

SCIENCE FAIR CENTRAL

MAKE. CREATE. EXPLORE.



ZANY INVENTORS

Difficulty: Intermediate Cost: \$\$

Families will construct a creative, multi-step chain reaction that completes one very simple task.

Background

Imagine if it took 10 steps to do one easy task—like pouring cereal, putting a coin in your piggy bank, or planting a seed. Rube Goldberg (1883 – 1970) was the master of drawing out one simple task into several varied and often funny steps. Picture this: A hammer hits a seesaw, which sends a tiny ball flying, which knocks over a tower of wooden block . . . and this chain continues until a single seed is dropped into a pot of soil. This is a Rube Goldberg machine! Rube Goldberg won a Pulitzer Prize for his cartoons, and his machines have become so well-known that his name is listed in the dictionary.¹ According to the Oxford Dictionary, Rube Goldberg is an adjective that means “ingeniously or unnecessarily complicated in design or construction.”

In this activity, your family will work together to create a Rube Goldberg machine that completes an easy, everyday task. Each step of a Rube Goldberg machine is simple, and every step leads to the next step in a domino effect.

A Rube Goldberg machine’s chain reaction begins with one uncomplicated action that changes the potential energy of the step (which is the stored energy that the step has the potential of changing into kinetic energy) into kinetic energy (energy that an object has as it moves). Each step of your machine will involve this transfer of energy as the chain reaction occurs.

While the design of the machine will rely on your family’s creativity, an understanding of simple machines will be helpful as you begin. In a nutshell, simple machines make work easier by increasing the distance that something is pushed or pulled. By increasing the distance, it decreases the force needed to do the very same amount of work!² The following are six simple machines your family should keep in mind for your machine:



- **Lever:** A lever is a long pole or a rod that is put under an object to lift it. Most levers sit on top of a fulcrum, which gives the lever something to push down upon and lift the object more easily. Scissors, bottle openers, and wheelbarrows are all examples of levers.³
- **Inclined Plane:** An inclined plane is a ramp where one side is higher than the other side. This allows objects to be moved up and down more easily than if they were lifted.²
- **Wheel and Axle:** A wheel and axle is simply a wheel with a rod attached to the middle of it, which works as the axle. The wheel turns around the axle. Other than the obvious wheels that you see in your everyday life, additional examples of wheels and axles are Ferris wheels, door knobs, and electric fans.⁴
- **Pulley:** A pulley combines a rope or cord with a wheel and axle. A pulley makes it easy to lift heavy objects or lower them down. Multiple pulleys can be connected together to make the work even easier! Cranes and elevators both use pulleys to lift heavy objects.²
- **Screw:** A screw is an inclined plane that is twisted in a spiral. Because it is twisted, it moves in a circle (twists) at the same time that it moves up and down. Light bulbs, jar lids, and drills are all examples of screws.²
- **Wedge:** A wedge is made of two inclined planes that are used to push objects apart (such as an ax or a saw) or hold things together (such as staples, pushpins, nails).²

To see simple machines in action, check out the following videos:

- For younger children: [Simple Machine Song](#)
- For older children: [Simple Machines for Kids: Science and Engineering for Children Video](#)

Plan

Your family is going to work together to create a machine that accomplishes a task of your choosing. Would you like a machine that turns off a light, splashes water on a family member, pops a balloon, or recycles a water bottle? The choice is yours and the possibilities are endless! Once your family has chosen the job that you would like your machine to complete, you will get started on the design process.

Your machine will be built on a peg board. Using the materials suggested below, it will be up to your family to work together and create a series of at least 10 steps that ultimately complete your chosen task. You can take advantage of gravity's pull by starting the first step at the very top of the machine and working



down from there. To get ideas straight from Rube Goldberg himself, [check out his cartoons here](#). (But, be warned: Many of these are pretty unrealistic!)

Design

A Rube Goldberg machine requires all of your creativity! Other than the pegboard, the materials listed to the right are suggestions. You will likely not need all of the listed materials; nor should your materials be limited only to this list. Use these as a starting point and go from there!

Create!

Once you've used the links in the section above to get an understanding of simple machines and what a Rube Goldberg machine is all about, it's time to get started!

