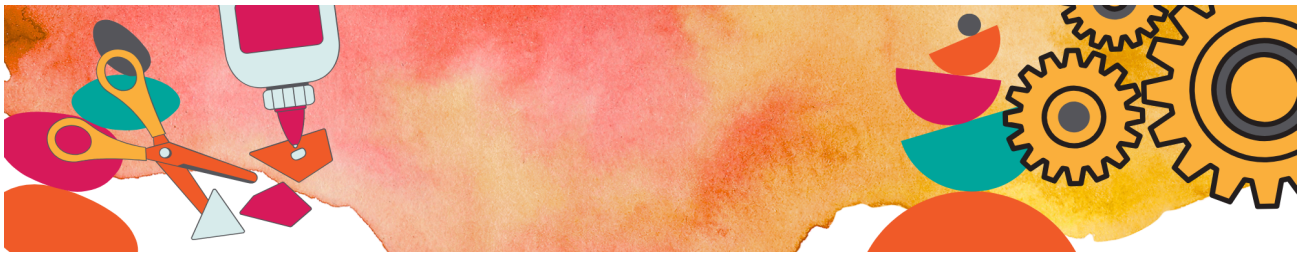
UNIT: CAN YOU BALANCE?
GOLDBERG'S NOT-SO-SIMPLE-MACHINE (Lesson 3 of 4)
Grade Band: 3, 4
Content Focus: Visual Arts & Science



LEARNING DESCRIPTION

In this project, students will engage in the engineering design process to create a Not-So-Simple-Machine demonstrating force and motion! Students will create a drawing of a Rube Goldberg Not-So-Simple-Machine and create a kinetic sculpture, or working model, of that machine. In this project, students will demonstrate how simple machines can be combined in a complicated way to perform a simple task.

LEARNING TARGETS

Essential Questions	"I Can" Statements
How do balanced and unbalanced forces relate to simple machines? How can simple machines combine to affect the balance of forces?	I can demonstrate how a simple machine works. I can revise and refine my plans as I experiment with my creation. I can create a working model from a sketch.

How can simple machines combine to affect motion? How can simple machines make a task easier/harder? How do we sometimes make things more complicated than they need to be?	I can represent a three-dimensional model by a two-dimensional drawing.

GEORGIA STANDARDS

Curriculum Standards	Arts Standards
Grade 4: S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces. a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results. b. Construct an argument to support the claim that gravitational force affects the motion of an object. c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks.	**Grade 4:** VA4.CR.2 Create works of art based on selected themes. VA4.CR.4 Understand and apply media, techniques, processes, and concepts of three-dimensional art.

SOUTH CAROLINA STANDARDS

Curriculum Standards	Arts Standards
Grade 3: 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	**Anchor Standard 2:** I can use different materials, techniques, and processes to make art. **Anchor Standard 7:** I can relate visual arts ideas to other arts disciplines, content areas, and careers.

KEY VOCABULARY

Content Vocabulary	Arts Vocabulary
• Force - Any interaction that, when applied to an object, can cause it to change its motion or shape	• Assemblage - An artistic process in which a three-dimensional artistic composition is made from putting together found objects

- Balanced forces - Two or more forces acting on an object in such a way that they cancel each other out, resulting in no change in the object's motion
- Unbalanced forces - Two or more forces acting on an object are not equal in size or are not opposite in direction, causing the object to accelerate (change its speed or direction)
- Gravitational force - The force of attraction that pulls objects toward each other due to their mass
- Motion - The change in the position of an object over time
- Mass - A measure of the amount of matter in an object or substance
- Simple machines - Basic mechanical devices that make work easier by altering the direction or magnitude of a force; the building blocks for more complex machines
- Rube Goldberg - An American cartoonist, engineer, and inventor best known for creating elaborate, humorous illustrations of complex machines designed to perform simple tasks in overly complicated ways
- Inclined plane - A flat surface that is tilted at an angle
- Lever - A simple machine consisting of a rigid bar or beam that pivots around a fixed point called the fulcrum
- Wedge - A simple machine that consists of a triangular-shaped object, often with a sharp edge, which is used to split, cut, or lift objects
- Pulley - A simple machine consisting of a wheel with a groove around its edge, through which a rope, chain, or belt can

- Kinetic sculpture - Three-dimensional art that is designed to move
- Craftsmanship - Skill in producing expertly finished products
- Sketch - A rough drawing, often made to help make a more finished product
- Variety - The differences in a work, achieved by using different shapes, textures, colors and values
- Two-dimensional art - Art depicted on a flat surface
- Three-dimensional art - Art that has height, width, and depth

pass • Screw - A type of simple machine that consists of an inclined plane wrapped around a central shaft or core • Wheel and axle - A simple machine that consists of two circular objects—a larger wheel and a smaller axle—that are connected and rotate together	

