Activity: Rube Goldberg Machine

Grade Range: 2-8
Length: 60 minutes
Materials: recycling, other household items of your choice!
Concepts: inclined planes, systems, mechanical engineering

Background Information:

What do Mechanical Engineers do?
Mechanical engineers use math, science, and their problem solving skills to make the world a better place. They constantly try to understand how things work and move in a system (a collection of different elements that work together) while analyzing its design to make it better. Do you like air conditioning, heat, or even refrigerators? All three items mentioned are systems that work to keep a certain temperature. You don’t want your refrigerator to melt your ice cream or freeze your milk. This is done through energy moving. Mechanical engineers work on teams with other types of engineers to make these things possible.

Who is Rube Goldberg?
Rube Goldberg was an American Pulitzer Prize winning cartoonist, sculptor, author, engineer, and inventor. His work is a great example of the connection between art and science. He began his career as an engineer and moved toward being a cartoonist, illustrating contraptions made of objects typically found around the house and simple machines. The point of these pictures was to design a contraption that looked complex to solve a simple task like opening a window or feeding a dog.
Goldberg never actually created any of his drawings, but they act as an inspiration for others who wish to take on the challenge of creating something to solve everyday problems and, of course, having a ton of fun!

Simple Machines

Simple machines are devices that are used to change the motion or amount of force in order to help make it easier to do work (or move an object over a distance). Two things go into doing work: distance and force. If you want to do a set amount of work, there are lots of different combinations of distance and amount of force you can use. Each of the 6 types of simple machines change the amount of force or distance needed to make it easier on you. Six types of simple machines: wheel and axles, inclined planes, levers, pulleys, screws, and wedges.

Have you ever walked up a ramp, used stairs, or slid down a slide? These are inclined planes. An inclined plane is a flat surface placed at an angle. It helps by increasing the distance used which in turn decreases the amount of force needed. For example, if you are running up a short, but very steep hill, you will expend a lot more effort. To help you get to the top of the hill using less effort, you could try creating a longer path that goes up the inclined gradually.

Think about it!
Maybe you have used a table knife (a wedge), opened a jar of something (lid uses a screw), or seen a car drive by (using wheel and axle). There are lots of simple machines around. How do they help us? What simple machines can you find around your house?
Definitions:

- **Inclined plane**: a flat surface placed at an angle
- **Force**: a push or pull – Forces cause an object to change its speed, direction, shape or stay the same.
- **Work**: occurs when you move an object over a distance (calculated with force used times distance)
- **System**: a collection of different elements that work together (ex: refrigerator)
- **Wheel and Axle**: a simple machine that uses a wheel and axle (rod) to move carry objects
- **Lever**: a long surface or rod that pivots from one side to another (ex: hammer or your arm)
- **Pulley**: uses a rope through a wheel when you pull on one side and the heavy object is brought up on the other side (ex: flagpole, crane, and elevators)
- **Screw**: an inclined plane wrapped around a pole (ex: light bulbs and hoses)
- **Wedge**: two inclined planes put together to create a sharp edge to split objects (ex: axe)

Activity:

Start by reading through the **Background Information**.

**What's the Problem**: Design a Rube Goldberg system of your own to complete a simple task using simple machines. **Try to use at least 3 types of simple machines**! You can use inspiration from common things around the house like things out of the recycling bin, toys and more.

**Explore the Constraints**: Just like engineers and scientists, you are limited to a select amount of materials. As instructed by your adult, you can use any household materials that you can find. Be creative!

**Design Your Solution**: Brainstorm what task you are going to complete. Where you are going to build this system around your home? What materials you will use? What simple machines will you put in it? Try to draw out the design before building!

**Create**: Now that you have planned an amazing design, build it! Keep thinking as you go. How are you going to make sure all the parts work the way they are supposed to? How will you record data about what went well and what didn’t go so well? How can you add in even more simple machines?

**Try it Out**: Go ahead and test it out. Did you accomplish your task? What went well? How can it be improved? What changes do you want to make? Do you need to change the distance an object travels or forces done to an object?

**Make it Better**: Everything can be made better! After you run the Rube Goldberg, keep working to improve the design! While your original model may have worked well, what else could this system do? Could you add another task? Make it even longer? What could be improved?

**Expand Upon your Design**. As time and materials permits, continue to innovate your solution and test.

Reading and Resources:

**Cool Ideas of Machines**:
- 11 Brilliant Rube Goldberg Machines
- The best Rube Goldberg machines
- 16 Cool Rube Goldberg Machine Ideas
- About Rube Goldberg
  [www.rube-goldberg.com](www.rube-goldberg.com)

**Videos**
- Simple Machines – Science with Sophie
  [https://youtu.be/zSymWaexstY](https://youtu.be/zSymWaexstY)
- Simple Machines – Generation Genius
  [www.generationgenius.com/videolessons/simple-machines-video-for-kids/](www.generationgenius.com/videolessons/simple-machines-video-for-kids/)
- Examples of Simple Machines – MooMoo Math
  [https://youtu.be/ fOA4nCWYms](https://youtu.be/ fOA4nCWYms)

Check out more great resources at [www.isek.iastate.edu](http://www.isek.iastate.edu)!