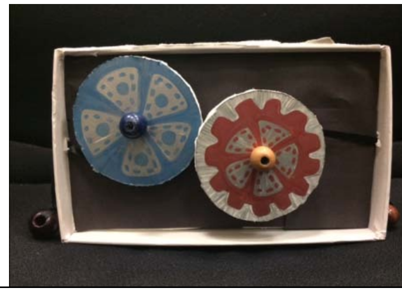


Teacher:	
Class: 2nd grade	
Duration: 2–3 class periods	
Course Unit:	
Lesson Title: Engineer a Simple Sculpture	

LESSON OVERVIEW

Artist U-Ram Choe uses math, science, and design to produce beautiful kinetic sculptures. Kinetic sculptures are three-dimensional artworks designed to create movement by mechanical or visual means. In this lesson, students will apply similar engineering and design principles to build a pulley-operated sculpture that will demonstrate how movement can be produced in art. This lesson prompts scientific exploration, employs basic mathematical practice, and encourages students to discover engineering applications in art. Vocabulary terms include: **kinetic sculpture**, **pulley**, **engineer**, **spool**, **gear**, and **axle**.

STANDARDS

Tennessee State Standards

Visual Art—Grade 2
1.2 Demonstrate an understanding of a variety of techniques.
1.4 Recognize and demonstrate levels of craftsmanship.
2.2 Identify, understand, and apply the principles of art.
2.3 Understand and apply purpose in art.
2.4 Understand and apply context in art.
5.1 Analyze the characteristics and merits of the student’s own work.
5.2 Analyze the characteristics and merits of other’s work.

Science—Grade 2
GLE 0207.T/E.1 Recognize that both natural materials and human-made tools have specific characteristics that determine their uses.
GLE 0207.T/E.2 Apply engineering design and creative thinking to solve practical problems.

Common Core Connections for Integrated Subjects—Mathematics/Language Arts, Writing, Speaking & Listening
Mathematics Standards—Grade 2
2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
CCSS.ELA-Literacy.W.2.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
CCSS.ELA-Literacy.SL.2.3 Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information or deepen understanding of a topic or issue.

OBJECTIVES

1. Students will be able to define kinetic sculpture and movement.
2. Students will discover the mechanical uses of a pulley.
3. Students will be able to build a kinetic sculpture using basic math and measuring skills.
4. Students will be able to follow the design process to test the success of their sculptures.

ASSESSMENT/EVALUATION

1. Students will participate in a critique in which they will test and evaluate the success of their kinetic sculptures as a class.
2. Students will complete a written response in which they record the results of their sculptures and describe how they might improve their designs.
3. Students will sketch a redesigned kinetic sculpture and describe how the design is improved.

MATERIALS

- Images of kinetic art (see Activating Strategy, Step 2)
- A PC-to-projector connection
- 1 pair of scissors per student
- 1 ruler per student
- 1 pencil per student
- 1 posterboard per table
- 2 compasses per table
- 1 yard of ribbon per student (students will measure and cut the ribbon for themselves)
- 1 container of markers per table
- 1 pencil per student
- 4 popsicle sticks per student
- 2 wooden spools per student
- One 12” x 3” foamboard per student (Note: if shoeboxes are longer than 12”, adjust the length of the foamboard accordingly; the foamboard must fit snugly lengthwise inside the box.)
- 1 straw per student. Straws must fit through the holes in the spools.
- 1 cup of pony beads per table. The holes in some of the pony beads (at least 4 per student) must fit around the straws.
- 1 bottle of glue per student
- 1 shoebox per student
- 1 large garbage bag
- 1 journal or sheet of paper per student

ACTIVATING STRATEGY

1. Begin by defining *kinetic sculpture*. [Say:] **Kinetic sculptures** are three-dimensional artworks made of parts designed to be set in motion by an internal or external force such as wind currents or water flow, or by mechanical means. It is art that depends on movement for its effect.
2. Show images or videos of kinetic art, using textbooks or online resources. Include *Bicycle Wheel* by Marcel Duchamp and *Arc of Petals* by Alexander Calder, or show examples of whirligigs from American folk art.

