Scavenger Hunt

Next school year I will be moving from my recent position teaching middle school science to teaching first grade. I wanted to develop an integrated STEM lesson that I could use in my new position, however I did not have an existing plan to draw from. As such, I developed the new, original lesson plan included below. Drawing on my passion for science education, I began by reviewing first grade NGSS Performance Expectations. Immediately, the topic of waves in light and sound seemed a perfect opportunity to integrate music or visual arts or theater. After further consideration, I decided to focus on the topic of light as it is so fundamental to how most of us interact with and navigate our environment. The NGSS Performance expectation is for students to make observations to develop an evidence-based claim that objects can only be seen when illuminated and to conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light.

The play of light and shadow and the exploration of transparent, translucent, and opaque materials could be beautifully enhanced by arts integration. Exploring the work of contemporary artist creating striking interactive and visual art through the use and light and shadow is an excellent opportunity to study the intersection of art and science. Students could create their own shadow art in support of First Grade Visual Arts Standard VA:Cr2.1.1a. Explore uses of materials and tools to create works of art or design. Students explore in generating shadows and projections to reimagine into original artwork.

Shadow puppet theater presents another wonderful opportunity for arts integration that supports students in exploring and expanding their study of how light interacts with various materials. Drawing from traditional Indonesian, Balinese, and Thai Shadow Puppet theater, students can create their own shadow puppets with various materials to create a variety of effects in casting shadows or translucent color. This supports further exploration of the science standard while also supporting First Grade Theater Arts Standard 1st Grade Theatre TH:Cr1.1.1b. Collaborate with peers to conceptualize costumes and props in a guided drama experience. Students engage in creatively designing and constructing their puppets and collaborate in small groups to create or adapt a plot to perform with their puppets supporting TH:Cr2-1a. Contribute to the development of a sequential plot in a guided drama experience and/or TH:Cr3.1.1a. Contribute to the adaptation of the plot in a guided drama experience.

I have created the following lesson plan to support students to first develop a foundational understanding of the interaction of light with various materials through hands-on investigation in the Explore phase. Students apply and extend this understanding through the creation of original shadow art and engaging in shadow puppet theater in the Elaborate phase.

Lesson Title: Light, Shadow, and Color: Exploring The Interactions of Light and Materials

Author: Cecily Phalen-Bartolome

Topic: Light, Constructing Explanations, Composite Shapes

Targeted Grade Level: First Grade

Time Needed:

Approximately 5-6 hours over several days. Estimated time for each segment is indicated in lesson procedure.

Subject Integration: Visual Arts, Theater, Science, Math, Engineering, ELA Speaking and Listening,

Standards:

NGSS Performance Expectations

1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated.

1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena (1-PS4-2)	**PS4.B: Electromagnetic Radiation** • Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2) • 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. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-2),(1-PS4-3) ----------

Common Core State Standards:

Math: CCSS.MATH.CONTENT.1.G.A.2

Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

ELA: English Language Arts Standards, Speaking and Listening, Grade 1,

Comprehension and Collaboration:

CCSS.ELA-LITERACY.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

- CCSS.ELA-LITERACY.SL.1.1.A. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
- CCSS.ELA-LITERACY.SL.1.1.B. Build on others' talk in conversations by responding to the comments of others through multiple exchanges.
- CCSS.ELA-LITERACY.SL.1.1.C. Ask questions to clear up any confusion about the topics and texts under discussion.

CCSS.ELA-LITERACY.SL.1.2 Ask and answer questions about key details in a text read aloud or information presented orally or through other media.

Presentation of Knowledge and Ideas:

CCSS.ELA-LITERACY.SL.1.4 Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.

ITEEA Standards

Standard 8 Students will develop an understanding of the attributes of design.

K-2 8.A Everyone can design solutions to a problem

K-2 8.B Design is a creative process

National Art Standards

1st Grade Visual Arts

VA:Cr1.2.1a. Use observation and investigation in preparation for making a work of art.

VA:Cr2.1.1a. Explore uses of materials and tools to create works of art or design

VA:Cr2.2.1a. Demonstrate safe and proper procedures for using materials, tools, and equipment while making art.

1st Grade Theatre

TH:Cr1.1.1b. Collaborate with peers to conceptualize costumes and props in a guided drama experience (e.g., process drama, story drama, creative drama)

TH:Cr2-1a. Contribute to the development of a sequential plot in a guided drama experience (e.g., process drama, story drama, creative drama). ***or*** TH:Cr3.1.1a. Contribute to the adaptation of the plot in a guided drama experience (e.g., process drama, story drama, creative drama)

TH:Cr2-1.b. With prompting and support, participate in group decision making in a guided drama experience (e.g., process drama, story drama, creative drama).

