 2-3.*
    a. *Before starting the investigation, emphasize safety procedures: when students have flashlights, do not shine into their eyes or other students' eyes.*
    b. *Teacher should model shining the flashlight on and through a couple of the materials and explaining which vocab word it relates to. Ask students to verbally predict with their partner the outcome of each test/investigation of how light behaves the same each time prior to actually running the test.*
    c. *Pass out investigation kits and allow students to explore the materials.*
3. *Have a class discussion about the investigations and students describe their investigations (e.g., I turn on the flashlight and put the ____ in front of the light and see what happens to the light.) Go through each material as a class, have the students say which vocab word is represented as you shine the light through each material for them. Explain why each vocab word matches with each one. Have students try shining the flashlight through their hands.*
    a. *Focus on the cause and effect and that some materials have structures that are different from other materials. Engage with students to brainstorm good questions! Students may come up with questions.*
    b. *Focus on how the materials affect the light. A core idea that may come out is that light travels in a straight line until it interacts with matter and that you cannot see light until it interacts with matter.*
4. *Have students draw a model to explain how the light is affected by each material.*

Extra - this can be done with the lesson or not. Conduct a class investigation where all of the students write down the color of objects of different shapes and colors when seen in a dark room. Hold up a red star then a blue square, etc. and ask students to describe the color, repeat with the room lights on.)

1. *Share the YouTube Video: Understanding Absorption of Light - Why do we see different colors?*

Appendix B -

Light Investigation Sheet

Appendix C -

1. *Online Video Resources: Mystery Doug "What if There Were No Windows?"*
2. *Book: Light and Sound, Building blocks of Science, Carolina Biological*
3. *Playing with Light and Shadows, by Jennifer Boothroyd, revisits the concept of transparent, translucent, and opaque.*
4. *Sensing Light and Sound, by Jennifer Boothroyd, shows that eyes to sense light and ears sense sound.*
5. *Sending Messages with Light and Sound, by Jennifer Boothroyd, describes how people use light and sound to send messages.*
6. *Lights Out!, by Lucille Recht Penner, is an entertaining story about a girl who counts lights at night as everyone goes to sleep. Great practice in subtraction.*

Materials needed for the investigation

Provided Materials:

- *Squares of cardboard*
- *Colored plastic cups*
- *Aluminum pans*
- *Mirrors*
- *Squares of wax paper*
- *Squares of tissue paper*
- *Flashlights*
- *CD 's*

Classroom Materials:

- *Squares of construction paper*
- *Bottles of drinks such as Gatorade, Coke, or water, etc.*
- *Chart paper for recording class data*
- *Student graphic organizer to record data. (from the investigation)*

1.3.3 - Making and Measuring Shadows

Grade: 1st **Time:** 30 minutes

Lesson Topic: Light

Utah SEEd Standard:
Standard 1.3.3 Plan and carry out an investigation to determine the effect of materials in the path of a beam of light. Emphasize that light can travel through some materials, can be reflected off some materials, and some materials block light causing shadows. Examples of materials could include clear plastic, wax paper, cardboard, or a mirror. (PS4.B)

Other standards:
Standard 1.MD.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.

Lesson Performance Expectations:

- Plan and conduct an investigation to determine the effect of placing solid objects in the path of a beam of light.
- Construct and explanation to explain how shadows are formed

Phenomenon: **Shadows come in all different shapes and sizes**

Gather

1. Students plan and carry out an investigation to determine the effects of placing a solid object in the path of a beam of light.
2. Students will record findings in a graphic organizer.

Discussion Questions:
Q: Can you make the shadow bigger or smaller?
Q: Do the shadows stay the same?
Q: Are the shadows larger, the same size or smaller than the toys?

Reason

3. Students analyze and interpret data by observing the lengths of the shadows.
4. Students think critically about their findings through a group discussion

Class Discussion:

Questions to initiate Discussion:

Q: How does light behave with a solid object?

Q: What happens when the light hits the solid object?

Q: What happens when an object blocks a path of light?

Q: Why is the shadow sometimes bigger or smaller than the object?

Q: How do they change with time?

Q: When you rotate the toys what happens to the shadows?

Q: Can you think of other objects that block light to create shadows?

Communicate Reasoning

5. Students construct an explanation to explain how shadows are formed

Science and Engineering Practices Plan and conduct investigation Construct and explanation Analyze and interpret data	Plan and carry out investigations that generate evidence. Compare data and use comparisons as evidence. Make careful observations to generate evidence. Construct explanations for the causes of phenomena. Construct explanations supported by evidence from investigations.
Crosscutting Concepts Change Cause and effect	Identify and describe cause of light hitting a solid object Explain how the size of the shadow change
Disciplinary Core Ideas Light	Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach.

