



TEACHER ACTIVITY

CHAIN REACTIONS

Wouldn't it be nice to press a button and have something magically done for you...such as having your room cleaned up, your homework completed, or a snack prepared?

In this challenge, you and a partner will create a chain reaction that results in doing a chore (without you!).

STEP 1: CONNECT

A chain reaction occurs when the results of one event trigger the next event, which triggers the next event, which triggers the next event, and so on.

Can you think of an example of a chain reaction?

STEP 2: INVESTIGATE

Rube Goldberg was a famous American cartoonist who drew cartoons of machines that accomplished a simple task—such as setting the table, turning off the light, or getting sand out of your shoe—through a series of humorous and overly-complicated chain reactions. Today, people follow in Rube's footsteps by creating real-life Rube Goldberg machines!

Visit rubegoldberg.org/all-about-rube/cartoon-gallery and check out some of the cartoons created by this worldwide phenomenon. Then share your favorite steps with your partner.

STEP 3: DISCUSS

Rube Goldberg machines are one example of how something can work by itself without much human intervention...even if it *is* overly complicated!

Today, automation—or processes that need as little human intervention as possible thanks to technology—is becoming more and more common. When you automate a task, you create a system in which a machine runs by itself.

When have you seen an example of automation in your everyday life?

Hint: *If you're stuck, think about cars and other vehicles, kitchen tools, or appliances in your home. Do any of these technologies have processes that happen on their own?*

What are the advantages of automation? Are there any disadvantages?

What is a simple process that you would like to automate? Think of a task or chore that a Rube Goldberg machine could do for you in order to make your life easier!

STEP 4: MATERIALS

Now gather materials that you could use to create your own Rube Goldberg-style chain reaction, such as:

- Materials needed for your specific task (such as an empty bottle and a recycling bin *or* a toothbrush and toothpaste)
- Cardboard
- Water bottles
- Paper towel or toilet paper tubes
- Boxes
- Cans
- Playing cards
- Dominoes
- Marbles or golf balls
- String
- Buckets, bowls, or cups
- Tape, glue, string, and/or rubber bands

STEP 5: THE CHALLENGE

Begin by taking out and examining the materials for your machine's final step—such as recycling the bottle, squeezing the toothpaste, etc.

Then work with your teammates to brainstorm a series of simple steps that follow the guidelines and result in this task being completed. First, read through the science principles to get some ideas. Then brainstorm and sketch your steps before you bring them to life one at a time.

GUIDELINES

- Your machine should have at least seven steps.
- You must do something to start the chain reaction (e.g., roll a ball, push a toy car, pull a string, etc.). After that, the machine should perform everything else autonomously.
- Your machine should take no longer than two minutes to run from start to finish.

TIPS

Work backwards! Start with your last step and then work your way back to the first one.

Look, touch, and play with your materials to gain inspiration.

If you're still not inspired, take a walk around your home and see what else you may be able to use.

Test each step as you complete it to see if it works as you had hoped!

SCIENCE PRINCIPLES RELATED TO RUBE GOLDBERG MACHINES

- **Newton’s First Law of Motion:** An object at rest will stay at rest and an object in motion will stay in motion unless a force acts on it. Friction, air resistance, and gravity are all forces that can stop or slow an object’s motion.
- **Newton’s Second Law of Motion:** Force equals mass times acceleration. In other words, the greater an object’s mass, the greater the force it will take to get it into motion. Alternatively, the harder something is pushed, the farther it will go.
- **Newton’s Third Law of Motion:** For every action, there is an equal and opposite reaction. If the forces are equal in both directions, the object won’t move—but if the force in one direction is greater than the force in the other direction, the object will move.
- **Acceleration:** The change in velocity (or speed) of an object, or—in other words—how fast an object speeds up!
- **Gravity:** The force that pulls everything toward the center of Earth. This is what keeps things on the ground and makes them fall!
- **Momentum:** The power an object has when it is moving, which is also how much force it can have on another object. For instance, an object moving slowly might not be able to knock something else over, but an object moving quickly may be able to!

STEP 6: SHARE

Once your Rube Goldberg machine successfully works from beginning to end without you needing to intervene, film it! Create a quick intro that explains the task or chore that your machine will perform *and* give it a fun ending that explains how the automation of this simple task will make your life easier. Then share it with others by posting the video to your Instagram story or TikTok.

Use the hashtags #_____ and #rube Goldberg magic button so others can learn from your design, too!

STEP 7: EXPLORE MORE

NGSS STANDARDS

- HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
- HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

COMMON CORE ELA STANDARDS

- CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.