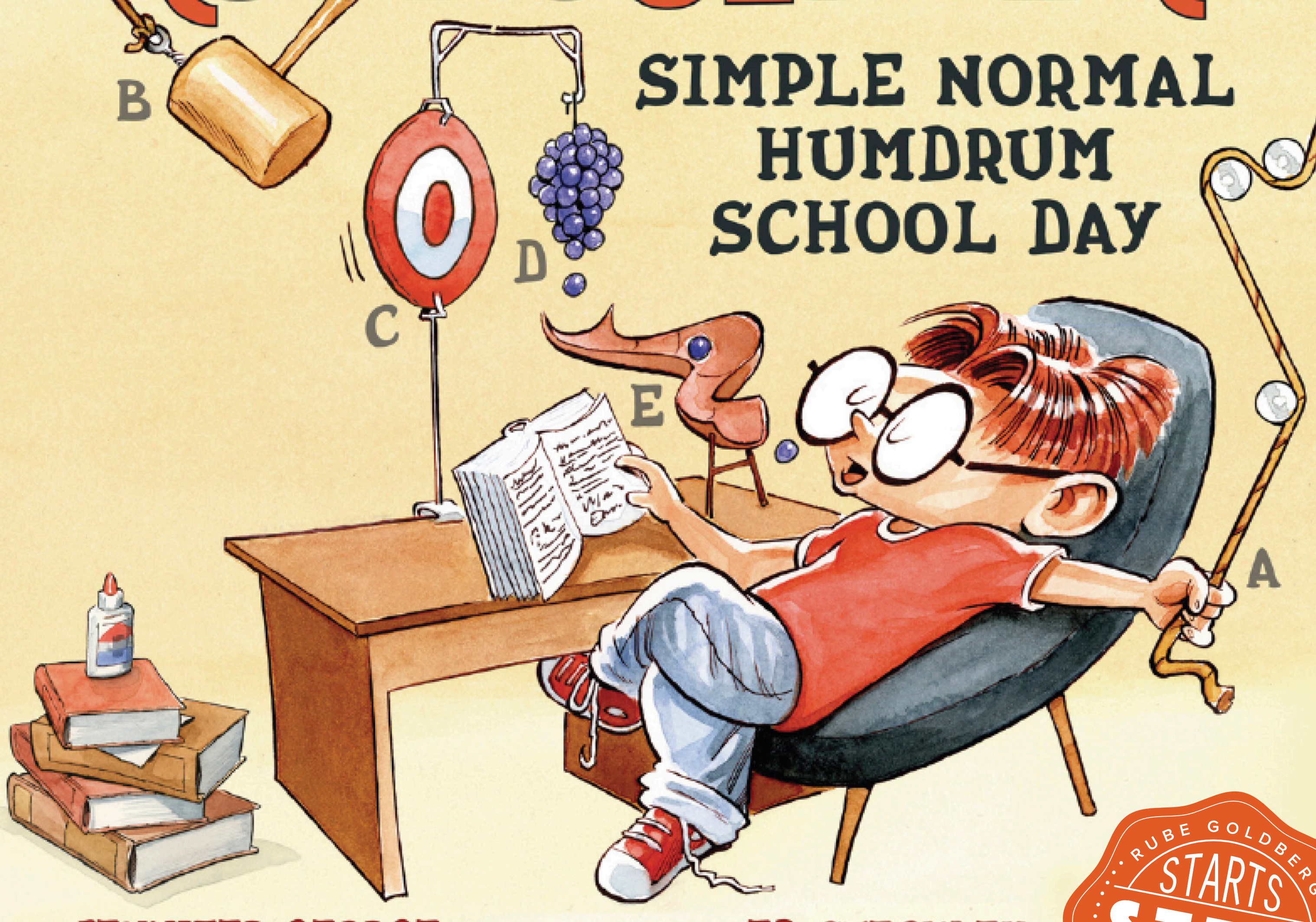
# LESSON PLANS FOR RUBE GOLDBERG'S SIMPLE NORMAL HUMDRUM SCHOOL DAY




BY JENNIFER GEORGE ILLUSTRATED BY ED STECKLEY

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# Introduction

*Rube Goldberg's Simple, Normal, Humdrum School Day* was created by Jennifer George, Rube Goldberg's granddaughter. This derivative work is primed to introduce the hilariously overwrought inventions of her grandfather to a new audience. The idea was to follow young "Rube" through his day and see all the gizmos he comes up with to make his life easier. George worked closely with Ed Steckley, the illustrator, Charlie Kochman, the Editor, and Joseph Herscher, the designer who helped engineer most of the contraptions in the book. Our hope is that you use this book as a fun tool when teaching kids about STEM and STEAM principles and to inspire them to build and tinker on their own.

