How to Get Rid of a Mouse

The best mousetrap by Rube Goldberg: Mouse (A) dives for painting of cheese (B), goes through canvas and lands on hot stove (C). He jumps on cake of ice (D) to cool off. Moving escalator (E) drops him on boxing glove (F) which knocks him into basket (G) setting off miniature rocket (H) which takes him to the moon.
Introduction

This curriculum guide is meant to accompany the Rube Goldberg Machine Speed-Build Trunk and provide a frame work to understanding simple machines. It is purposefully written to be adaptable to almost any grade level, ability or background. The standards used in guidance of creating this curriculum are the Next Generation Science Standards (http://www.nextgenscience.org/).

The Learning Outcomes this curriculum will provide are:

1. Understand the basic simple machines.
2. Evaluate the mechanical advantage of simple machines.
3. Design simple and compound machines.

These lessons are meant to be used in conjunction with, not in replacement of, the current simple machine curriculum that your school is using. These lessons can be used in succession, separately or in any order that is appropriate for your school. These are meant to be used in Science classrooms, but are cross-curricular to include writing components.

Time requirements have specifically been left off the following lesson plans as we understand every school has a different schedule and each teacher knows their students best. We estimate that Lessons 1 and 2 are approximately one class period long, while Lessons 3 through 8 could be two or more class periods long.

There may be some materials that will need to be sourced outside of the Rube Goldberg Machine Speed-Build Trunk. Please see the included Resources for colorized images of cartoons, worksheets and links to videos.

Any questions or edits, or for further materials, please contact Janine@rubegoldberg.com.
Rube Goldberg (1883-1970) was a Pulitzer Prize winning cartoonist best known for his zany invention cartoons. He was born in San Francisco on the 4th of July, 1883 – and graduated from U. Cal Berkeley with a degree in engineering. His first job at the San Francisco Chronicle led to early success, but it wasn’t until he moved to NYC and began working for Hearst publications that he became a household name. Rube Goldberg is the only person ever to be listed in the Merriam Webster Dictionary as an adjective. It’s estimated that he did a staggering 50,000 cartoons in his lifetime. For videos about Rube: https://www.rubegoldberg.com/about/.

A Rube Goldberg Machine is “a comically involved, complicated invention, laboriously contrived to preform a simple operation” (Webster’s New World Dictionary). Humor and a narrative are what separate a Rube Goldberg machine from a chain-reaction machine. Each of Rube’s cartoon’s told a story and his entire goal was to get you to laugh.

Rube Goldberg, Inc. is dedicated to keeping laughter and invention alive through the legacy of its namesake. Annual competitions, image licensing, merchandising, and museum and entertainment opportunities continue to grow and enhance the brand. At the helm is Rube’s granddaughter, Jennifer George, with her recent book, The Art of Rube Goldberg.

For a “Skype in the Classroom” lesson with Jennifer, please email Janine@rubegoldberg.com.

For more information, go to: www.rubegoldberg.com

RGI is a not-for-profit 501(c)3 dedicated to promoting STEM & STEAM education for students of all ages.
Lesson 1: Draw a Simple Machine Cartoon

Materials/ Resources:
1. An example of a Rube Goldberg cartoon (see Resources).
2. Drawing Rube Goldberg Machines worksheet (see Resources) or any size paper.
3. Pencils, markers or crayons.

Pre-activities:
Students will need to know the following:
• What is work?
• What are the six simple machines?
• How do machines multiply force without multiplying work?

Activities:
1. Give some history of Pulitzer Prize winning cartoons by Rube Goldberg.
2. Show an example of Goldberg’s work and follow each segment to the completion of his designated task, highlighting each simple machine.
3. Explain that a team of students (seems to work best with two students per team) is to decide on a simple chore or task and devise a “Rube Goldberg” way to accomplish this activity using at least five simple machines.
4. Have students draw a cartoon of their machine labeling each step and making sure to include humorous elements.
5. Have students present their cartoon to class explaining how it would work to accomplish their chosen task.

