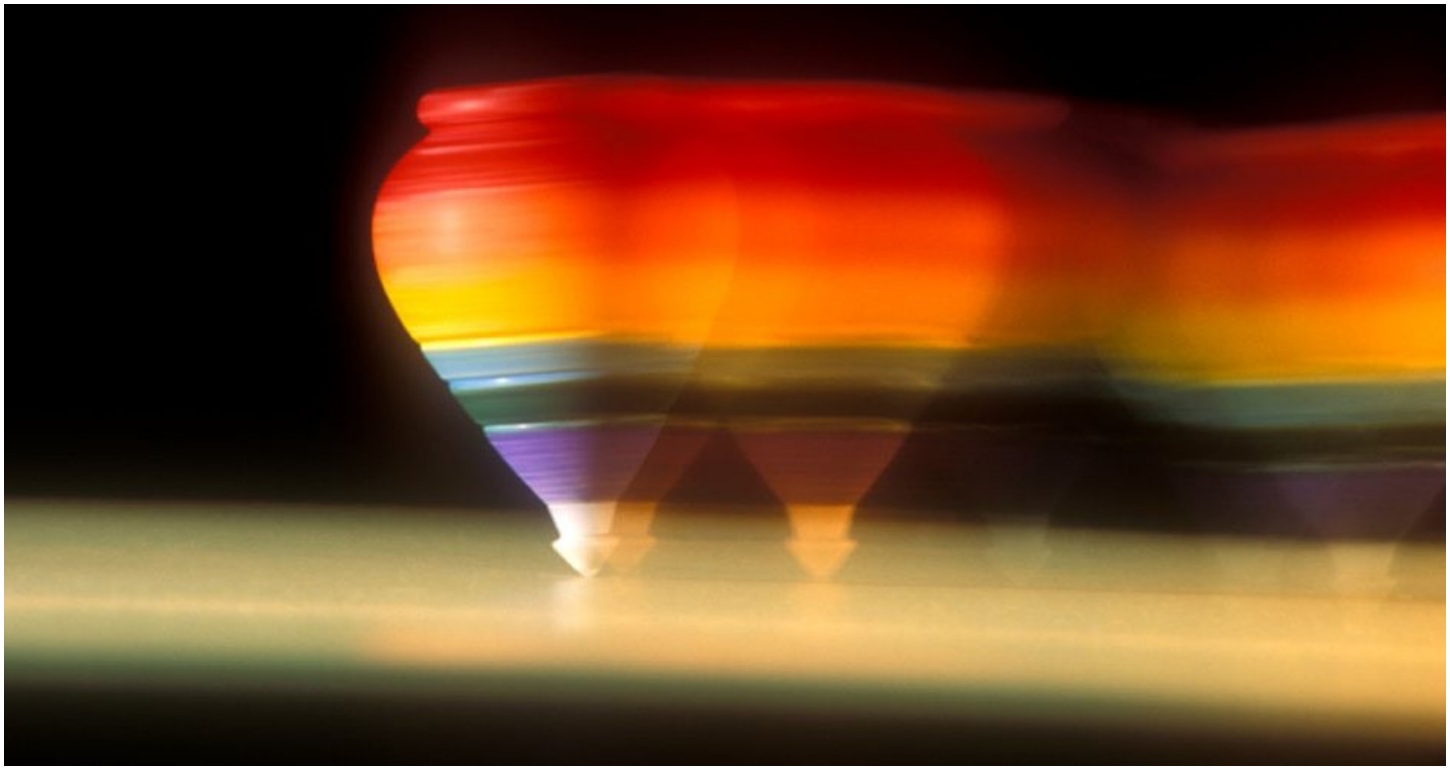
ArtsNow®
Teaching and Learning Across the Curriculum

Goldberg's Not-So-Simple Machine



Unit Essential Questions

How do balanced and unbalanced forces relate to simple machines?

How can simple machines combine to affect the balance of forces?

PROJECT DESCRIPTION

In this project, students will engage in the design process around an exciting 4th grade science topic: Force & Motion! Students will create a drawing of a 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

"I Can…"

- **Demonstrate how a simple machine does work**
- **Create sketches for planning and self-reflection**
- **Revise and refine my plans as I experiment with my creation**
- **Create a working model from a sketch.**
- **Represent a 3-dimensional model by a 2-dimensional drawing**

Produced through the U.S. Department of Education: Arts in Education—Model Development and Dissemination Grants Program
Cherokee County (GA) School District and ArtsNow, Inc.