This curriculum guide is meant to accompany the book *Rube Goldberg's Simple, Normal, Humdrum School Day* by Jennifer George and provide a frame work to understanding simple machines. It is purposefully written to be adaptable to almost any grade level, ability or background. These lessons can be used in succession, separately or in any order that is appropriate for your school. The standards used in guidance of creating this curriculum are the Next Generation Science Standards (http://www.nextgenscience.org/). For questions, please contact Janine@rubegoldberg.com.

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.

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 the lessons are approximately one class period long, though could be extended to two or more class periods long.

**Assessment Ideas:**

1. Observe student's ideas, progress and teamwork.
2. Observe student's understanding of the physical task of each simple machine.
3. Assign students open-ended questions for reflection through writing/talking/summarizing/journaling.
4. Have students think-pair-share before, during and after the lesson.
5. Give students a one-question quiz on the main concept of the lessons.

## Recommended Next Generation Science Standards Connections

**Kindergarten**

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

**Second Grade**

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be
disassembled and made into a new object.

**Kindergarten-Second Grade**

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

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.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

**Third Grade**

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

**Fourth Grade**

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

**Third-Fifth Grade**

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

**Middle School**

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

# Who is Rube Goldberg?

**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 a not-for-profit 501(c)3 dedicated to promoting STEM & STEAM education for students of all ages and 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, *Rube Goldberg's Simple, Normal, Humdrum School Day*.

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

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

# Lesson 1: What are Simple Machines?

**Resources:**
1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
2. Simple Machines worksheets (see Resources, page 16-22) See "Simple Machine Station Guide" for each station's materials and resources for worksheets.

**Guiding Questions:**
1. What is a Rube Goldberg Machine?
A. A Rube Goldberg Machine is "a comically involved, complicated invention, laboriously contrived to preform a simple operation."
2. What are the 6 Simple Machines?
A. The 6 Simple Machines are: wedge, screw, lever, wheel and axel, inclined plane and pulley. See following Resources worksheets for definitions and examples.
3. What do Simple Machines do?
A. Simple machines make work easier for us by allowing us to push or pull over increased distances. They help humans increase and/or redirect the force applied to an object. The main benefit of machines is that they allow us to do the same amount of work by applying a smaller amount of force over a greater distance.

**Activities**
1. Read *Rube Goldberg's Simple, Normal, Humdrum School* and give students some history of original cartoons by Rube Goldberg.
2. Discuss the 6 Simple Machines and Guiding Questions with students.
3. Show an example of Goldberg's invention or an invention from the book, and follow each segment to the completion of his designated task, highlighting each simple machine.
4. Find the six simple machines illustrated in the inventions in the book. See the last page of the book (STEM Starts Here) for reference.
5. Complete the first two worksheets from the Resources section: Page 13 "Label the 6 Simple Machines from Rube's Inventions," and Page 14 "Circle and Label Simple Machines in Rube's Invention."
6. 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.

**Further Ideas:**
1. Have a scavenger hunt to look for the 6 Simple Machines is use around your house, neighborhood or school.
2. Recreate some of the depictions of the 6 Simple Machines from the book using household materials.

# Lesson 2: Make a Pinwheel featuring a Wheel and Axle

**Materials/ Resources:**

1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
   *A Simple Machine to Wake Up in the Morning* illustration, letter G "Train Wheel and Axel"
2. Pinwheel template (see Resources, page 23)
3. 8" squares of heavy paper, plastic bendy straws, hole punches, tape, scissors, pencils.

**Pre-activities:**

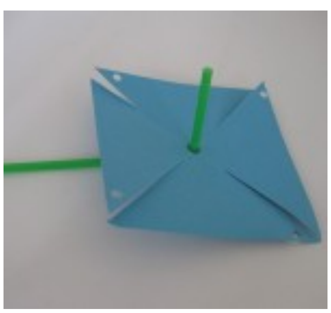
Students will need to know the following:

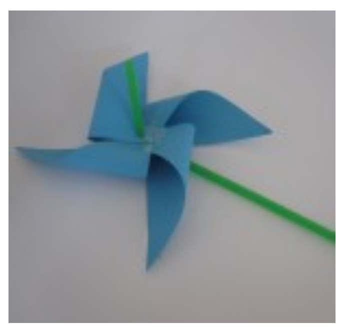
1. What is a Wheel and Axle?
   A. A Wheel and Axle is a simple lifting machine consisting of a cylindrical drum or shaft joined to the wheel to provide mechanical advantage. Synonyms: axis, shaft.
2. How is a pinwheel a Simple Machine?
   A. The "wheel" of a pinwheel is the blades and the "axle" is the straw the blades spin around.