Assessment
1. Observe team’s ideas and progress.
2. Check to see if the five simple machines are incorporated in the design.
3. Determine if the machines will accomplish the tasks they are designed to complete.
4. Creativity and imagination are also assessed.

Differentiations:
1. Students can work alone, or in larger groups, on their cartoon.
2. Students can collage pictures of objects into their cartoons instead of drawing them.
Lesson 2: Human Rube Goldberg Machine

Materials/ Resources:
1. An example of a Rube Goldberg cartoon (see Resources).
2. Space: open space like a gym or hallway, or have the students use the perimeter of the classroom with desks pushed in to center.
3. Video Examples:
   https://www.youtube.com/watch?v=4MiYtvbK4JY

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?

Activities
1. Give some history of Pulitzer Prize winning cartoons by Rube Goldberg, or review prior lesson (Draw a Simple Machine Cartoon).
2. Show an example of Goldberg’s work and follow each segment to the completion of his designated task, highlighting each simple machine.
3. Explain that a team of students (seems to work best with five students per team) is to decide on a simple chore or task and devise a “Rube Goldberg” way to accomplish this activity using at least five simple machines.
4. Have students act out their machine in a linear fashion like a skit with each student taking on the role of an object.
5. Have students present their human Rube Goldberg Machine to class explaining how it would work as they go along to accomplish their chosen task.

Assessment:
1. Observe team’s ideas and progress.
2. Check to see if the five simple machines are incorporated in the design.
3. Determine if the machines will accomplish the tasks they are designed to complete.
4. Creativity and imagination are also assessed.

Differentiations:
1. Students can mime their machine actions and have other students guess what they are portraying.
2. Students can incorporate props from the classroom into machine portrayals.
3. Record the student’s machine on video and review with class which were most successful, funny, etc.
4. One student on the team can be the narrator to the actions, or each student “object” can explain their role and connection to next person.
Lesson 3: Experiment with Simple Machines

Materials/Resources:
1. An example of a Rube Goldberg cartoon (see Resources).
2. See following “Simple Machine Station Guide” for each station’s materials and Resources for worksheets. Materials can be found in the Rube Goldberg Machine Building Trunk, or can be sourced elsewhere.

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?

Activities
1. Give some history of Pulitzer Prize winning cartoons by Rube Goldberg, or review prior lesson (Draw a Simple Machine Cartoon, Human Rube Goldberg Machine).
2. Show an example of Goldberg’s work and follow each segment to the completion of his designated task, highlighting each simple machine.
3. Assign students a Simple Machine Station to start at and set a rotation schedule. (Students generally need at least 15 minutes at each station).
4. Review with students in a large group, or at each station, what the experiment is.
5. After the students have had a chance to visit all six stations, ask one student from each station to give a quick summary explanation of that simple machine to the class.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of the physical task of each simple machine.

Differentiations:
1. After students rotate to all six simple machine stations have them revise their cartoons from the first lesson (Draw a Simple Machine Cartoon) to make edits to the simple machines from what they learned.
Simple Machine Station Guide

**Lever** - The students will make a lever out of the given materials and explore the relationship of the fulcrum to the load. The students will discover that it is easier to move an object when the fulcrum is closer to the load.

**Materials:**
- Wooden ruler
- Object to lift
- Tape
- Can or toilet paper roll
- Lever

**Hint:**
- Move the fulcrum closer to the load.
- Move the fulcrum away from the load.

**Inclined Plane** - The students will make inclined planes with boards varying the slope of the board. There will be rubber bands around the book. The students will tie the string to the rubber bands and pull the books up the different inclined planes. They will also pull the books straight up without using the inclined planes. The students will find that it take more work to move an object up an inclined plane with the steepest slope.

**Materials:**
- 2 Boards varying in lengths
- String
- Rubber bands
- Ruler
- Heavy Book
- Inclined Plane worksheet

**Hint:**
- Look at the stretch of the rubber bands straight up compared to different inclined planes.

**Wheel and Axle** - The students will push one car on its side and the other on its wheels. They will note the difference in distance traveled.

