GRADE BAND K-2

Shadow Makers

LEARNING OBJECTIVES

- Explain how a shadow is made.
- Identify what every shadow needs.
- Design and build an object that creates a shadow.

STANDARDS (NGSS)

- **1-PS4-3**: Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.
- **K-2-ETS1-2**: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- **Science and Engineering Practices (SEP)**
    - Planning and Carrying Out Investigations (testing different materials to see which creates the clearest shadow)
    - Developing and Using Models (building a cardboard object to model how light creates a shadow)
    - Constructing Explanations and Designing Solutions (designing an object that creates a specific shadow)
- **Crosscutting Concepts (CCC)**
    - Cause and Effect- Students discover that when light is blocked by an object, a shadow is formed. They also investigate how different materials affect the darkness and clarity of a shadow.
    - Structure and Function-Students learn that the way an object is shaped determines the shadow it creates. By combining simple shapes in different ways, they can create recognizable shadows.

Materials:

- Lesson Overview
- Vocabulary Slides for frontloading
- Full Lesson Slide Deck
- Shape Mission Cards
- Planning Page
- Shape Final Design Page
- Assessment
- Chompsaw(s)
- Cardboard
- Tape, glue

VOCABULARY

- Shadow- A dark shape made when an object blocks light.

- Light Source- Anything that gives off light.
- Object- A thing that can be seen or touched.
- Shape- The outline of an object.
- Material- What something is made out of.
- Model- A smaller version or example of something used to show or test an idea.

DRIVING QUESTION

- How can we use light to turn shapes into shadows?

ACTIVITY

Prior to the lesson, pre-teach key vocabulary by reviewing the slides with students who would benefit from additional language support.

Explore (20 minutes)

- Use the lesson slides to introduce content, model thinking, and guide student activities
  - (Slides 1-2) Introduce title page and read objectives to class. “At the end of the lesson we will be able to...
    - explain how a shadow is made.
    - identify what every shadow needs
    - design and build an object that creates a shadow.
  - (Slide 3) Look Closely! Display the pictures showing different shadows.
    - Ask: "What do you notice?" "How are these shadows the same?" "How are they different?"
    - Allow students to share observations without explaining why shadows form yet.
    - "Scientists always start by looking closely before trying to explain what they see."
  - (Slide 4) Shadows Need Light- Show the sun, flashlight, and lamp.
    - Ask: "What do all of these have in common?"
      - Allow students to share ideas before revealing that they are all light sources.
      - "The first thing every shadow needs is light.”
  - (Slides 5–7) How Are Shadows Made?
    - Begin with the sun and penguin diagram.
    - Explain that light travels in a straight line until something blocks it.
    - Click to show the shadow forming.
    - Then repeat the process using the flashlight and toy dinosaur.
      - Ask: "What is blocking the light?" "Where does the shadow appear?"
      - Finish by explaining: "When an object blocks light, a shadow forms behind it."

- (Slide 8) Which Material Makes the Best Shadow?
    - Show the different materials.
    - Cardboard
    - Clear plastic
    - Tissue paper
    - Wax paper
        - Ask: "Which material do you think will make the darkest shadow?" Allow students to predict before revealing the answer.
        - Explain: "Cardboard blocks the most light, so it makes the darkest, clearest shadow. That's why we'll use cardboard today."
- (Slides 9–10) Shadow Detectives
    - Explain that students are now going to become Shadow Detectives.
    - Display only the shadow first.
    - Example 1: Ice Cream Cone
        - Ask: "What do you think this shadow is?"
        - Allow several guesses before clicking to reveal the cardboard object.
        - Next ask: "What simple shapes do you think were used to build it?"
            - Click to reveal the individual shapes.
        - Repeat the process with the house example.
    - Encourage students to notice that large, recognizable pictures can be created using only a few simple shapes.
        - Say: "Sometimes something complicated is really made from just a few simple shapes working together."
- (Slide 11) Shapes Can Work Together
    - Review the examples from the previous slides.
    - Explain that engineers often break large ideas into smaller parts.
    - Point to the simple shapes used to build each object.
        - Say: "When we combine simple shapes, we can create something completely new."
    - Transition: "Now it's your turn to become a Shadow Maker!"

Plan (15 minutes)

- (Slide 12) Shadow Makers — Your Mission
    - Introduce the engineering challenge.
    - Read the mission together:
        - "Cut out cardboard shapes to build an object that makes the same shadow as the item on your Shadow Mission Card."