**Activity:**

1. Fold your square of paper in half at the corners, corner to corner, both ways and unfold.
2. Cut slits from the corners ¾ of the way in towards the middle, as indicated by the lines on the template.
3. Punch a hole over each dot on the template, 5 total including each corner and the middle.
4. Take a bendy straw and bend it to a right angle.
5. Place the short end of the straw through the center hole of the paper (see image 5 below).
6. Pull one corner to the center of the card and thread the hole over the straw. Tape down (see image 6 below).
7. Repeat until all four points are joined in the center (see image 7 below).
8. Remove the straw and widen the holes with a pencil so the wheel will spin easily.
9. Replace the wheel on the straw; fold over the tip of the short end of the bent straw and tape down so that if forms a bump, keeping the wheel on the axle.

**5.**





**Differentiation:**

1. Paper squares can be different sizes to make larger or smaller pinwheels. Does a larger pinwheel need more force (blowing on it harder) to make it spin?

**Further Ideas:**

1. Discover and experiment with other Wheel and Axles: cars, bicycles, Ferris wheels, door knobs, etc. How do they make work easier for people? Discuss.

# Lesson 3: Open a Door using a Lever

**Resources:**

1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
   *An Excellent Way to Make Breakfast* illustration, letter A "Board and Can Lever"
2. Any door with hinges

**Guiding Questions:**

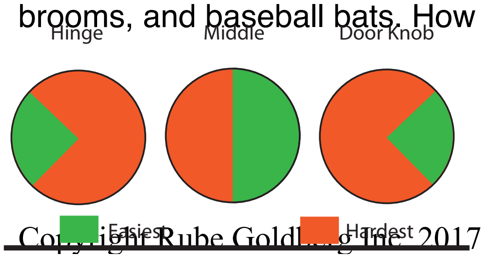
1. What is a Lever?
   A. A Lever is a rigid bar resting on a pivot, used to help move a heavy or firmly fixed load with one end when pressure is applied to the other. Synonyms: crowbar
2. How is a door a Lever?
   A. A door is a Second Class Lever because its pivot point/fulcrum (hinge) is at the end, the load (weight of the door) is at the center, while the effort (opening the door) is applied at the other end.
3. Why does moving where you push to open the door from (door knob, middle or hinge side) change the amount of force needed to open the door? Has the amount of work changed?
   A. No, the amount of work has not changed. Moving the point effort is applied (your hand) on the door closer to the fulcrum (door hinge) changes the distance you need to push. If you apply the force over a longer path, you need less force to perform the same amount of work. This is exactly what you are doing when you push the door on the door knob which is the point furthest away from the hinge. The arc your hand makes becomes larger (see image A below), so you do not need to apply as much force to open the door.

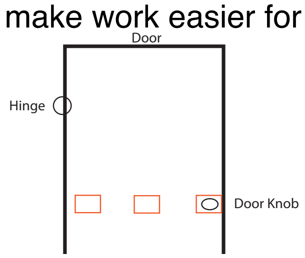
**Activity:**

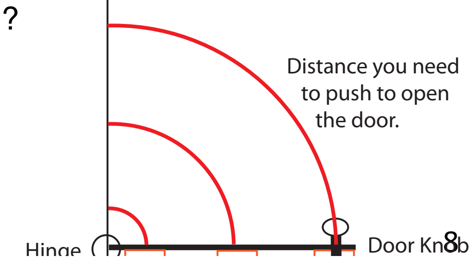
1. Discuss the job of a Lever and Guiding Questions with students.
2. Locate a few different doors around your school or house; close door but no not latch so that it could open with a push.
3. Have students push open the door by placing their hand on the door knob. How does this feel?
4. Have students push open the door by placing their hand on the middle of of the door. How does this feel? Is it harder or easier than using the door knob? Why?
5. Have students push open the door by placing their hand on the hinge side of door. How does this feel? Is it harder or easier than using the door knob or middle of the door? Why?
6. Make a graph with students depicting their opinions of which location on the door (knob, middle or hinge side) was hardest to push and easiest to push (see image below). What does the effort needed to move the door tell us about how much work the person is doing? Discuss.

**Further Ideas:**

1. Mark the door with sticky note in the location you want students to push (see image below).
2. Change the order of hand placement (hinge, middle then door knob) in the experiment.
3. Discover and experiment with other Levers: spoons, wheel barrows, seesaws, scissors, staplers, brooms, and baseball bats. How do they make work easier for people?