**Materials:**
- 2 matchbox cars
- Rulers
- Wheel and Axle Worksheet

**Hint:**
- Try one of the cars on its side.
**Screw**- The students will make a screw out of an inclined plane. Student will cut the square diagonally to make an inclined plane. Tape one of the short edges of the triangle to a pencil. Wrap the triangle around the pencil. They will actually see the inclined plane as part of the screw.

**Materials:**
- 9 inch Paper Square
- Tape
- Pencil
- Scissors
- Tabletop
- Screw Worksheet

Hint:
- What is a screw made out of?
- How can you make an inclined plane with the given materials?

**Wedge**- The students will cut paper with both sharp scissors and dull scissors. They will observe that the sharp scissors will cut better than the dull scissors.

**Materials:**
- Paper
- Dull Scissors
- Sharp Scissors
- Wedge Worksheet

Hint:
- How are the cuts different?

**Pulleys**- The students will make a pulley with a sewing spool, string, and a pencil. They will use this pulley to lift an object. They will compare lifting the object with the pulley and without the pulley. They will find that it is easier to lift an object with the use of a pulley.

**Materials:**
- Sewing spool
- String
- Pencil
- Object to lift
- Pulley worksheet

Hint:
- Compare using the pulley and not using the pulley.
Lesson 4: Machine Poetry

Materials/Resources:
1. Click, Rumble, Roar edited by Lee Bennett Hopkins, Machine Poems edited by Jill Bennett, or other poetry books with machine references
2. Chart paper, marker/white board
3. Clipboards with paper and pencils for every two students.

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• Types of poem structures and descriptive words.

Activities:
1. The teacher will choose and read aloud a poem asking the students to write a quick personal response to the poem.
2. Read 2 - 3 poems and have students verbally share responses, writing key terms on the board when appropriate. Discuss any terms that may be new to some students.
4. Now students will go on a “machine walk.” *
5. Divide the class into teams of 2. Give each team these directions:
   a. Each team has 20 minutes to take a machine walk.
   b. The teams should describe any machines that they see around the school using descriptive words and drawings.
   c. Each team should look for a different machine.
   d. They should not interrupt any classes. (If possible, students should observe from the hallways. If this is not the case at your school, you might check with some teachers and ask if one or two groups can quietly come in the room.)
6. Send the teams on their mission with a designated time of return.
7. Monitor the halls while the groups are out to keep groups on task.
8. Regroup in the classroom at the designated time.
9. Allow groups to share machines they wrote down while the teacher writes these on chart paper/white board.
10. Each team of students can work together or separately to write a short poem about the machine they observed. Review descriptive words that could describe the machine’s sounds, smells, they way it looks and its purpose/task.
11. Have students share their machine poem with the class.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s poetry composition and use of descriptive words to learn about machines.

Differentiations:
*1. If it is not possible for students to leave the classroom, the teacher can gather examples of machines to display in the classroom and students can view them there. Or the teacher may ask students to bring in examples of machines.
Lesson 5: Machine Stories

Materials/Resources:
1. An example(s) of a Rube Goldberg cartoon with the accompanying text covered or removed (see Resources).

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?

Activities:
1. Students will look at Rube Goldberg’s cartoon machines without their accompanying text.
2. Students will use descriptive words to portray the machine’s actions.
3. This can be done as a writing assignment on paper, a presentation assignment out-loud to the class or in small groups or a combination of both.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of the physical task of each machine.
3. Observe student’s use of descriptive words to learn about machines.

Differentiations:
1. Have students write a short story about a machine they wish they had to accomplish an everyday task in their lives, ex. chore machine like feed the dog, using descriptive words to “paint the image of the machine” as well as define why they want such a machine and how it would help them.
Lesson 6: Energy Transfers

Materials/Resources:
1. An example(s) of a Rube Goldberg cartoon (see Resources).
2. 3 marbles (Different sizes &/or weights), inclined plane, ruler, milk carton.
3. Baking soda, vinegar, 5 plastic flasks with corks and 5 measuring cups, plus protective eye wear, like goggles, for each student.
4. Balls that will bounce.
5. Rubber bands.
6. Online interactives:

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?
• What are the different types of energy?
• What is mechanical energy?