MATERIALS

- Goldberg's Not-So-Simple-Machine Rubric
- Mousetrap game by Hasbro (or a video of the game being played)
- Notecards with simple machines written on them
- Copy paper (1-2 sheets for each student for sketches)
- Drawing paper (9"x12")
- Paper storage boxes
- Safety goggles
- Materials for constructing matches, such as:
  - Dominoes
  - Marbles
  - Ping-pong balls
  - Trains tracks
  - Cars tracks
  - LEGOs
  - Wooden blocks (e.g. Jenga)
  - String
  - K'nex pieces
  - Mini-pulleys
  - Masking tape
  - Rubber bands
  - Glue
  - Paper towel rolls
  - Cardstock

INSTRUCTIONAL DESIGN

Opening/Activating Strategy

- Divide students into small groups.
- Human Simple Machines: Each group will choose a card with the name/picture of a simple machine. The group will act out the simple machine for the class to identify.
- Encourage students to think about how they can creatively use their body to work together and become the various parts of a simple machine
- Have the Mousetrap Game set up and choose a group of students to demonstrate to the class how it runs. Explain to students that they will be using their creativity to design an

unnecessarily complicated machine to do a simple job. *Alternative: Show a video of the game being played.*

Work Session

- Tell students that they will be designing a machine inspired by Rube Goldberg. It will be a complicated machine to complete a simple task.

Part I - Planning:

- Students will work in small groups to:
  - Research Rube Goldberg machines.
  - Brainstorm ideas for possible purposes of a machine they will create.
  - Brainstorm uses for materials provided.
  - Experiment with various materials.
  - Decide on a goal for the machine.
- Show students a list of the materials that are available to them.
- Individually, students will sketch an initial design with pencil on copy paper. Tell students that they should include six or more individual steps, using four or more simple machines.
- Remind students that they should use as much variety as they can and try to include a "Wow!" factor.
- Students should compare their designs and choose which to build or combine ideas into one final idea.
- Students should label their sketch with the materials that they will use.

Part 2 - Creating:

- Students should work in their small groups to create their machines.
- Students should create one piece of the machine at a time and combine components as the test whether they work.
  - *Teacher tip: If creating takes more than one class period, at the end of class, take photos of the machines created in each group and disassemble enough to store. Machines can be stored in storage boxes.*
- After the machines are finished, students should test run the machine three to four times for evaluation.
- Finally, students will sketch their final machine and label the simple machines that they used.

Classroom Tips:

Divide students into groups of three to four. Students who are having difficulty might start with the last step and work backwards. One student in each group should take pictures of building progress at the end of each class period before the machine is disassembled and stored. Each group should have a labeled box for storing partial products.

Closing/Reflection

- After completing their machines, have students reflect on the following questions:
  - How did you choose the job you wanted your machine to do?
  - What would have been the simplest way to do the job without the machine?
  - Why was it important to plan before trying to build the machine?
  - How did your drawing change from your first sketch to the final copy?
  - What would have made the process simpler?

ASSESSMENTS

Formative

- Teacher will observe the students experimenting to determine whether they understand how simple machines work.
- Teacher will question students on the functions of their simple machines.
- Teacher will observe cooperation and participation.
- Teacher will periodically assign each group a different simple machine to act out for a neighboring group to identify.

Summative

- Final drawing of completed machine with simple machines labeled
- Working Rube Goldberg machine
- Goldberg's Not-So-Simple-Machine Rubric

DIFFERENTIATION

Accelerated:

- Students can document the process through video.
- Students can create a cartoon of their machine in the spirit of Rube Goldberg.

Remedial:

- Preview the key vocabulary with pictures listed beside each word on an anchor chart, word wall, or flashcards. The teacher and students will define words together. This may be done in small groups the day before the unit begins.
- Group students heterogeneously and assist the group to help find appropriate contributions for each step of the project based on individual strengths.
- Allow students to proofread their responses by dictating their reflections in OneNote (OneNote > Learning Tools Add-in > Dictate).

ADDITIONAL RESOURCES

- http://www.softschools.com/science/simple_machines/games/ (students can visit to review the six simple machines)
- https://www.rubegoldberg.com/
- https://www.youtube.com/watch?v=84cyAyzzzic (Helpful Rube Goldberg hacks)
- https://www.youtube.com/watch?v=OCqGi2RDm5s (Tips and tricks)
- *Rube Goldberg Inventions* (book)

CREDITS

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**This integrated lesson provides differentiated ideas and activities for educators that are aligned to a sampling of standards. Standards referenced at the time of publishing may differ based on each state's adoption of new standards.*