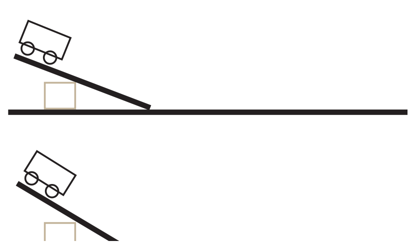
# Lesson 4: Win a Race with an Inclined Plane

**Resources:**
1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
    *A Surefire Way to Catch the School Bus* illustration, letter B "Zip Line"
2. Two small toy cars of the same weight and size, material to make ramps like cardboard, thin wood or sheets of plastic and blocks or small boxes, measuring tape

**Guiding Questions:**
1. What is an Inclined Plane?
    A. A plane inclined at an angle to the horizontal; sloping ramp up which heavy loads can be raised. Synonyms: ramp, slant, gradient.
2. How is the zip line from *A Surefire Way to Catch the School Bus* an Inclined Plane?
    A. The zip line is an inclined plane because it slopes downward from beginning to end. Gravity is pulling Rube's mass down the negative incline of the zip line producing the direction of motion.
3. Why does changing the angle of an Inclined Plane change the distance a car will travel when rolled down it?
    A. The pull of gravity acts more on an object rolling down a ramp inclined at a steeper angle, causing it to accelerate and move faster. Any object on or near the surface of the earth experiences a constant pull of gravity that is directed straight down. When the object is on a ramp, it does not experience the full straight-down pull of gravity. When the ramp is steeper, the car will go faster and travel a longer distance.

**Activity:**
1. Discuss the job of an Inclined Plane and Guiding Questions with students.
2. Have students set up two ramps of different angles next to each other using the materials listed above by resting the cardboard, wood or plastic sheet on blocks (see image below). Label the ramps: lower ramp A, taller ramp B. Make sure there is a lot of space at the end of the ramp so the cars can travel unhindered. Setting up the ramps on the floor is best.
3. Assign two students, one to each ramp, with small toy cars. Have students hold their car at the top of the ramp, then release the cars at the same time. Make sure students do not add force to the cars by pushing them.
4. Let the cars stop rolling on their own and measure the distance they each traveled.
5. Repeat the activity with different students and record the data.
6. Make a graph with students depicting their measurements of the distances the cars travel (see image 6 below). What does the angle of the Inclined Plane tell us about the distance the car will travel? Discuss.

**Further Ideas:**
1. Make a giant inclined plane by placing a table on an angle to meet the floor, then race cars down it.
2. Discover and experiment with other Inclined Planes like stairs and ladders. How do they make work easier for people? Discuss.



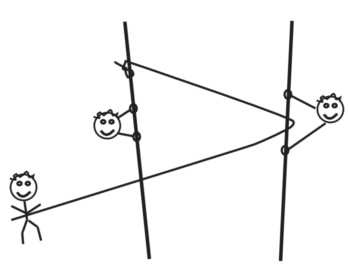
# Lesson 5: Test Your Strength with Pulleys

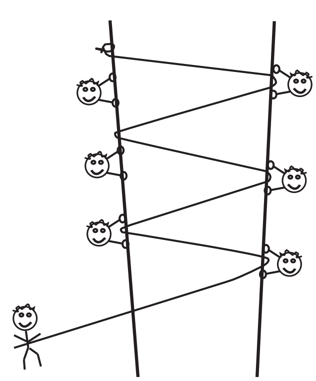
**Resources:**
1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
*An Awesome Way to Open a School Locker* illustration, letter B "Pulley"
2. Two long rods, such as broom handles, a 10' piece of rope

**Guiding Questions:**
1. What is a Pulley?
A. Wheel with a grooved rim around which a cord passes. It acts to change the direction of a force applied to the cord and is chiefly used to raise heavy weights. Synonyms: sheave, drum.
2. How does a Pulley make work easier?
A. Pulleys help make work easier because when you pull down on the rope, you are moving with gravity, making the motion more efficient.
3. What are the different types of Pulley systems?
A. A Fixed Pulley's wheel and axle stay in one place. A good example of a fixed pulley is a flag pole: When you pull down on the rope, the direction of force is redirected by the pulley, and you raise the flag. A Movable Pulley is a pulley that is free to move up and down, and is attached to a ceiling or other object by two lengths of the same rope. Examples of movable pulleys include construction cranes and modern elevators. A Compound Pulley consists of combinations of Fixed and Movable Pulleys.