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Approx. Duration of Project: 4 (minimum) 45-minute class periods

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ESSENTIAL QUESTIONS

- How do balanced and unbalanced forces relate to simple machines?
- How can simple machines combine to affect the balance of forces?
- 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?

STANDARDS

Curriculum Standards	Arts Standards
• **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. 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.	• **VA4MC.1 Engages in the creative process to generate and visualize ideas.** b. Formulates visual ideas by using a variety of resources (e.g., books, magazines, Internet). **VA4MC.2 Formulates personal responses to visual imagery.** a. Uses a sketchbook for planning and self-reflection. c. Self-monitors by asking questions before, during, and after art production to reflect upon and guide the artistic process. • **VA4PR.1 Creates artworks based on personal experience and selected themes.** b. Makes design decisions as the result of conscious, thoughtful planning and choices. g. Combines materials in new and inventive ways to make a finished work of art. • **VA4PR.2 Understands and applies media, techniques, and processes of two-**

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	dimensional art processes (drawing, painting, printmaking, mixed-media) using tools and materials in a safe and appropriate manner to develop skills. a. Produces drawings with a variety of media (e.g., pencils, crayons, pastels, and charcoal). • **VA4PR.3 Understands and applies media, techniques, and processes of three-dimensional works of art (ceramics, sculpture, crafts, and mixed-media) using tools and materials in a safe and appropriate manner to develop skills.** a. Creates 3-D artwork that demonstrates a design concept: open or closed form, proportion, balance, color scheme, and movement.

KEY VOCABULARY

Content Vocabulary	Arts Vocabulary
• simple machine • balanced forces • unbalanced forces • force • work • inclined plane • lever • wedge • pulley • screw • wheel and axle	• assemblage: an artistic process in which a 3-dimensional artistic composition is made from putting together found objects • kinetic sculpture: 3-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 picture • variety: refers to differences in a work • two-dimensional art: art depicted on a flat surface • three-dimensional art: art that has height, width, and depth

TECHNOLOGY INTEGRATION

- http://www.softschools.com/science/simple_machines/games/ (students can visit to review 6 simple machines)
- https://www.rubegoldberg.com/
- https://diy.org/skills/physicist/challenges/389/make-a-rube-goldberg-machine (OKGo "This Too Shall Pass" video - incredible Rube Goldberg machine and music video) -or-
- http://okgo.net/category/videos/ (alternate access to "This Too Shall Pass" video listed above)
- https://www.youtube.com/watch?v=84cyAyzzzic (Helpful Rube Goldberg hacks)

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- https://www.youtube.com/watch?v=OCqGi2RDm5s (Tips and Tricks)

ASSESSMENTS

Formative	Summative
• Teacher will observe the students experimenting for understanding of 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.	• Initial pencil sketch of project idea • Pen and ink drawing of final product • Working Rube Goldberg Machine • Rubric

MATERIALS

- Mousetrap Game by Hasbro
- Copy paper (1-2 sheets for each student for sketch)
- 60# weight drawing paper (9"x12")
- Black matting
- Black Sharpies (fine point and extra-fine point)
- Paper storage boxes
- Safety goggles
- Dominoes
- Marbles
- Ping-pong balls
- Trains and tracks
- Cars and tracks
- Action figures
- LEGOs
- Wooden blocks (e.g. Jenga)
- String
- K'nex pieces
- Mini-pulleys
- *Rube Goldberg Inventions* (book)

Activating Strategy (5- 10 min)

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- Human Simple Machines: Each group chooses a card with the name/picture of a simple machine. The group acts 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
- Show the OKGo music video of a Rube Goldberg machine for inspiration.
- 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.

Main Activity

PROCESS

PART I - Planning (45 minutes)
Students work in Small Groups:

- Research videos online of Rube Goldberg machines.
- Brainstorm uses for materials.
- Experiment with various materials.
- Decide on a goal for the machine.
- Individually sketch an initial design with pencil on copy paper. The goal is to include 6 or more Individual steps, using 4 or more simple machines.
- Remind students that they should use as much variety as they can and try to include a "wow!" factor.
- Compare designs and choose which to build or combine ideas into 1 initial idea.