1. Choose family members to fill the following roles. But remember: it's all hands-on deck so be ready to chip in wherever necessary!
 - The **Scribe** will take notes and record ideas.
 - The **Sketch Artist** will bring your family's design to life on paper.
 - The **Builder-in-Chief** will help with any tricky parts of construction. (*Note: This is a good role for an adult to have!*)
 - **Everyone** will take turns building and testing your machine.
2. As a family, brainstorm simple tasks that your machine could complete as the **Scribe** takes notes. Once you have several ideas written down, take a family vote to determine your favorite and choose a winner.
3. Now that you know what you want your machine to accomplish, it's time to begin figuring out how! First, find a spot in your home where you can place your pegboard. This pegboard will serve as the base of your machine, and you can use pegs, tape, hooks or other materials of your choosing to secure each of the steps onto and/or around this board. You

Materials

- Pegboard
- (2-4) Peg hooks
- Pegs
- Marbles, of various sizes
- Clear Piping
- Foam Piping
- (2) Elbow, 90 Degrees
- (2) Elbow, 45 Degrees
- Tubing
- Pulley
- Rubber Bands
- Dominos
- Strip Board
- String
- Wooden Dowel
- Rubber Caster
- Craft sticks
- Table Tennis Balls
- Funnels
- Paper Plates
- Super Glue
- Cardboard
- Spool
- Binder Clips
- Scissors
- Clear Packaging Tape
- Duct Tape
- *Materials from around your home!*

Many of these items are available at your local Home Depot store



will want to be able to lean it against something sturdy in a safe area of your home. You don't want to risk it getting knocked over by a family member or pet!

4. Once your pegboard is secure, gather your other materials. Then take some time to play with the different parts, both as a family and individually. There's no better way to come up with ideas than to be hands-on! **Scribe**, keep a piece of paper nearby so that you can write down potential steps as you go!
5. Once everyone in your family has contributed some ideas, you can start putting them together – on paper, that is! Decide as a family whether you would like to start from the last step or from the beginning. (It may be easier to “begin” with the task you want completed and then work backwards from there!) **Scribe** and **Sketch Artist**, do your best to record the steps that your machine could potentially include and the materials you may use. Don't forget that you'll need to build the step, as well as secure it to the pegboard. Materials like the peg hooks, pegs, string, and even tape could come in handy for this!

Pro Tip: Remember to listen to everyone's ideas. The best creations usually occur when everyone is involved!

6. Now the fun really begins: It's building time! Have your plan handy and keep the rules of gravity in mind. (If you choose to build the last step first, for instance, you may want to start as close to the bottom as possible!) **Builder-in-Chief**, be ready to lend a hand whenever needed!
7. Test, test, test! Each time you add a new step, test it out before you move on to the next step. You wouldn't want to get done with your machine only to realize that the middle step needs to be reworked! Be ready to change your original design based on what happens during your trials. And don't be afraid to add in an extra step somewhere if inspiration hits!
8. Once it seems that your Rube Goldberg machine is finished, try several complete trial runs. You'll want a machine that is reliable and accurate—meaning that it works all the way through and it completes the desired task. Don't be afraid to tweak a step or change it altogether if it doesn't seem to be working consistently.
9. Celebrate! When your creation runs like a well-oiled machine, it's time to sit back, relax, and enjoy watching your invention do your work for you!



Next Steps

- Students can carefully bring their machine to school and share it with their class. Maybe they will inspire their classmates to create their own!
 - Share pictures of your family building and using your Rube Goldberg machine on social media.
 - Take a video of your Rube Goldberg machine in action from start to finish, and share it with friends and family. See if anyone has clever ideas on new and improved steps, and continue upgrading your machine!
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References

1. "About Rube." <https://www.rubegoldberg.com/about/>.
2. "Simple Machine Facts." Idaho Public Television.
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3. Tucker, Christine. "Levers Used in Everyday Life." Sciencing.
<https://sciencing.com/levers-used-everyday-life-8435160.html>
4. "Physics for Kids: Simple Machines." Ducksters.
http://www.ducksters.com/science/simple_machines.php