Appendix A - Student Prompts for the Lesson

Phenomenon: Shadows come in all different shapes and sizes

Group Performances:

1. Plan and carry out an investigation for the causes of placing a solid object in the path of a beam of light.
2. Plan an investigation to gather evidence for ……. causes of changes in the system …
3. Analyze and interpret data by observing changes in the lengths of shadows.

Class Discussion

4. Construct an explanation …… for the causes of placing an object in the path of a beam of light and changes in the shadow sizes.

Individual Performances:

5. Develop an explanation to explain how shadows are formed using the evidence you collected.

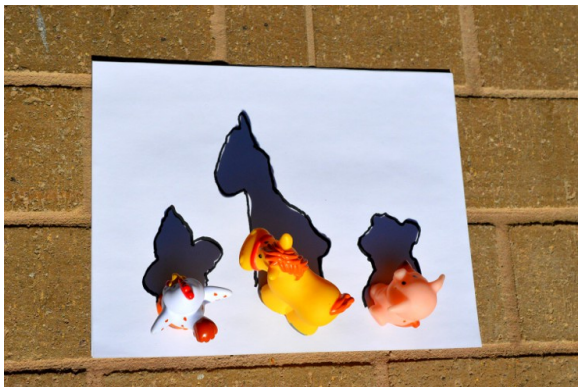
Lesson Steps:

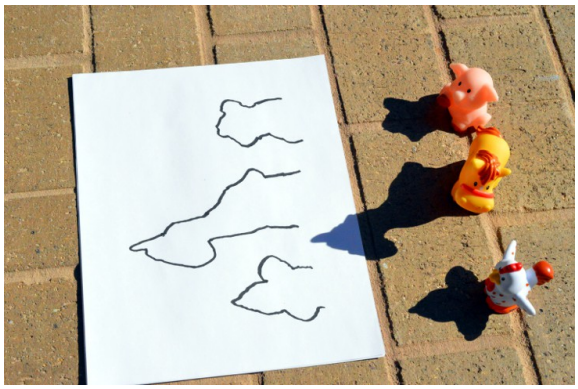
1. *Introduce the lesson by showing students a shadow from an object and moving it so it becomes bigger/smaller. Ask them to share their observations. Why does the shadow get bigger/smaller? What do they think a shadow is? Emphasize that engineers ask questions and experiment to find answers to their questions. Review the vocab words:*
    a. ***Shadow:*** *shape that is formed when light is dark*
    b. ***Light:*** *something that makes things visible*
2. *Begin the investigation:*
    a. *Students will be given a handful of legos. They will create their own tower or creation to use throughout the investigation.*
    b. *Go outside on a sunny day in the morning or later afternoon. If it isn't sunny enough, or time doesn't allow you to go out during prime time, students can use lamps and clamp them to their desks as a light source instead.*
    c. *Have students lay out their paper and place their object on the edge of the paper. They will trace the shadow that they see. Have students move the objects at different angles from the light and trace those shadows. There should be a short, long, and almost invisible shadow.*
    d. *Students should move the lamps far and close to the paper so they can see how the location of the light source will affect what the shadows look like.*
3. *When students are finished with the investigation, have a class discussion about what they observed from their drawings. Questions to initiate discussion can be found above in the "Reason" section. Emphasize how shadows are changed based on the position of the light source. Define what a shadow is.*
4. *Students will draw a picture or write words to define what a shadow is and why it looks different at different times of day.*

Appendix B -

Student recording sheet

Example of student work:





Materials:

Provided Materials:

- *Legos*
- *Lamps*

Classroom Materials:

- *2-3 sheets paper*
- *markers, crayons, or pencils*
- *Student Recording Sheet*
- *Clipboards(if need a hard surface to write on)*

1.3.4 - Code and Decipher a Secret Greeting

Grade: 1st **Time:** 30-45 minutes

Lesson Topic: Sound

Utah SEEd Standard:
Standard 1.3.4 Design a device in which the structure of the device uses light or sound to solve the problem of communicating over a distance. *Define the problem by asking questions and gathering information, convey designs through sketches, drawings, or physical models, and compare and test designs*. Examples of devices could include a light source to send signals, paper-cup-and-string telephones, or a pattern of drum beats.

Lesson Performance Expectations:

- Students will use a variety of materials to create a pattern that will communicate a message over a distance using light or sound.
- Students will design a code to solve the problem of communication over a distance with light and sound.

Phenomenon: **There are many different ways to communicate the greeting "hi."**

Gather

1. Students *obtain information* about how light and sound *patterns* are used to communicate information in their everyday life.
2. Students *solve a problem* using *patterns* of light or sound to communicate information over a distance.

