

Build a Machine

Primary Audience: Individuals and Families

Description: In this fun and, at times, hilarious force and motion activity, learners will use household objects to build a crazy contraption and see how far they can get a tennis ball to move. This is an excellent activity to explore all of the various forces that can act upon an object.

Keywords: Energy, Force and Motion, Engineering

Concepts:

- **Kinetic energy** is energy that a body possesses as a result of its motion.
- **Potential energy** is stored energy. The energy is stored by doing work against a force such as gravity, a spring in a clockwork motor, or even an electromagnetic field.
- **Engineering** is the branch of science and technology concerned with the design, building, and use of engines, machines, and structures.

Materials will vary. Recommended:

- Kitchen gadgets
- Various tools and toys
- String
- Rubber bands
- Tennis ball or racquetball
- Fasteners, like Velcro or tape
- Lots of space!

Instructions:

You will build a machine to complete a simple task in an elaborate fashion using a variety of simple and/or complex machines. Can you create your own machine capable of completing a simple task? How many different simple machines can you use in your design? If you are looking for a bit of inspiration to get you started, try looking on YouTube for ideas. They range from [simple](#) to very [complex](#)!

1. Start with a simple challenge; move a ball along a track to knock something over.
2. Once you've completed this simple task, challenge yourself and other learners to work together to create a complex machine that completes 1-2 simple tasks. Be creative!

Possible Interactive Questions:

- Did the ball sometimes roll off the side of the machine? Why? How can you ensure that the ball stays on the machine for the entire run?
- What forces are acting on the ball or marble as it travels through the machine? Can you affect these forces by altering other variables?

What's Going On?

Energy cannot be created or destroyed, but it can be converted from one form to another. At the top of the hill, the ball has potential energy. When the ball is released, that potential energy is converted into kinetic energy as gravity pulls it down. The ball begins moving slowly, and then picks up speed as it accelerates (due to gravity) toward the bottom of the hill. If the ball ascends another hill, the kinetic energy is converted into potential energy again.

Friction is the main cause of energy leaks in the system. Friction opposes motion by working in the opposite direction. The friction between the ball and its path as well as between the ball and the air take energy out of the system, slowing the ball and creating heat and sound. Because of the energy leaks due to friction, each successive hill, loop, turn, and bounce within the machine must be shorter, smaller, and easier than all of the previous activities – otherwise the ball will not have enough energy to make it all the way.

Extension:

Do you really have a knack for creating these machines? You could try submitting to a competition, like the annual [Rube Goldberg Machine Contest](#).

Additional Resources:

- www.rube-goldberg.com
- Reach out the [COSI Department of Science](#) Content if you have any questions or comments.

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