Measurable Student Learning Objectives:

Students will be able to…

- Develop an evidence-based claim from observations that objects can only be seen when illuminated.
- Conduct an investigation to make observations to determine the effect of placing materials made with different materials in the path of a beam of light.
- Compose a composite shape from simple two-dimensional and three-dimensional shapes
- Create original artwork using composite shapes of different materials that produce varying effects with light (transparent, translucent, opaque)
- Create a shadow puppet using composite shapes of different materials that produce varying effects with light (transparent, translucent, opaque)
- Explain the process they used to construct their puppets and shadow art, tell about the shapes used, the materials selected, and the effect of light cast upon said materials.
- Perform in an original or adapted shadow puppet play using student-created puppets.

Lesson Procedure:

5E Model	5E Objectives
Engage *(15 minutes)* *Introduce the lesson with an anchoring phenomenon. Facilitate student questions, discussion, etc. as appropriate. Learn about what students already know and want to know.*	**Procedure:** Gather students together after returning to the classroom from outside. Students should be able to see the screen to view the video projection clearly. State to the class, "I noticed the sun was shining very brightly today. There was a lot of light outside on the playground. Did anyone else notice that too?" Students might respond with a silent signal such as a thumbs up or "I agree" hand sign, have a few students share responses. Continue by saying, "Sometimes some very interesting things happen when there's something in the path of a beam of light. I'm going to show you a short video. We're going to watch it quietly all the way through so we can observe closely. Then, we'll have a chance to talk about what we noticed." Show the Red Hong Yi's Star Wars Shadow Art or Christine Marie's (antiquated) Augmented Reality video selection to the class. After the video, direct students to share their observations with a peer. "Thank you for watching quietly. That lets us all focus and pay close attention to what we noticed. Please turn and talk with a neighbor and share something you noticed and ask what they noticed." Allow time for discussion and join a few student conversations. Gather the attention of the class. "I heard some wonderful observations! Let's watch the video again and see what else you can observe." Replay the video and have students discuss with a different partner. "Wow, I'm hearing some wonderful observations. Please raise your hand if you would like to share something a friend observed." Record student responses on chart paper. Ask the class, "What do you wonder about what you see in this video? What would you like to know?" Record student responses on a second chart paper. "These are wonderful things to wonder about. Let's pick one question to investigate first." Guide a class discussion to develop a guiding question that expresses the idea of "**What happens when different materials are placed in the path of a beam of light?"**

Engage **(continued)**	**Modifications** The anchoring phenomena invites students to make observations based on what is directly observable in the video. This presents an accessible point of entry into the lesson for students regardless of scientific background knowledge, vocabulary, or lived experiences. Understanding what is observable in the video is not language dependent and also supports visual learning modalities making it inclusive of English language learners. Strategic pairing of students to provide shared language support and allowing greater wait time can provide support for ELL students to sharing observations with a partner. Students may also respond with non-verbal signals utilizing Total Physical Response (TPR) or SDAIE strategies or pointing to portions of the displayed video. As key vocabulary is introduced, terms can be translated and displayed as a word bank. **Standards Addressed** NGSS 1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated. NGSS 1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light. CCSS.ELA-LITERACY.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. • CCSS.ELA-LITERACY.SL.1.1.A. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion). • CCSS.ELA-LITERACY.SL.1.1.B. Build on others' talk in conversations by responding to the comments of others through multiple exchanges. • CCSS.ELA-LITERACY.SL.1.1.C. Ask questions to clear up any confusion about the topics and texts under discussion. CCSS.ELA-LITERACY.SL.1.2 Ask and answer questions about key details in a text read aloud or information presented orally or through other media.

Formative/Summative Assessments

Observe students engaging in partner and whole class discussions. This provides general formative assessment to establish existing knowledge base, misconceptions, and what students would like to know.

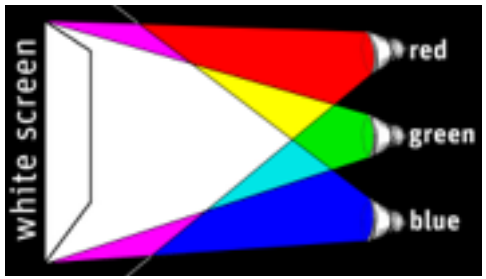
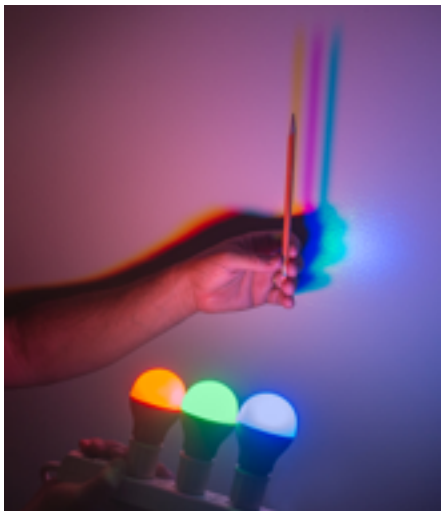
Resources

Chart paper and markers to record student responses
A whiteboard or projection screen to show video.