Discuss how we can use different signs and signals to communicate over a distance. Review a few of the different ways to communicate over a distance using light or sound. With their partner students will pick out a few materials that use sound and light to communicate a message.

Reason

3. Students *develop a model* (drawing or diagram) to show how lights or sound can be used to transmit a message.
4. Students *communicate information* over distance using patterns (code) via rays of a flashlight or beats of sound). See the T-chart at the bottom of the lesson.

Class Discussion:
Questions to initiate Discussion:
Q: How can you cause the loudness to change?
Q: What are some other objects you could use to create light/ sound? (fire, hitting sticks together)
Q: What are some challenges that you might have if you use sound or light to communicate?
Q: Why is light/ sound a good way to communicate?
Q: Would it be better to use sound or light to communicate?

Q: What could block light or sound from communicating to you?
Q: What could I use to reflect light?
Q: Why is it hard to communicate using light or sound?
Q: How do you see people communicating with light and sound in real life? Examples (traffic lights, horns, blinking lights, bells, sirens, flashing lights, school bell, intercom, Cell phone. lighthouse, alarm clocks, fire alarms, timer, doorbell/knock, train horn, whistle, clapping,...etc)

(Teaching Suggestions: Students will continue to work with their partner as they make a model to show how light or sound is being transmitted in their secret message. They will then create patterns or codes to communicate a greeting. After creating greetings they will share those with other classmates, and see if they can break the code. (students should be given a key). We will then discuss our experiments today. Focus on how light and sound help people communicate in ways other than yelling or speaking really loud.

Communicate Reasoning

5. Students *construct an explanation* for how messages can be sent and received using light or sound and how *patterns* are used to communicate.

(Teaching Suggestions: students have to devise a system of light or sound signals (code) to communicate messages like the t-chart below. Students/Groups can share out to the class what they came up with and demonstrate to the class. Combine two groups together and have them see if they can decipher each other's code/greetings).

Science and Engineering Practices Asking questions and defining problems Constructing explanations and designing solutions	Identify questions relevant to science or engineering problems. Work collaboratively to construct science explanations and design solutions.
Crosscutting Concepts Patterns Cause and Effect	Use patterns as evidence to support explanations. Use cause and effect to determine what effect messages have Use patterns to communicate
Disciplinary Core Ideas PS4.C Information Technologies and Instrumentation	People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

Appendix A - Student Prompts for the Lesson

Phenomenon: There are many different ways to communicate the greeting "hi."

Group Performances:

1. Students *obtain information* from the videos about how light and sound *patterns* are used to communicate information in their everyday life.

2. Students *solve a problem* using *patterns* of light or sound to communicate information over a distance.

3. Students *develop a model* (drawing or diagram) to show how lights or sound can be used to transmit a message.
4. Students *communicate information* over distance using patterns (code) via rays of a flashlight or beats of sound). See the T-chart at the bottom of the lesson.

Class Discussion

Individual Performances:

5. Students *construct an explanation* for how messages can be sent and received using light or sound and how *patterns* are used to communicate.

1. *Start the lesson by showing this video. After watching the video, ask students where they see light and sound being used to send a message. Emphasize that engineers come up with ideas for communicating signals using different methods, such as light or sound. Go over vocabulary.*
    a. ***Sound:*** *vibrations that you can hear*
    b. ***Light:*** *something that makes things visible*
    c. ***Message:*** *something that is telling you something*
2. *As a whole class, have the students say "hi". Explain that this is them saying a message of greeting through words. Explain that today we will be creating messages with only light and sound, like the examples in the book.*
3. *Ask students to close their eyes, play this siren sound and ask them what it means. Ask them what color lights they usually see with that sound. Have the students open their eyes and turn the lights off, ask what that means (i.e. we are watching a video, it's time to sleep, telling us to be quiet etc.) ask them what the bell means at the beginning and end of the school day. Explain that all of these are messages that are being communicated through sound and light. We do not have to speak to tell someone something.*