**Activity:**
1. Discuss the job of a Pulley and Guiding Questions with students.
2. Tie the rope to one end of one rod. Place the second rod parallel to the first, loop the loose end of the rope around the second rod and back to the first. Set up one student on each pole holding it out horizontal in front of them. Have a third student hold the loose end of the rope (see image below).
3. Have the student holding the loose end of the rope pull on the rope while the other two students pull back on the rods. What happens?
4. Now loop the rope around the rods five or six times. Have two students hold the rods and one student hold the loose end of the rope (see image below).
5. Have the student holding the rope pull. Now what happens? Have more students (2-3) join inholding on to the poles. Who is doing more work? Why can the student pulling the rope move the students holding the rods?

**Further Ideas:**
1. Who uses Pulleys to make their work easier? Sailors (sail rigging), people at the gym (weight machines), and people using fishing rods (reel).





# Lesson 6: Draw Your Own Simple Machine Cartoon Using a Wedge

**Materials/ Resources:**

1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
   *A Goof-proof Way to Sneak into Class Late* illustration, letter K "Arrow"
2. Draw Your Own Rube Goldberg Machine worksheet (see Resources, page 24), pencils, markers

**Guiding Questions:**

1. What is a Wedge?
   A. Piece of wood, metal, or some other material having one thick end and tapering to a thin edge, that is driven between two objects or parts of an object to secure or separate them. Synonyms: doorstop, chock.
2. Is a pencil point a Wedge?
   A. Yes, it is!

**Activity:**

1. Discuss the job of a Wedge and Guiding Questions with students.
2. Show an example of a Rube Goldberg machine from *Rube Goldberg's Simple, Normal, Humdrum School Day,* such as *A Goof-proof Way to Sneak into Class Late* and follow each segment to the completion of his designated task, highlighting each simple machine.
3. Explain that students will decide on a simple chore or task and devise a "Rube Goldberg" way to accomplish this activity using at least three 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 to class explaining how it would work to accomplish their chosen task.

**Differentiations:**

1. Students can work alone, or in larger groups, on their cartoon.
2. Students can draw larger cartoons on rolls of paper.
3. Students can collage pictures of objects into their cartoons instead of drawing them.
4. Have students cut their drawing out of the worksheet; scissors blades are two Wedges.

# Lesson 7: Use a Screw to Move Water Uphill

**Materials/ Resources:**

1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
   *An Epic Way to Make a Painting* illustration, letter L "Lawn Mower Blades"
2. 3' of thin flexible clear plastic tubing per student, a 2' pipe or stick per student, masking or duct tape, shallow dishes or pans, water

**Guiding Questions:**

1. What is a Screw?
   A. Short, slender, sharp-pointed metal pin with a raised helical thread running around it and a slotted head, used to join things together by being rotated so that it pierces wood or other material and is held tightly in place. Synonyms: bolt, fastener.
2. What is an Archimedes Screw?
   A. The Archimedes Screw is a machine that can be used to transfer water from a lower body of water into elevated irrigation ditches; water is pumped by turning a screw-shaped surface inside a pipe. For this project, the Screw will be the clear plastic tubing on the outside of the stick.

**Activity:**

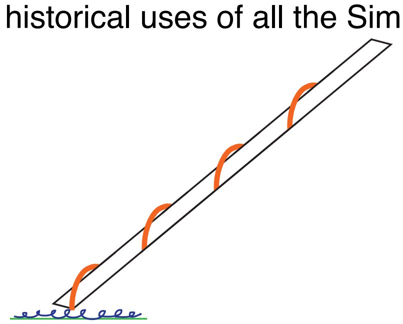
1. Discuss the job of a Screw and Guiding Questions with students.
2. Show students a video of an Archimedes Screw in action such as:
   http://kids.britannica.com/kids/assembly/view/69599
3. Give each student a stick or pipe, piece of plastic tubing and tape. Have students tape one end of the tubing to one end of the stick.
4. Next wrap the tubing around the stick so that it winds to the other end. Tape in place.
5. Place one end of the stick/tubing contraption in the shallow dish of water at a 45-degree angle.
6. Slowly turn the stick/tubing contraption while maintaining the 45-degree angle. The water should move up the plastic tubing. If not, try adjusting the angle you are holding the contraption at, adding more water to the dish or adjusting the way the tubing is wrapped around the stick.
7. Discuss the history of the Archimedes Screw and have the students research historical uses of the contraption.
8. Have students share their research with the class.

**Differentiations:**

1. Students can work alone, or in larger groups, on their contraption.
2. Students can make larger Archimedes Screws with longer and/or larger sticks and tubing.