Star Wars Shadow Art by Red Hong Yi https://www.youtube.com/watch?v=oKd_cAvIZO8

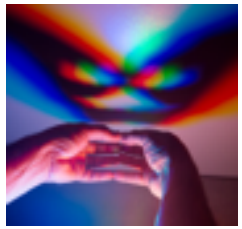
Engage **(continued)**	**Resources** *(continued)*  (antiquated) Augmented Reality by Christine Marie https://www.youtube.com/channel/UCnTqMlbG3bcf0_WgINNvW2w
Explore *(about 60-90 minutes)* *Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.*	**Procedure:** Once the guiding question for investigation is established with the class in the Engage phase, begin guiding students to think about how they might investigate this question and what evidence they would collect to try to establish a claim in response to the question. In order to investigate "**What happens when different materials are placed in the path of a beam of light?"** students are likely to suggest gathering a variety of materials and placing them in the path of a beam of light produced by something such as a flashlight. Collaboratively plan out the investigation and discuss what observations and evidence would be important to record. Provide students with copies of investigation sheets to record their observations at each station below or guide students through setting up science notebook pages for the investigation.

Explore **(continued)**	**Procedure** *(continued)* Group students to rotate through the five stations described below. Remind students of expectations for working at exploration centers including safe handling of materials, cooperation, sharing of materials, collecting and recording data, and remaining at the station for the entire time. Explicitly remind students not to touch the lights as they may become hot or could get knocked over and create the danger of broken glass. Be sure that all cords are secured and do not present a tripping hazard. Set up the stations described below. Model each station for students. Students will spend 10-15 minutes at each station. Approximately the first 5-7 minutes will be available for open exploration of station materials. Then, gently remind students, "If you have not begun recording your observations, please begin doing so now. Remember to record facts and specific details." At the end of 9-14 minutes, remind students to clean up their station and return all materials to how they found them at the beginning of the rotation. Then, signal for student groups to move to the next station. Stations may be explored over multiple sessions. ***Stations****:* *Shadow Shapes: What happens when you combine different shapes in the path of light?* Provide a light box if available, otherwise a simple light box can be improvised by inverting a clear storage container, lining it with wax paper to act as diffuser, and placing a light inside. Alternatively*, s*et up a desk lamp or other directional light source so that it shines against a wall or other surface. Provide a collection of shapes such as tangrams for students to explore with. Materials may be a variety of transparent, translucent, and opaque substances of various colors and shapes. Color transparencies are great to include here. Students can explore combining shapes to create pictures like tangram images. Students can also try their hand at making shadow puppets. *Flashlight Fun: What happens when you put different materials in the path of light?* Provide flashlights and a variety of materials for exploration. Materials may be a variety of transparent, translucent, and opaque substances of various colors and shapes. Remind students not to shine flashlights at faces. *Black Out Box: Can you still see things if there is no light?* Set up this station by providing a pinhole box and a selection of small items that can fit inside the pinhole box. Students place an item in the box, close it so that no light enters the box, and look inside to

Explore **(continued)**	determine if they can still see the object if there is no light shining on it. Be sure to include some glow-in-the-dark items as well! *Colorful shadows: What happens when you put different materials in the path of different color lights?* Set up red, green, and blue lights to shine upon a white background or wall as indicated in the diagram. Provide a variety of materials for students to explore with. Be sure there are some red, green, and blue objects as well. Students can explore what happens when an object is placed in the path of different color lights. Some students may notice that color mixing of red, green and blue yields white light. Students may delight in creating multicolor shadows of cyan, yellow, magenta, blue, and green in addition to black.   *Open exploration/observations: What other materials would you like to investigate? Use these lights to explore around the room!* This station allows for students to explore with materials of their own choice and/or finish recording observations from previous stations. For example, students may wish to explore the effect of light on objects around the classroom, through a window, or other materials. Provide flashlights and different color lights for students to explore with.