Activities:
1. Set up a demonstration of rolling three different sized marbles down an inclined plane. Place the bottom section of a milk carton at the bottom of the ramp to catch the marble and measure the distance that it moves the carton. Ask students to predict how many centimeters each marble will move the milk carton, and which marble will move it the most. Demonstrate one marble and record the distance the milk carton was moved. Repeat five times and take the average distance. Demonstrate the second and third marbles using the same process. Compare student’s predictions with outcomes. Which marble had the most energy? Why? Students will discover that the larger the mass, and the higher an object is raised, the more energy is stored.
2. Have students assume a standing X (“jump jack open”) position, with arms above their shoulders in a wide V and legs apart in an inverted V. Tell them to hold the position, and explain that they are storing potential energy, just waiting to be converted into kinetic energy - energy in motion. Allow them to do a jumping jack. Explain that, as they move, they're creating kinetic energy; at each pause their bodies are holding potential energy.
3. Demonstrate the relationship of potential energy and chemical energy using vinegar and baking soda. Explain that vinegar and baking soda are made of molecules that contain potential energy in their chemical bonds, or potential chemical energy. Have students write a one sentence prediction of what will happen when baking soda, vinegar and water are mixed together. Break students into 5 groups of 4. Instruct students to put their goggles on. Have students mix half a
cup each of water and vinegar in a plastic flask. Put a teaspoon of baking soda in a coffee filter. Insert it in the flask. Place cork securely on flask. Quickly move away. After the cork pops off the flask have students write a paragraph about the steps of the experiment and the results. They should write it on the same sheet of paper as the prediction. The energy created -kinetic energy created when chemical interaction converts potential energy -will blow the cork right off the flask. (For a less messy -- but also less dramatic -- experiment, pour vinegar over a pile of baking soda and watch the energy conversion occur.)

4. Potential Energy and Gravity: A bouncing ball is an interesting way to demonstrate a rapid conversion from potential to kinetic energy and back, created by gravity. Allow students to hold a ball over their heads, let it bounce off the floor and allow it to continue bouncing. Explain that gravity is the force that converts the ball's potential energy to kinetic energy; when it hits the pavement, it possesses potential energy for an instant, and then the force of the ground converts it to kinetic again as it bounces upward.

5. Potential and Kinetic Energy: Rubber bands provide an excellent vehicle for explaining potential energy to students. Give a rubber band to each student. Ask them to hold it tightly and stretch it almost as tightly as possible. Explain that the stretched rubber band exemplifies potential energy, which they can feel in the tension as the rubber band pulls against their hands. Then let them let go of the rubber band -pointing it at the wall and not at each other. Explain that movement in the rubber band demonstrates potential energy being converted to kinetic energy.

**Assessment:**
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of kinetic versus potential energy.

**Differentiations:**
1. Not every activity needs to be done in this lesson; the teacher can choose what is appropriate for their classroom.
Lesson 7: Build a 3-Step Rube Goldberg Machine

Materials/Resources:
1. An example(s) of a Rube Goldberg cartoon (see Resources).
2. The Rube Goldberg Machine Speed-Build Trunk, plus any specific materials your class desires.

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?
• What is an energy transfer?
• What are the different types of energy?
• What is mechanical energy?

Activities:
1. Review history of Pulitzer Prize winning cartoons by Rube Goldberg, or review prior lesson (Draw a Simple Machine Cartoon, Human Rube Goldberg Machine).
2. Review each simple machine with class. Have students brainstorm ways to connect simple machines to make compound machines.
3. Set parameters for each step, what “counts” as a step, such as an energy transfer, plus size allotment for each machine (a table top or a few desks pushed together is recommended for each group of students).
4. Break students into groups of 2-4 each.
5. Assign a task*, or let the students choose their task, and decide how long they will have to build their machine.
6. Have students build a three step Rube Goldberg machine. The teacher may assign materials from the Trunk or let students choose.
7. After the allotted period of time, each team of students should “run” their machine to see if it works for the rest of the class.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of the physical task of each simple machine.
3. Observe student’s