**Further Ideas:**

1. Have the students research the historical uses of all the Simple Machines and present their findings.



# Lesson 8: Build Your Own Rube Goldberg Machine

**Materials/ Resources:**
1. *Rube Goldberg's Simple, Normal, Humdrum School Day* book by Jennifer George
*An Epic Way to Make a Painting* illustration, letter L "Lawn Mower Blades"
2. Random junk, literally anything you have: cups, boxes, toy cars, balls, tape, paper clips, string, tubing, pipes, sticks, plastic recyclables, paper/cardboard, scissors, rubber bands, safety pins, etc.

**Guiding Questions:**
1. Who is Rube Goldberg?
A. 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.
2. What is a Rube Goldberg Machine?
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.

**Activities:**
1. Review cartoons by Rube Goldberg. Examples here: https://www.rubegoldberg.com/gallery
2. Review each simple machine with class. Have students brainstorm ways to connect simple machines to make compound machines.
3. Show students videos of Rube Goldberg Machines: https://www.rubegoldberg.com/rube-tube/
4. 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).
5. Break students into groups of 2-4 each.
6. Assign a task for the machine to complete, or let the students choose their task, and decide how long they will have to build their machine. We recommend Pop A Balloon or Trap A Mouse.
7. Have students build a three step Rube Goldberg machine. The teacher may assign materials from the Trunk or let students choose.
8. 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.

**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.
4. Have students create machines with more steps or include all of the simple machines.

Name:________________________________________Date:__________________

# Label the 6 Simple Machines from Rube's Inventions

Key words: Pulley, Lever, Inclined Plane, Screw, Wedge, Wheel and Axle

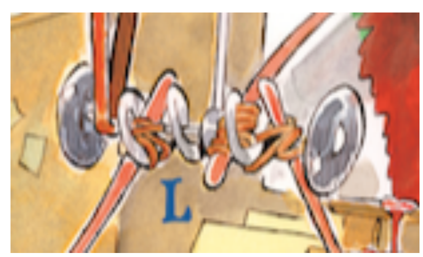




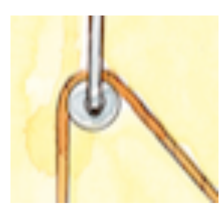










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# Circle and Label Simple Machines in Rube's Inventions

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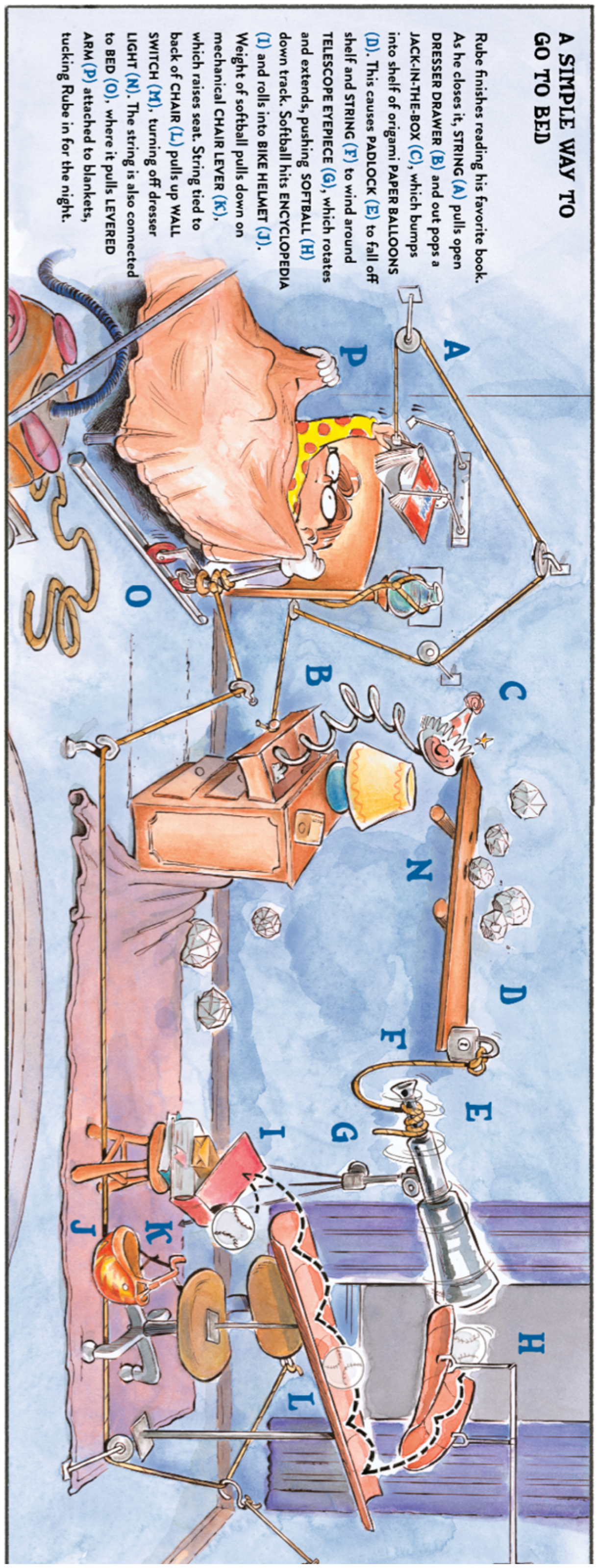