Explore **(continued)**	**Modifications** Modeling, visual cues, and image based data support emergent readers, language learners, and visual modalities. Translation of relevant vocabulary in non-English speaking students' home language is encouraged whenever possible. Students are physically engaging with and exploring realia. The largely independent nature of student-led exploration creates opportunities for the teacher to provide individual support to students that require additional assistance. The investigation stations are visually and tactilely based supporting kinesthetic and visual learners as well as incorporating SDAIE and TPR strategies. **Standards Addressed** NGSS 1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated. NGSS 1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light. Math: CCSS.MATH.CONTENT.1.G.A.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. **Formative/Summative Assessments** Observing student groups engaging in discussion at each station provides an opportunity for formative assessment. Probing questions can provide further information. Reviewing what students record for observations provides additional formative assessment.

Endeavor STEM Teaching Certificate Project
Cecily Phalen-Bartolome



Explore **(continued)**	**Resources:** Investigation Sheets or Science Notebooks *Shadow Shapes Station:* Light box or Light source (such as a flashlight, desk lamp, or clamp light) Tangrams or similar shape manipulatives  Hand Shadow Puppetry Clip Art ETC, University of Southern Florida https://etc.usf.edu/clipart/galleries/266-hand-shadow-puppetry *Black Out Box Station:* Create a pinhole box that blocks light from entering. Begin with a box that can be easily opened and closed by students. Paint the interior of the box black or line it with black paper. Create a small hole to look through or attach a cardboard sight tube that is also black to absorb excess light. *Optional:* Attach a light to shine into the box that can be easily turned on and off from the exterior of the box while it remains sealed. Assorted items to place in the black out box including some that glow. *Flashlight Fun Station:* Flashlights and a variety of transparent, translucent, and opaque materials of various colors and shapes. *Open Exploration Station:* Flashlights, preferably including some of different colors.

Explore **(continued)**	*Colorful Shadows Station:* Assorted materials for exploring creating shadows. Colored Shadows, Exploratorium Science Snacks https://www.exploratorium.edu/snacks/colored-shadows
Explain *(about 20 minutes)* *Facilitate opportunities for students to explain their understanding of concepts and processes and make sense of new concepts.*	**Procedure:** Begin by having students review the observations they recorded at each station. Have students form small groups with classmates that were not in their same group for exploration stations. Provide time for students to discuss their observations with peers. Convene the group. On a large piece of chart paper, display the question, "What happens when different materials are placed in the path of a beam of light?" Remind students, "We started with the goal to investigate what happens when different materials are placed in the path of a beam of light. You explored this idea by conducting your own investigations with light at five different stations. You recorded some wonderful observations about what you noticed happening when different things were in the path of the light." Invite several students to share their observations. For each response, guide students to connect their observation to the question being investigated. Record student responses on the chart paper. After several responses reflecting a variety of effects scaffold students to use the evidence of their observations to develop a generalized claim. This claim should include the concept that different objects may let light pass through (transparent), some light pass through (translucent), no light pass through (opaque), or may reflect light. Ask the class, "What happens if there is no light?" Guide a class discussion to establish and evidence based claim that objects can only be seen when illuminated. Provide time for students to record their claim in their investigation sheets or science notebook **Modifications** Visual images of each exploration station, multi-lingual vocabulary cards, and visual anchor charts provide support to ELLs. Strategic pairing of students to provide shared language support and allowing greater wait time can provide support for ELL students to sharing observations within small groups.

Explain **(continued)**	**Modifications** *(continued)* Sentence frames for discussion support students in constructing an argument and disagreeing respectfully. Behavior charts can help support select students in making positive choices during discussion. Some students that have difficulty sitting at the carpet may be provided bumpy cushions or might find alternative seating or use a bouncy band. **Standards Addressed** 1-PS4-2 Make observations to construct an evidence-based account that objects can be seen only when illuminated. 1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light. CCSS.ELA-LITERACY.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. • CCSS.ELA-LITERACY.SL.1.1.A. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion). • CCSS.ELA-LITERACY.SL.1.1.B. Build on others' talk in conversations by responding to the comments of others through multiple exchanges. • CCSS.ELA-LITERACY.SL.1.1.C. Ask questions to clear up any confusion about the topics and texts under discussion. CCSS.ELA-LITERACY.SL.1.2 Ask and answer questions about key details in a text read aloud or information presented orally or through other media. CCSS.ELA-LITERACY.SL.1.4 Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.