4. *I do - As a class, make a T-chart on the board. Write a list of things you would like the students to make a signal about (i.e. class bathroom break, class drink break, Time for lunch, Line up, Pay attention, etc.)*
    a. *Split the class into pairs. Model for them your secret message (i.e two stomps and two claps means to get your backpacks) have the student's repeat the message back to you and say what it means.*
    b. *With boomwhackers and a flashlight, model another message (i.e. one hit of the boom whacker and one click on and off of the flashlight means to sit down on the carpet). Pass out the materials and have the students repeat the message back and say what it means. Put these examples on the Class T- chart.*
5. *We do - To ensure students are understanding the task, have the students come up with a message as a class. Pick one of the messages on the T-chart to do together. Tell them to talk to their partner and come up with an idea for a signal they could use for the message. Then have students share their ideas and incorporate them to create one message. (this part may need to be repeated several times)*
6. *You do- Once you know that the students understand the concept, you can assign each group a message from the board. They will come up with a class code for this message.*
7. *When the class is finished coming up with their messages, they will each present their message to the class. Write each one on the T-chart. Go through each of the messages as a class and test the students by using the codes and having them identify what it means, etc.*
8. *Students will then discuss what they just learned from the investigation. Questions to initiate discussion can be found above in the "Reason" section.*

Materials:

Provided Materials:

- Flashlight, boomwhackers

Classroom Materials:

- clapping, stomping, snapping
- Any material used to make light or sound

T-Chart to Send and Receive Message

Pattern	Greeting
Example: 2 boom whacks and 2 claps	Welcome to school!

Engineer Design Sheet- listed in appendix

Appendix:

Light Investigation Sheet

Directions:

1. Gather up materials
    - 1 Square construction paper, aluminum foil, wax paper, plastic wrap,tissue paper, cardboard, and colored cellophane.
    - 1 mirror
    - 1 CD
    - 1 drink bottle
    - 1 flashlight
2. Make a prediction about how much light will be seen when you shine the flashlight on it?
3. Shine your flash light through the object. Does light pass through? If so, how much light do you see?
4. Record your observations in the table below
5. Write a conclusion (Remember to use the vocab words we talked about in class: Opaque, transparent, translucent, and reflective)

Object	Prediction (What is the light going to do?)	Observation (What happened to the light?)	Conclusion (This object is _____ (connect to vocab words))
Construction Paper			
Aluminum Foil			
Wax Paper			
Plastic Wrap			
Mirror			
Tissue Paper			
Cardboard			
CD			
Colored Cellophane			
Fingers			
Plastic water bottle			

Making and Measuring Shadows

Directions:

1. First measure the height of your object using your ruler in inches
2. Place objects on the edge of your paper
3. Make a sketch showing the shadows you created
4. Next, measure your shadows and record your findings in the table below
5. Rotate your objects to get different sized shadows **HINT**: you should find a long, short and almost invisible shadow.

	Is the shadow light or dark?	How long is the shadow? Short or long
Object REALLY CLOSE to the light		
Object KINDA CLOSE from the light		
Object FARAWAY from the light		
Object REALLY FAR AWAY from the light		

Materials List By Lesson

1.3.1- good Vibrations

Provided Materials:

- Sequins (4 bags)
- Hand drums and mallets (10 drum sets and 31 mallets)
- Bells of different sizes (3 sets)

Classroom materials:

- Paper and pencil for drawing a model.

1.3.1 Make a Splash and musical Ruler

Provided Materials:

- tuning forks (5 boxes)
- Plastic reusable cups (36)
- Large plastic bowl (4)
- 12 in plastic rulers (51)

Classroom Materials:

- Water
- Paper Towels (to clean up spilled water)
- Paper clips (if needed)
- Colored paper (if needed)
- Student journal pages (Print)

1.3.2- In the dark

Provided Materials:

- Pinhole boxes or 3-4 long cardboard boxes, or tubes (63)
- All about light by Lisa Trumbauer (2 books)

Classroom Materials:

- Coats/jackets

1.3.3 Experimenting with light

Provided Materials:

- *Squares of cardboard* (26)
- *Squares of cellophane of different colors* (26)
- *Squares of Aluminum foil* (26)
- *Mirrors* (26)
- *Squares of wax paper* (26)

- *squares of tissue paper* (26)
- *Flashlights and Batteries* (51)
- *CD 's* (26)

Classroom Materials:

- *squares of construction paper*
- *bottles of drinks such as Gatorade, Coke, or water, etc.*
- *Chart paper for recording class data*
- *student graphic organizer to record data. (from the investigation)*

1.3.3- Making And measuring shadows

Provided Materials:

- *Legos* (4 Boxes)
- *Lamps or flashlights* (51)
- Tubes of animal figures (7)

Classroom Materials:

- *2-3 sheets paper*
- *markers, crayons, or pencils*
- *Table to record data*
- *Clipboards(if need a hard surface to write on)*

1.3.4- Code and Decipher a secret greeting

Provided Materials:

- Flashlights (51)
- Boomwhackers (24)

Classroom Materials:

- Kazoos, clapping, stomping, snapping, shakers
- Any other material used to produce light or sound

Procedures

Hand bells
Tuning Forks
Boom Whackers