INSTRUCTIONS

1. Introduce the project and state the objectives.
2. Show the "Engineering Art" episode of *ArtQuest: Art Is All Around You*.
3. [Say:] A **pulley** is a simple machine that uses grooved wheels and a rope to raise, lower, or move a load. It is a scientific tool used to make our lives easier, and it will be the foundation of our kinetic sculptures.
4. [Say:] **Engineers** apply scientific and mathematic knowledge to create solutions for various technical problems. Like some artists, an engineer follows a step-by-step design process: brainstorm, design, build, test, and redesign.
5. Show the class the project diagrams. Point to the various parts of the simple sculpture design so that students can understand how the sculpture will be built.
6. Introduce the **brainstorm** portion of the design process. Have students share how they believe the kinetic sculpture will function. [Say:] This is a simple pulley-operated sculpture. Remember that a pulley is a simple machine that uses wheels and rope to move objects. Which part of the sculpture do you think is going to move? Will it be the gears, the spools, or the ribbon? Why do you think this?
7. Demonstrate how to measure and cut a 4" x 4" piece of posterboard.
8. Hand out scissors, rulers, pencils, and posterboards. Have students measure and cut two 4" x 4" pieces of posterboard.
9. Demonstrate how to measure and cut circles from the 4" x 4" squares, using a compass or a circular object.
10. Hand out compasses. Have students measure and cut circles from their squares as demonstrated. Students will use rulers to find the center of each circle and mark it with a dot.
11. Demonstrate how to measure and cut 1 yard of ribbon.
12. Have each student measure and cut 1 yard of ribbon and set it aside.
13. Hand out markers as you introduce the **design** portion of the process. Have students draw **gear** designs on the posterboard circles and color in the designs. Encourage students to incorporate a variety of lines and patterns.
14. Have students create a straw-sized hole in the middle of each circle, using the pointed end of a pencil.
15. Hand out popsicle sticks and spools. Have students take one of their circles and glue 2 popsicle sticks horizontally to either side of the hole, making sure not to cover the hole. These popsicle sticks should not extend beyond the edges of the circle, so you will need to cut them down to size if necessary, using adult scissors. Have the student glue a wooden **spool** directly over the hole and on top of the popsicle sticks.
16. Have students repeat this action with their other circle. Direct students to set circles aside.
17. Hand out one 12" x 3" foamboard per student.
18. Have students place the circles on the board to determine spacing and order, and tell them to mark the locations with dots. Students should make sure that the circles are evenly spaced and side-to-side.
19. Help students drill holes through the board, using a pencil as the drill.
20. Introduce the **build** portion of the design process by pressing the straw through 1 set of circle, spool, and foamboard holes and showing how to determine the length needed for the straw to become an **axle**, leaving about 1/4" through the front side of the circle-spool-foamboard combination and 1/4" through the back.
21. Hand out straws and assist students with the measurements for the first axle. Have students cut the straw with scissors. Using the rest of the straw, repeat the press-measure-cut process to create the axle for the other circle.
22. Distribute beads and glue to each table. With both axles in place (i.e., threaded through the circle-spool-foamboard), have students thread a pony bead over each end of each straw. Place a drop of glue at the center of each bead to hold it in place.
23. Have each student wrap their yard of ribbon around their two spools from one side to the other, forming a single loop around each.
24. Hand out shoeboxes. Direct students to proceed as follows:
    a. Position the foamboard inside the shoebox so that its long edges are parallel to the long sides of the box. Use glue to reinforce the placement of the panel.
    b. Using scissors or a pencil, punch holes on either side of the shoebox to lace the ribbon through.

c. Tie 1–2 pony beads to each end of the ribbon to secure it into place.

25. To clean up:
    a. Students will return materials to the appropriate bins.
    b. One student will collect paper scraps and other material waste into a large garbage bag.

ALTERNATE/EXTRA ACTIVITIES

- Students could embellish their shoeboxes with aluminum foil, silver or gold paint, and/or jewels.
- Students could build the gear panel without laying it into the shoebox.
- Students could construct their own spools with found materials around the classroom.
- For students with special needs, panels with spools and gears could be premade before class.