Explain **(continued)**	**Formative/Summative Assessments** Observing student groups engaging in discussion provides an opportunity for formative assessment. Probing questions can provide further information. Reviewing what students record for their claim in response to the investigation question and the evidence they provide yields additional data for formative assessment. **Resources** Chart paper, markers Previously distributed investigation sheets or student science notebooks.
Elaborate *(approximately 3 one-hour sessions)* *Provide applications of concepts and opportunities to challenge and deepen ideas; build on or extend understanding and skills.*	**Procedure:** State to the class, "We've been exploring what happens when different materials are put in the path of light. As we saw at the start of our investigation, some people use light and materials to create amazing art. Today, you will create your own original artwork using light and materials of your choice but first, I'm going to share with you what two artists are creating with light and different shapes and materials." *Making Art with Shapes and Shadow:* Share examples of work from artists working with light, shadow and materials such as Red Hong Yi, Vincent Bal, and Kumi Yamashita (see resources below). Encourage students to examine how the artists play with shapes and how they are arranged to create art with both the materials used and the shadows they cast. Clearly define criteria for the project to 1) combine two or more shapes into a composite shape and 2) reimagine that shape into something besides what it actually is 3) explain the effect of the different materials used in the path of light. Engage students in a conversation to clarify expectations for success and to develop a rubric. Take the class outside on a sunny day. Early morning or late afternoon may be preferable for creating shadows. Provide students with paper and art supplies such as pencils, markers, and crayons. Supply shape manipulative for students. Challenge students to arrange shapes in combination to create compound shapes and create new shapes from the compound shape. Students can add additional found and/or natural items as well. Students will trace the shadows and embellish the shadow shapes with drawings and color to create original artwork. Photograph student work with the shadow casting objects in place. Collect finished student artwork and display with printed thumbnails of photographs taken in a classroom gallery. Students may present their artwork to the class or view each other's work through a gallery walk for evaluation (see Evaluate below).

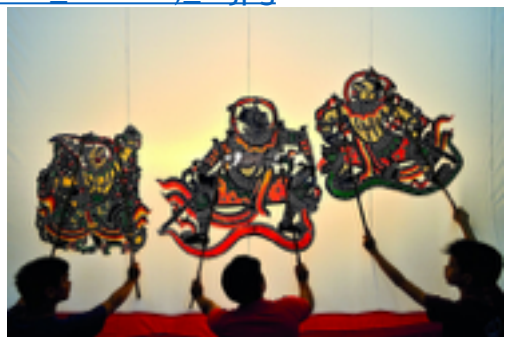
Elaborate **(continued)**	**Procedure** (continued): *Shadow Puppet Theater:* Introduce the shadow puppet theater project to the class. “Last time you combined different shapes to create original artwork using shadows. Today you’re going to create a form of moving artwork. In many places around the world, puppets are used to perform shadow puppet theater. Today, you will combine shapes to create your own shadow puppet!” Explain to students that they will be combining shapes to build their own unique shadow puppet. Students have an opportunity to use all they have learned about how light interacts with different materials to create various effects for their own shadow puppet. Students will use geometry skills to create new complex shapes from compound shapes. Students can use provides shape templates to trace onto various materials to create puppet shapes to cut out. Students may embellish their shapes as they please to fit their character. Students are encouraged to use a combination of cut outs, color transparencies, diffusers, and solid materials to create a variety of light effects on their puppet. Students will work in small groups of 3-4 to create a plot for the group to perform with their puppets. Students may create an original plot or create an adaptation a familiar story of their choice. Graphic organizers support students in the design process and story writing process (beginning-middle-end or first-then-last). Show video examples of shadow theater such as Thai and Indonesian Shadow Puppet Theater, N*ang Yai* or *Nang Talung* or Australian puppeteer, Richard Bradshaw, or VERBA shadow theater (see resources). Make images of shadow puppets from around the world available for students to view for inspiration and research purposes. Clearly articulate the criteria for the project with the class including 1) create a puppet by combining two or more shapes into a composite shape 2) create a puppet that interacts with light in at least two different ways (transparent, translucent, opaque), 3) create or adapt a story for your puppet to perform 4) perform your story with your puppet 5) present your puppet and tell about the shapes you used, the materials selected and the design process. Engage students in a conversation to identify characteristics of a successful project and cooperatively develop a visual rubric. Display the visual rubric in the class and encourage students to refer to it as they work on their puppets and develop their shadow play. Provide sufficient time for students to plan and develop puppets and plot for shadow play. Provide support to students in small groups as they work. Place a light directed at a sheet to create a screen for shadow theater performances. Student presentations and performances will serve as evaluation.

Elaborate **(continued)**	**Modifications** Some precut pieces can be available for students with fine motor issues and to support students in developing compound shapes. The highly visual and tactile nature of the work creating shadow art and puppets and visual rubrics support comprehension by students with emerging English language skills. Modeling, visual cues, and image based data support emergent readers, language learners, and visual modalities. Translation of relevant vocabulary in non-English speaking students' home language is encouraged whenever possible. Students are physically engaging with and exploring realia. The largely independent nature of student-led exploration creates opportunities for the teacher to provide individual support to students that require additional assistance.  **Standards Addressed** NGSS 1-PS4-2 Make observations to construct an evidence-s can be seen only when illuminated. NGSS 1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light. Math: CCSS.MATH.CONTENT.1.G.A.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. CCSS.ELA-LITERACY.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. CCSS.ELA-LITERACY.SL.1.4 Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.