PART 2 - Beginning Creation Day 1 (45 minutes)
Students work in Small Groups:

- Students choose a simple machine to incorporate.
- Students choose materials to create their part of the machine.
- Students combine components as they get them to work.
- Students work together to test each step and trouble-shoot.
- At end of class, take photos of the machines created in each group and disassemble enough to store.

PART 3 - Final Creation Day 2 (45 minutes)
Students work in Small Groups:

- Refer back to photos to reassemble machines in small groups.
- Complete machine and test run the machine 3-4 times for evaluation.
- Students begin sketch of their final machine. *(Remind students that they must be very careful because they will only receive 1 piece of drawing paper.)* Trace the drawing with a Sharpie to create final pen and ink drawing.
- Neatly label all simple machines with ball-point pen or extra-fine Sharpie.

Classroom Tips:
Divide students into groups of 3-4. Students who are having difficulty might start with the last step and work backwards. 1 student in each group should take pictures of building progress at the end of each class period before machine is disassembled and stored. Each group should have a labeled box for storing partial products. Students should be cautioned to use dominoes sparingly due to difficulty of use

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and unpredictability.

REFLECTION

Reflection 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?*

DIFFERENTIATION

BELOW GRADE LEVEL:
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 group 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.

ABOVE GRADE LEVEL:
- Students keep a blog or vlog of the process.
- Students create a cartoon in the spirit of Rube Goldberg.

EL STUDENTS: (ELP=English Language Proficiency)
- Pre/Post Test: read aloud or small group accommodation as needed
- 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 group the day before the unit begins. The ESOL teacher may meet with students who are lacking the basic vocabulary for additional practice before starting the unit.
- Written reflection: (a version with sentence starters is on pg. 2)

ELP 1-2 Pair students with partners with higher writing proficiencies. Allow students to respond in their native language and have a peer translate their responses.
ELP 3-6 Allow students to proofread their responses by dictating their reflections in OneNote (OneNote>Learning Tools Add-in>Dictate).

ADDITIONAL RESOURCES

- Skype: "Talk with Jennifer George, Rube's Granddaughter and author of the best-selling book, *The Art of Rube Goldberg*. Jennifer discusses her grandfather's cartoons and little-known facts about the man she knew as Papa Rube." (from https://www.rubegoldberg.com/education/skype-in-the-classroom/)
- Students keep a blog or vlog of the process.
- Students create a cartoon in the spirit of Rube Goldberg.

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APPENDIX

- Rubric for this project

CREDITS

U.S. Department of Education
Arts in Education--Model Development and Dissemination Grants Program
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Goldberg's Not-So-Simple-Machine

TASK: Create a complex machine in the style of Rube Goldberg.

Task	4	3	2	1
Creating Goldberg Machine	Machine successfully achieved its goal and included 6 or more individual steps, using 4 or more simple machines.	Machine mostly successfully achieved its goal and included 4 or more individual steps, using 4 or more simple machines.	Machine inconsistently worked and included less than 3 individual steps, using less than 3 simple machines.	Machine does not achieve its goal due to lack of individual steps and mastery of any simple machines.
Communicate	Student has planned out construction of machine; student uses appropriate language skills; students can inform and explain to audience what they created	Student has a plan for the construction of machine; student has minimal errors in language skills, students can inform and explain to audience what they created	Student doesn't have a plan for the construction of machine; student has major (more than 5) errors in language skills, students can inform and explain to audience what they created	Student does not have a plan for the construction of their machine; language errors make understanding difficult; students do not inform/explain what they created
Sketching 2-Dimensional	Student demonstrated how a simple machine worked and created sketches that communicated balanced and unbalanced forces of motion clearly.	Student's thoughts show understanding of balanced and unbalanced forces, but no relationship to the Goldberg machine they designed.	Students sketches show a minimal understanding of balanced and unbalanced forces; relationship to Goldberg machine is not apparent.	No understanding of balanced and unbalanced forces evident.

Teacher Commentary: _____
_____
_____
_____

Student Commentary:_____
_____
_____
_____

Total Score: _____