CLOSURE

1. Introduce the **test** portion of the design process. Have students test their sculptures' pull-strings by holding each ribbon end between a thumb and index finger and pulling gently from side to side. Do the gears move as they are intended to? Do all the other pieces stay in place? Have students compare and discuss their works.
2. Introduce the **redesign** portion of the design process. Have students record the results of their sculptures in their journals (or on sheets of paper) and describe how they might improve their designs. [Ask:] Did you run into any problems? How might you redesign your kinetic sculpture to fix those problems?
3. Tell students to sketch their redesigned sculptures in their journals (or on a sheet of paper) and describe why they changed certain elements. Have students recall the design process and write down the steps.

CROSS-CURRICULAR CONNECTIONS

- Language Arts
- Math
- Science

EXTENDED LEARNING

Activities:
- Design Squad Nation, "Kinetic Sculpture," pbskids.org
- Design Squad Nation, "Resources: Simple Machines," pbskids.org
- Exploratorium Teacher Institute, "Science Snacks: Spinning Blackboard," exploratorium.edu

Books:
- Michael Dahl, *Pull, Lift, and Lower: A Book About Pulleys* (Minneapolis: Picture Window Books, 2006)
- Robert E. Wells, *How Do You Lift a Lion?* (Park Ridge, IL: Whitman, 1996)

Videos:
- Blick Art Materials, *Art-O-Motion* (2011; available at YouTube.com)
- Frist Center for the Visual Arts, "Engineering Art," *ArtQuest: Art Is All Around You* (2015; available at fristkids.org)

Webpages:
- Chicago Architecture Foundation, "Discover Design: The Design Process," discoverdesign.org
- Science Kids, "Science Careers: Engineer," sciencekids.co.nz

Vocabulary Terms

axle: a bar on which a wheel or a pair of wheels turns.

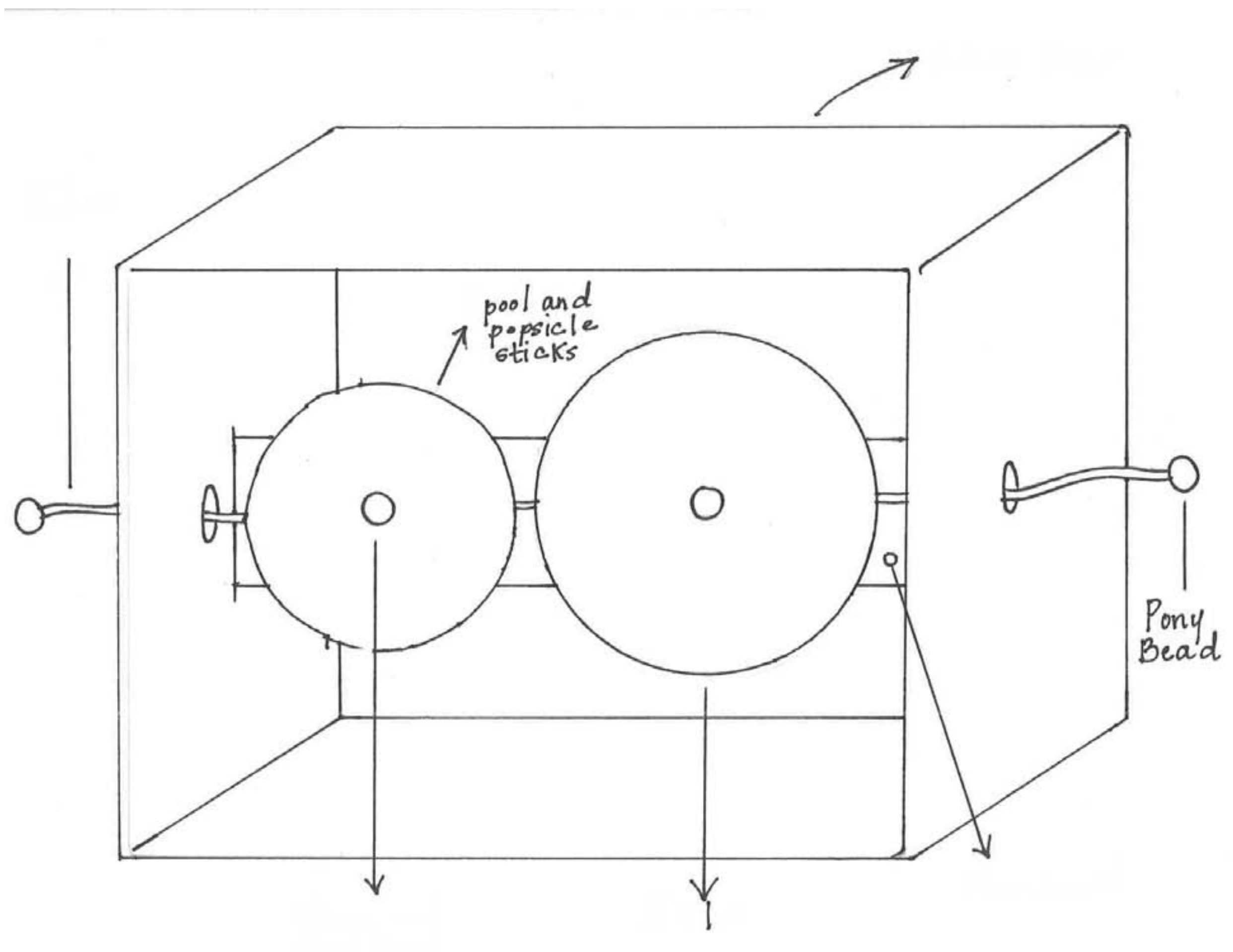
engineer: a person who applies scientific and mathematic knowledge to create solutions for various technical problems.