<u>Elaborate</u> **(continued)**	**Standards Addressed** *(continued)* *1st Grade Visual Arts* VA:Cr1.2.1a. Use observation and investigation in preparation for making a work of art. VA:Cr2.1.1a. Explore uses of materials and tools to create works of art or design VA:Cr2.2.1a. Demonstrate safe and proper procedures for using materials, tools, and equipment while making art. *1st Grade Theatre* TH:Cr1.1.1b. Collaborate with peers to conceptualize costumes and props in a guided drama experience (e.g., process drama, story drama, creative drama) TH:Cr2-1a. Contribute to the development of a sequential plot in a guided drama experience (e.g., process drama, story drama, creative drama). ***or*** TH:Cr3.1.1a. Contribute to the adaptation of the plot in a guided drama experience (e.g., process drama, story drama, creative drama) TH:Cr2-1.b. With prompting and support, participate in group decision making in a guided drama experience (e.g., process drama, story drama, creative drama). ITEEA Standard 8 Students will develop an understanding of the attributes of design. ITEEA K-2 8.A Everyone can design solutions to a problem ITEEA K-2 8.B Design is a creative process **Formative/Summative Assessments** Student puppet design planning sheets and puppet theater plot graphic organizers serve as excellent sources of formative assessment. Observing students as they work, combining shapes and asking probing questions provide additional data that informs student support and ongoing instruction.

Elaborate **(continued)**	**Resources** *Making Art with Shapes and Shadow:* Paper and art supplies such as pencils, markers, watercolors, etc. Assorted shapes and other materials for creating shadows. **Examples of artwork from artists to serve as models and inspiration:** Red Hong Yi: Anamorphic Star Wars Shadow Art https://www.youtube.com/watch?v=oKd_cAvIZO8 Vincent Bal https://www.instagram.com/vincent_bal/?hl=en video: Artist Creates Art From Shadows of Everyday Objects https://youtu.be/NInkH0ukCOI  Kumi Yamashita http://kumiyamashita.com/light-shadow 

Elaborate **(continued)**	**Resources** *(continued)* *Shadow Puppet Theater:* Large tangram shapes or assorted sized shape cut out of cardboard to serve as tracers. Assorted dark color card stock, construction paper, feathers, and other craft items for use in creating puppets Color transparency or cellophane sheets diffusing materials such as wax paper or parchment paper Thin dowels for puppet supports Brass fasteners and hole puncher Scissors, tape, glue and other tools and supplies for puppet construction Light source Sheeting or screen to project shadow puppets onto for presentation **Examples of artwork from artists to serve as models and inspiration:** Richard Bradshaw, Australian Puppeteer https://youtu.be/a-fmsVDFpTE  

Elaborate **(continued)**	**Resources: Examples of artwork from artists to serve as models and inspiration** *(continued)* Shadow Puppet Theater from Indonesia, Malaysia and Thailand Example of *nang yai* puppet showing translucent and opaque features https://www.kcwtoday.co.uk/2016/10/shadow-puppet-theatre-indonesia-malaysia-thailand/ Ratchaburi Shadow Puppet Museum Example of *nang yai* puppet showing translucent and opaque features https://commons.wikimedia.org/wiki/Category:Wat_Khanon,_Ratchaburi#/media/File:Ratchaburi_Shadow_Puppet_Museum_(Wat_Khanon)_3.jpg   VERBA Shadow Theatre: The Story of Cinderella https://www.youtube.com/watch?v=0j4hR08T0Bs&t=184s 