# Simple Machine Station Guide

**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 worksheet
*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 scissor 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 pull

# LEVER

Lever
lev·er, ˈlevər,ˈlēvər/, *noun*
1. a rigid bar resting on a pivot, used to help move a heavy or firmly fixed load with one end when pressure is applied to the other. A **first-class lever** is a stick where the fulcrum is between the weight and the energy moving the weight (your hands, for example). Some common first-class levers are see-saws, crowbars, pliers, scissors (which use two first-class levers together), and a hammer pulling a nail. A **second-class lever** is a stick where the fulcrum is at one end of the stick, you push on the other end, and the weight is in the middle of the stick. Some common second-class levers are doors, staplers, wheelbarrows, and can openers. A **third-class lever** is a stick where the fulcrum is at one end of the stick, you push on the middle, and the weight is at the other end of the stick. With a third-class lever, you have to put in more energy than you would just lifting the weight, but you get the weight to move a longer distance in return. Some common examples are a broom, a hoe, a fishing rod, a baseball bat, and our own human arms.
*Synonyms:* Crowbar.

Make a lever out of the given materials and explore the relationship of the fulcrum to the load.
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.



**Does the lever make it easier to lift the load?**

**Move the fulcrum closer to and away from the load. Which is easier to lift?**

**Draw an example of a lever in action.**

# INCLINED PLANE

in·clined plane, *noun*
1. a plane inclined at an angle to the horizontal. 2. a sloping ramp up which heavy loads can be raised by ropes or chains.
*Synonyms:* Ramp, slant, gradient.

Make inclined planes with boards varying the slope of the board. Try leaning the board against objects of different heights. Tie rubber bands around the book. Tie the string to the rubber bands and pull the books up the different inclined planes. Also pull the books straight up without using the inclined planes.
**Materials:** 2 Boards varying in lengths, String, Rubber bands, Ruler, Heavy Book.




**Is it easier to pull the book straight up in the air, or up the inclined plane? Why?**

**Look at the stretch of the rubber bands during the straight up pull compared to different inclined planes. During which is the rubber band longer?**

**What is an example of an inclined plane in your every-day life?**

# WHEEL AND AXLE

wheel and ax·el, *noun*
1. a simple lifting machine consisting of a rope that unwinds from a wheel onto a cylindrical drum or shaft joined to the wheel to provide mechanical advantage.
*Synonyms:* Axis, shaft.

Push one car on its side and the other on its wheels. Note the difference in distance traveled.
**Materials:** 2 matchbox cars, Rulers.



**Which car moved easier, the one on its' wheels or the one on its' side?**

**If cars did not have wheels, how might they move? Would it be harder this way?**

# SCREW

skrōō/, *noun*
1. a short, slender, sharp-pointed metal pin with a raised helical thread running around it and a slotted head, used to join things together by being rotated so that it pierces wood or other material and is held tightly in place.
*Synonyms:* Bolt, fastener.

Make a screw out of an inclined plane. Cut the paper 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. An inclined plane is part of a screw.
**Materials:** 9 inch Paper Square, Tape, Pencil, Scissors.



**What is a screw typically made out of?**

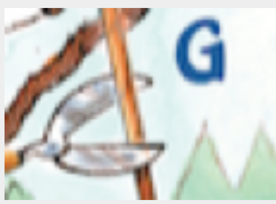
**What do we use screws for in every-day life?**

**What tool do we use to get a screw into a piece of wood? Why?**

# WEDGE

wej/, *noun*
1. a piece of wood, metal, or some other material having one thick end and tapering to a thin edge, that is driven between two objects or parts of an object to secure or separate them.
*Synonyms:* Doorstop, chock.

Scissors are made up of two wedges (the blades) and fixed at an axis point. Cut paper with both sharp scissor and dull scissors. Observe that the sharp scissors cut better than the dull scissors as the wedge's point narrower and therefore slices more easily.
**Materials:** Paper, Dull Scissors, Sharp Scissors.