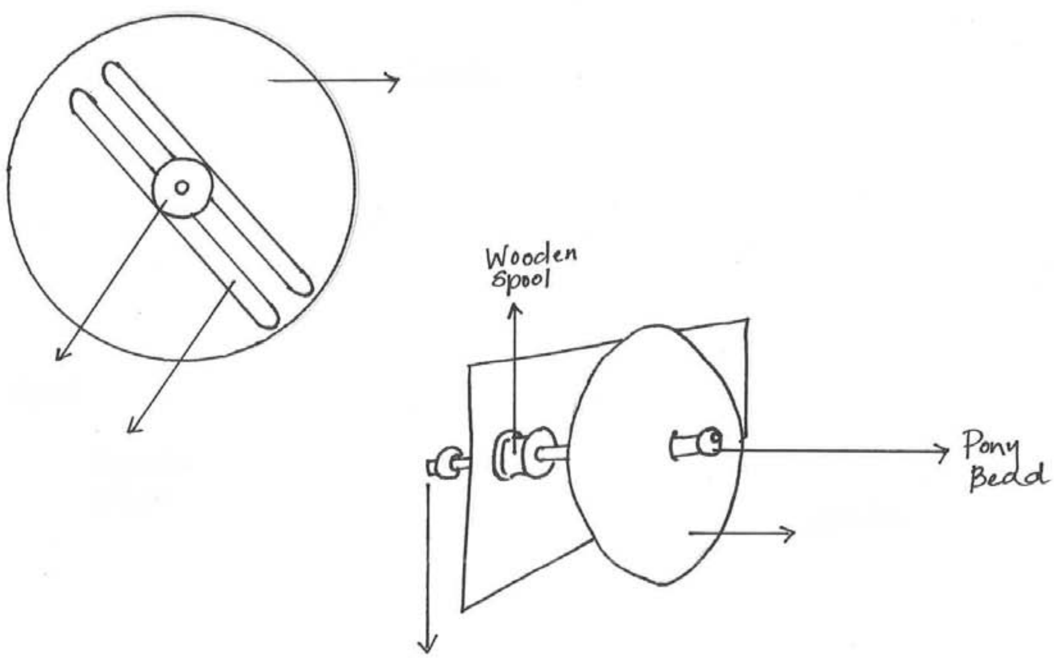
gear: a toothed wheel in a machine.

kinetic sculpture: a three-dimensional artwork made up of parts designed to be set in motion by an internal or external force such as wind currents or water flow, or by mechanical means. It is art that depends on movement for its effect.

pulley: a simple machine that uses grooved wheels and a rope to raise, lower, or move a load.

spool: a cylindrical object that is made to have something (thread, ribbon, or wire) wrapped around it.




Wooden
Spool
Pony
Bead