Evaluate (about 40 minutes) *Assess students knowledge, skills and abilities.*	**Procedure:** *Shadow Art Evaluation* Once students have completed their artwork projects, they will orally present their artwork to the class. Alternatively, students may work in partnerships to "interview" each other and video record the interview. Student presentations of artwork will elaborate how the student met the following criteria for the project 1) combine two or more shapes into a composite shape and 2) reimagine that shape into something besides what it actually is 3) explain the effect of the different materials used in the path of light. Referencing the collaboratively created visual rubric for the project can provide support to students to recognize and describe how they successfully met each criterion. Evaluate students on their success meeting the criteria using the collaboratively established rubric. *Shadow Puppet Theater Evaluation; Puppet Construction* After completing construction of their individual shadow puppets, students will present their creations. Students will describe the process they used to construct their puppets, tell about the shapes you used, the materials selected, and how the shadow puppets they created meet the following criteria: 1) create a puppet by combining two or more shapes into a composite shape 2) create a puppet that interacts with light in at least two different ways (transparent, translucent, opaque). Referencing the collaboratively created visual rubric for the project can provide support to students to recognize and describe how they successfully met each criterion. Alternatively, students may work in partnerships to "interview" each other and video record the interview. Evaluate students on their success meeting the criteria using the collaboratively established rubric. *Shadow Puppet Theater Evaluation; Theater* After collaboratively composing or adapting a plot for theater, students perform the story in small groups using the constructed puppets. Evaluate students for 1) collaboration with peers to conceptualize costumes and props in a guided drama experience, 2) Contribute to the development of a sequential plot in a guided drama experience or adaptation of the plot in a guided drama experience, and 3) With prompting and support, participate in group decision making in a guided drama experience.

Evaluate (continued)	**Modifications** Translation of relevant vocabulary in non-English speaking students' home language is encouraged whenever possible. Strategic pairing of students to provide shared language support and allowing greater wait time can provide support for ELL students to sharing observations with a partner. Students may work in partnerships to "interview" each other and video record the interview using an iPad or other device. Referencing the collaboratively created visual rubric for the project can provide support to students to recognize and describe how they successfully met each criterion. **Standards Addressed** NGSS 1-PS4-3 Plan and conduct an investigation to determine the effect of placing materials made with different materials in the path of a beam of light. Math: CCSS.MATH.CONTENT.1.G.A.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. CCSS.ELA-LITERACY.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. CCSS.ELA-LITERACY.SL.1.4 Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly. VA:Cr2.1.1a. Explore uses of materials and tools to create works of art or design TH:Cr2-1a. Contribute to the development of a sequential plot in a guided drama experience (e.g., process drama, story drama, creative drama). ***or*** TH:Cr3.1.1a. Contribute to the adaptation of the plot in a guided drama experience (e.g., process drama, story drama, creative drama)

Evaluate (continued)	**Formative/Summative Assessments** *(How will you assess in each phase?)* *Shadow Art Evaluation* Student presentations of artwork will elaborate how the student met the following criteria for the project 1) combine two or more shapes into a composite shape and 2) reimagine that shape into something besides what it actually is 3) explain the effect of the different materials used in the path of light as described above in the procedure section. *Shadow Puppet Theater Evaluation; Puppet Construction* Students will describe the process they used to construct their puppets, tell about the shapes you used, the materials selected, and how the shadow puppets they created meet the following criteria: 1) create a puppet by combining two or more shapes into a composite shape 2) create a puppet that interacts with light in at least two different ways (transparent, translucent, opaque) as described above in the procedure section. *Shadow Puppet Theater Evaluation; Theater* After collaboratively composing or adapting a plot for theater, students perform the story in small groups using the constructed puppets. Evaluate students for 1) collaboration with peers to conceptualize costumes and props in a guided drama experience, 2) Contribute to the development of a sequential plot in a guided drama experience or adaptation of the plot in a guided drama experience, and 3) With prompting and support, participate in group decision making in a guided drama experience as described above in the procedure section. **Resources** Students will reference their original artwork and puppets created in the Elaborate phase. List of criteria and/or collaboratively created visual rubrics Optional: iPad or other video recording equipment for student interviews

Teacher Background:

Teachers should have some basic understanding of light including. In particular, teachers should understand that objects are visible as light receptors (cones and rods that line the retina in the eye) detect light in the visible spectrum as it is reflected by an object. Some students might bring up that they can “see in the dark” for example, after turning out the light, their eyes adjust to perceive things better in the dark. It is true that our eyes do adjust - the pupil expands to allow more light to enter the eye. However, some light must be present in order for us to see. In the absence of any light in complete darkness, we would not be able to see anything.

Teachers should also understand that light may interact with different materials in different ways. Some objects are transparent and light can pass through them (water, window pane), others are translucent (wax paper, frosted glass), others do not let light pass and are opaque (solid wood) and others are reflective (mirror).

For more information about light see the following resources:

NASA: Explore Light https://www.nasa.gov/content/explore-light

NASA: Visible Light https://science.nasa.gov/ems/09_visiblelight

Teachers should also feel comfortable supporting students in creating composite shapes from basic shapes and a basic understanding of elementary geometry.

Experience working with various mediums can be helpful in creating shadow art. See resources for Vincent Bal and Kumi Yamashita below. Teachers are strongly encouraged to experiment in creating their own shadow puppets prior to the lesson. In addition to the video links provided below in resources, a google search of Richard Bradshaw yields numerous interviews and recordings of his performance that yield valuable insight into shadow puppet theater.