Differentiations:
1. Have students write a machine task description like Rube Goldberg (A. The palm tree falls over, knocking into parrot B….etc. See Resources for examples of text accompanying cartoons).
2. Have students present their machines to the rest of the class with the task description serving as a narrative.
3. Have students judge the machines on a rubric you create or for funniest, most creative, etc.
*Pop a Balloon is a simple but exciting task and the Rube Goldberg Machine Building Trunk is equipped with balloons and sharp objects.
Lesson 8: Build a 7-Step Rube Goldberg Machine

Materials/Resources:
1. An example(s) of a Rube Goldberg cartoon (see Resources).
2. The Rube Goldberg Machine Speed-Build Trunk, plus any specific materials your class desires.

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?
• What is an energy transfer?
• What are the different types of energy?
• What is mechanical energy?

Activities:
1. Review history of Pulitzer Prize winning cartoons by Rube Goldberg, or review prior lesson (Draw a Simple Machine Cartoon, Human Rube Goldberg Machine).
2. Review each simple machine with class. Have students brainstorm ways to connect simple machines to make compound machines.
3. Set parameters for each step, what “counts” as a step, such as an energy transfer, plus size allotment for each machine (a table top or a few desks pushed together is recommended for each group of students).
4. Break students into groups of 2-4 each.
5. Assign a task*, or let the students choose their task, and decide how long they will have to build their machine.
6. Have students build a seven step Rube Goldberg machine. The teacher may assign materials from the Trunk or let students choose.
7. After the allotted period of time, each team of students should “run” their machine to see if it works for the rest of the class.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of the physical task of each simple machine.
3. Observe student’s

Differentiations:
1. Have students write a machine task description like Rube Goldberg (A. The palm tree falls over, knocking into parrot B….etc. See Resources for examples of text accompanying cartoons).
2. Have students present their machines to the rest of the class with the task description serving as a narrative.
3. Have students judge the machines on a rubric you create or for funniest, most creative, etc.
*Pop a Balloon is a simple but exciting task and the Rube Goldberg Machine Building Trunk is equipped with balloons and sharp objects.
Lesson 9: Build a 15-Step Rube Goldberg Machine

Materials/ Resources:
1. An example(s) of a Rube Goldberg cartoon (see Resources).
2. The Rube Goldberg Machine Speed-Build Trunk, plus any specific materials your class desires.

Pre-activities:
Students will need to know the following:
• What is a Rube Goldberg Machine?
• What are the six simple machines?
• How do machines multiply force without multiplying work?
• What is an energy transfer?
• What are the different types of energy?
• What is mechanical energy?

Activities:
1. Review history of Pulitzer Prize winning cartoons by Rube Goldberg, or review prior lesson (Draw a Simple Machine Cartoon, Human Rube Goldberg Machine).
2. Review each simple machine with class. Have students brainstorm ways to connect simple machines to make compound machines.
3. Set parameters for each step, what “counts” as a step, such as an energy transfer, plus size allotment for each machine (a table top or a few desks pushed together is recommended for each group of students).
4. Break students into groups of 2-4 each.
5. Assign a task*, or let the students choose their task, and decide how long they will have to build their machine.
6. Have students build a fifteen step Rube Goldberg machine. The teacher may assign materials from the Trunk or let students choose.
7. After the allotted period of time, each team of students should “run” their machine to see if it works for the rest of the class.

Assessment:
1. Observe student’s ideas, progress and teamwork.
2. Observe student’s understanding of the physical task of each simple machine.
3. Observe student’s

Differentiations:
1. Have students write a machine task description like Rube Goldberg (A. The palm tree falls over, knocking into parrot B….etc. See Resources for examples of text accompanying cartoons).
2. Have students present their machines to the rest of the class with the task description serving as a narrative.
3. Have students judge the machines on a rubric you create or for funniest, most creative, etc.
*Pop a Balloon is a simple but exciting task and the Rube Goldberg Machine Building Trunk is equipped with balloons and sharp objects.