        - Show students several examples of the Shadow Mission Cards.
    - *Students may choose their own mission card, or you may assign one based on readiness.*
        - *If assigning to students- use the numbers in the corner as a guide*
            - *1- Beginner*
            - *2- Intermediate*
            - *3-Advanced*
        - Say: "Remember, there isn't only one right way to build your object. Engineers solve problems in different ways!"
    - (Slide 13) Let's Plan
        - Display the planning sheet.
        - Explain that engineers always make a plan before they build.
        - Model the sailboat example.
            - Ask: "What simple shapes do you see?" "How could we break this picture into smaller pieces?"
        - Click through the example until students see the picture broken into simple shapes.
            - Say: "Before we build, we need to think about the shapes we'll use."
    - (Slide 14) Let's Draw
        - Display the planning sheet next to the blank drawing page.
        - Explain that students should draw each individual shape the size they want it to be before building.
            - Say: "Draw each shape the size you want your cardboard object to be. This will become your cutting guide."
        - Remind students that they are drawing separate shapes—not the completed object.

Create (35 minutes)

- (Slide 15) Materials & Safety
    - Review each material students will use.
        - Cardboard
        - Planning page, final sheets page
        - Glue or tape
        - ChompSaw
        - Flashlight
    - Review ChompSaw safety expectations before students begin.
        - Say: "Today we're using real tools like engineers. Let's make sure we use them safely."
- (Slide 16) Let's Cut!
    - Model cutting around each paper shape.
    - Explain that students are creating templates that will be glued

onto the cardboard.
        - Say: "First, cut out each paper shape. These will help you trace and cut your cardboard accurately."
- (Slide 17) Let's Glue!
    - Model gluing or taping each paper shape onto the cardboard.
    - Explain that the paper pieces stay attached while students cut the cardboard.
        - Say: "Glue each paper shape onto the cardboard so it's ready for the ChompSaw."
- (Slide 18) Let's Cut!
    - Demonstrate how to safely cut each cardboard shape using the ChompSaw.
    - Circulate to assist students as needed.
        - Say: "Take your time. Engineers know that careful work leads to better designs."
- (Slide 19) Let's Create!
    - Students glue or tape their cardboard shapes together to match their Shadow Mission.
    - Encourage students to compare their creation to both their planning sheet and mission card.
        - Ask: "Does your object match your plan?" "Are there any changes you want to make before testing?"
        - Explain that engineers often make adjustments while they build.

Test and Share (20 minutes)

- (Slide 20) Shadow Showcase
    - ***Prepare the Shadow Theater before students begin.***
    - Create the Shadow Theater by cutting a large rectangular opening in one side of a cardboard box. Cover the opening with parchment paper (or white tissue paper) and secure it with tape.
    - Have a flashlight ready behind the box so students can shine light through their cardboard creation onto the parchment paper, creating a large shadow for the class to see.
    - One student at a time places their Shadow Maker between the flashlight and the parchment paper while the class watches the shadow appear.
    - Before revealing the cardboard object, ask:
        - "What do you think this shadow is?"
        - "What clues helped you figure it out?"
    - After several guesses, invite the student to reveal their cardboard creation and explain which simple shapes they combined to make the shadow.

- Say:"Great engineers communicate their ideas. Today your shadow tells the story of your design!"

Assess (5-10 minutes)

- (Slide 21) Show What You Know
  - Distribute the assessment.
- Students demonstrate what they learned about light, shadows, and using simple shapes to create recognizable shadows.

RESOURCES

- Lesson Overview
- Vocabulary Slides for frontloading
- Full Lesson Slide Deck
- Shape Mission Cards
- Planning Page
- Shape Final Design Page
- Assessment

Extensions:

- Shadow Story Theater
  - Students create two or three cardboard objects that can be used to tell a short story with shadows.
  - Challenge: Can your shadows act out a beginning, middle, and end?
  - Students perform their shadow story for classmates using the Shadow Theater.
    - Skills: sequencing, storytelling, engineering, creativity
- Giant Shadows Outdoors
  - Take the lesson outside.
  - Students use the sun instead of a flashlight to investigate shadows.
    - Questions to explore:
      - Does your cardboard shadow change if you move farther away?
      - What happens at different times of day?
      - Students compare indoor and outdoor shadows.
    - Skills: scientific investigation, observation, real-world connections
- Reverse Engineer
  - Show students only a shadow.
    - Their challenge: Build the object you think could have made it.

- There isn't just one correct answer!
- After everyone builds, compare the different solutions and discuss why each one worked.