The Union Internationale de la Marionette (UNIMA) maintains a Wold Encyclopedia of Puppetry Art that includes a wonderful background of Shadow Theatre around the world. https://wepa.unima.org/en/shadow-theatre/

Resources:

Star Wars Shadow Art by Red Hong Yi

Anamorphic shadow art

https://www.youtube.com/watch?v=oKd_cAvIZO8

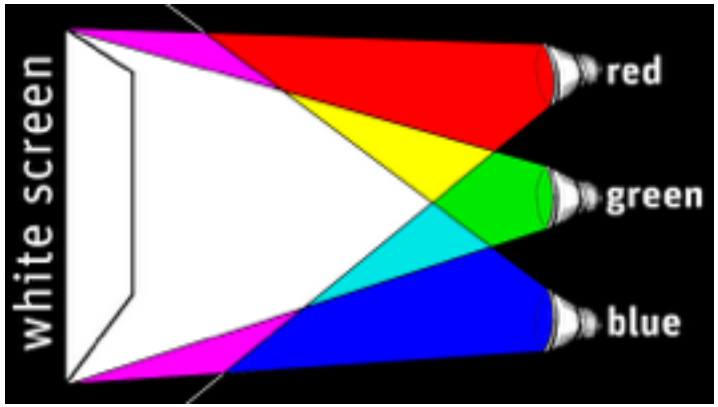
Shadows in Stereo by Christine Marie

An interactive Installation using red and cyan light and anaglyph glasses to create “shadowgraphs” or stereoscopic shadows

https://fellowsblog.ted.com/how-to-create-3d-augmented-reality-in-real-time-without-a-computer-f0c4ca94582a

Colored Shadows
Exploratorium Science Snacks

Create multi colored shadows
https://www.exploratorium.edu/snacks/colored-shadows



Shadow Puppet Theater from Indonesia, Malaysia and Thailand

Example of nang yai puppet showing translucent and opaque features

https://www.kcwtoday.co.uk/2016/10/shadow-puppet-theatre-indonesia-malaysia-thailand/

Ratchaburi Shadow Puppet Museum

Example of nang yai puppet showing translucent and opaque features

https://commons.wikimedia.org/wiki/Category:Wat_Khanon,_Ratchaburi#/media/File:Ratchaburi_Shadow_Puppet_Museum_(Wat_Khanon)_3.jpg

The Story of Cinderella
VERBA Shadow Theatre

Dance and shadow play tell the familiar tale in a surprising new way

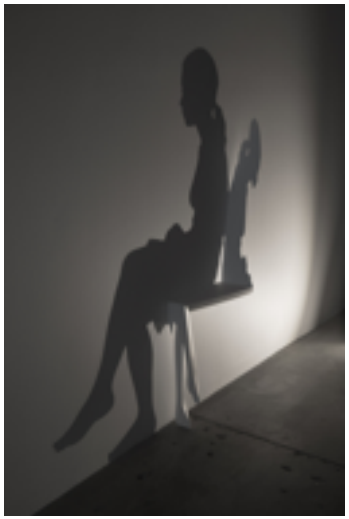
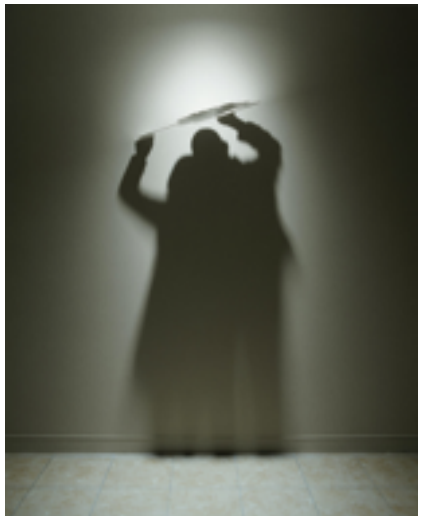
https://www.youtube.com/watch?v=0j4hR08T0Bs&t=184s

Richard Bradshaw, Australian Puppeteer

https://youtu.be/a-fmsVDFpTE

https://www.qt.com.au/news/puppets-shadows-in-a-different-light-for-kids/1803862/



The artwork of Kumi Yamashita http://kumiyamashita.com/light-shadow

From Yamashita's website: "I sculpt using both light and shadow. I construct single or multiple objects and place them in relation to a single light source. The complete artwork is therefore comprised of both the material (the solid objects) and the immaterial (the light or shadow)."




The artwork of Vincent Bal https://www.instagram.com/vincent_bal/?hl=en

video: Artist Creates Art From Shadows of Everyday Objects https://youtu.be/NInkH0ukCOI