**Which scissor is easier to cut with, the sharp or the dull? Why?**

**How are the cuts different?**

**Is a scissor a simple machine or a compound of two simple machines?**

# PULLEYS

pul·ley, ˈpo͝olē/, *noun*
1. a wheel with a grooved rim around which a cord passes. It acts to change the direction of a force applied to the cord and is chiefly used (typically in combination) to raise heavy weights.
*Synonyms:* Sheave, drum.

Make a pulley with a sewing spool, string, and a pencil. Use this pulley to lift an object. Compare lifting the object with the pulley and without the pulley.
**Materials:** Sewing spool, String, Pencil, Object to lift.

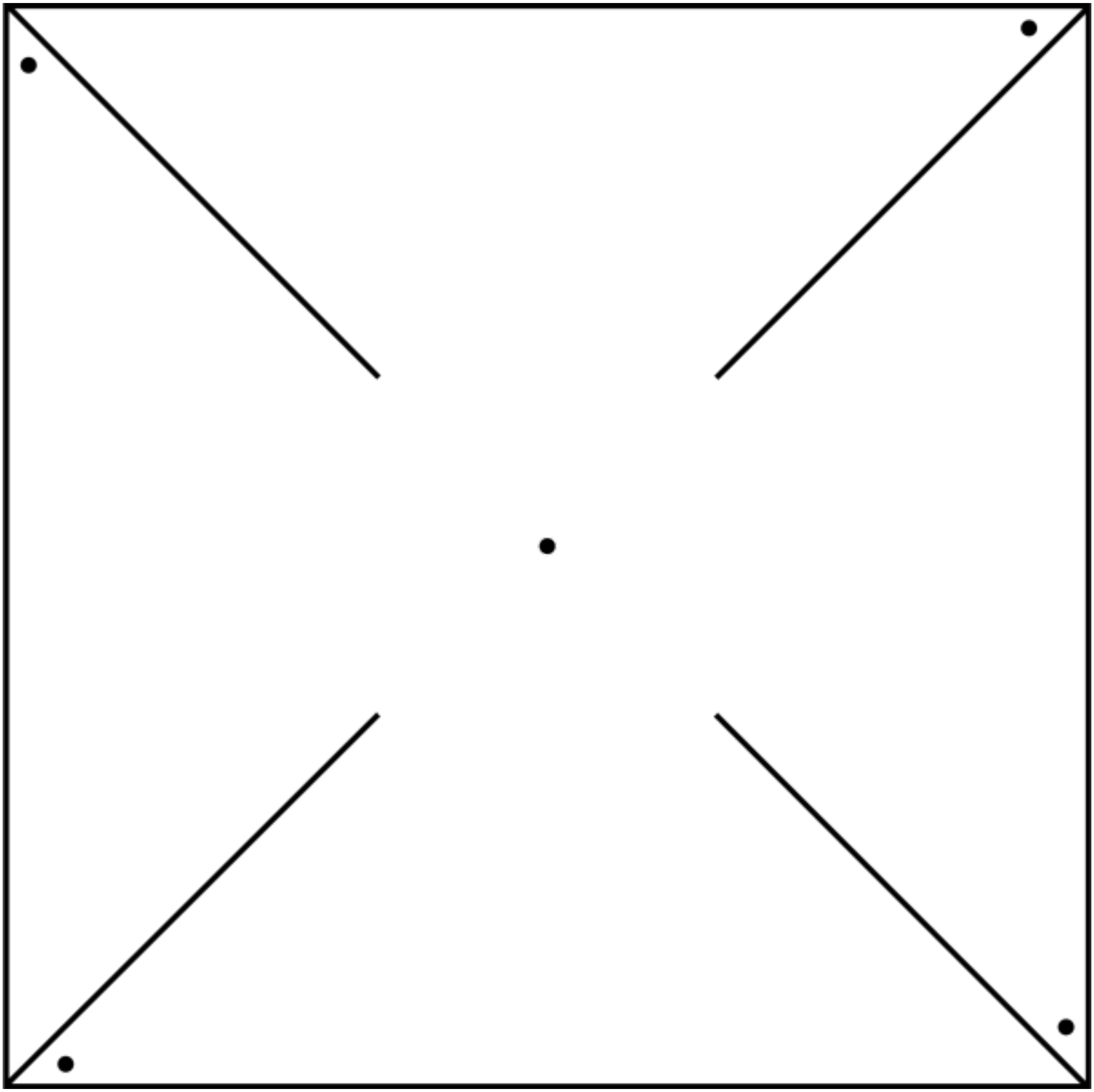


**Compare using the pulley and not using the pulley. Which is easier to lift the load?**

**Where do we use pulleys in our every-day life?**

**Draw an example of a pulley system using more than one pulley.**

# Pinwheel Template



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# Draw a Rube Goldberg Machine!