



Traveling Science Workshops

Simple Machines: The Lever

A lever is a type of simple machine that is used to help make doing work easier. Levers are used frequently in everyday life, from the handle used to open a door, to the light switch that turns on a light, to the baseball bat that swings through the air and strikes a ball. A lever, in its most crude form, is a board or rod that pivots around a point called a fulcrum and is used to move or lift something. There are four parts to any lever system. The load is the object that needs to be moved, the effort is the force being applied to the lever, the lever (or lever arm) is the tool itself, and the fulcrum is the point at which the lever turns or pivots.

Let's explore some levers!

Activity 1: Lever Treasure Hunt

Supplies: You just need this checklist of everyday levers:

- Scissors
- Stapler
- Door Handle
- Broom or mop with long handle
- Car door handle
- Baseball bat
- Hockey Stick
- Wheelbarrow
- Toys with levers on the outside
- Toys with levers on the inside
- Butter knife
- Pot with long handle
- Spatula
- Kitchen Faucet Handle
- Shower or Bathtub Faucet Handle
- Flush lever on toilet
- Tweezers
- Hammer
- Paint Lid Remover Tool
- Bottle Opener
- Kitchen Tongs
- Garden Shears
- A door
- Lid on a box



What to do

Take a walk through your house, garage, and yard and see how many of the levers on the list above you can find.

Bonus: Can you spot a lever not on this list?

As you can see, we use levers a lot in our everyday life. Consider how some of these levers are used to make doing work easier.

Activity 2: Build a Mini Lever

Supplies

- ruler
- pen or pencil
- tape
- small action figure toy or doll

What to do

Place the pen or pencil (the *fulcrum*) under the ruler (the *lever arm*) and hold it in place with a piece of tape to make a ruler seesaw. Place the action figure (the *load*) on one end of the ruler. Tape the action figure to the ruler to help it stay standing or sitting. Use your pinky to press down on the other end of the ruler to make the ruler pivot over the pencil and raise up on the opposite end.

Notice how hard or easy it is for you to lift the action figure. Slide the pen or pencil (fulcrum) a little bit closer to the end of the ruler with the action figure and press with your pinky again.

Is it easier or harder to lift the action figure (load) with your pinky when the pen is closer to that end?

Now slide the pencil back in the opposite direction, away from the end with the action figure, and try pressing down with your pinky again.

Is it easier or harder to lift the action figure (load) with your pinky when the pen or pencil (fulcrum) is further away from the action figure (load)?

Scale It Up! Build a Mega Lever

Supplies

- long, wide board, roughly 6 inches wide and 6 to 8 feet long
- block of wood or a brick to serve as a fulcrum
- carpeted floor or area rug to lay underneath the brick to provide a source of friction and avoid slippage
- one big kid or an adult and one smaller kid

What to do

Using the materials and people you have assembled, can you figure out a way to lift a heavy load—the biggest kid or adult—approximately 6 inches into the air using the smallest effort—the smallest kid in the house?

What is happening

When set on the block of wood or brick, the piece of wood is able to pivot and becomes a lever. It can be used to raise and lower someone or something. If the fulcrum is moved close to the end of the board with the heaviest load, the smallest effort can succeed in lifting the load. If the fulcrum is moved away from the load, lifting the load requires more effort.

Activity 3: Bull's-Eye Challenge

Supplies

- paper plate or piece of paper that is about 6" in diameter to serve as a target or bull's eye
- marker or pen
- popsicle stick or tongue depressor
- plastic spoon or fork
- Post-It® note-sized piece of paper, wadded up to make a ball

What to do

Color a bull's eye pattern on the plate or paper and place it in the center of your workspace, about 3 feet from where you are sitting. This is your target. Using the supplies you have collected, invent as many ways as possible to move the ball of paper across the floor or table or through the air to reach the target.

How many different ways did you come up with to move the ball of paper either through the air or across the table or floor?

Was it easy or hard to come up with lots of different ways?

Did you use any of the following design ideas: a catapult, hockey stick, or pair of chopsticks?

If you did, then you happened to have used a lever. A lever is a handy simple machine that helps make getting work done easier.

Activity 4: Build a Catapult

Supplies

- wire coat hanger
- 2 thick rubber bands
- plastic spoon
- pair of pliers
- small ball of paper

What to do

1. Lay the hanger on a table and bend the “wings” of the hanger up vertically (see diagram).
2. Squeeze the tip of each wing so it is thinner and bend them slightly out.
3. Slide a rubber band over the two wings, stretching it between them.
4. Slip the handle of a plastic spoon between the rubber band, and wind to twist the band.
5. When the band is wound tightly, slide another rubber band over the tips of the coat hanger so it hits the spoon where the bowl joins the handle.
6. Adjust the twisted band to about 1 ½” from the end of the spoon handle (see diagram).
7. Place a small ball of paper in the bowl of the spoon. Pull back on the bowl, and release (see diagram).



Notice how far the paper travels and in what direction.

How can you adjust the catapult to change these outcomes?

Experiment with using a thicker or thinner rubber band or a different type or size of spoon.



Activity 5: Toy Banks Exploration (15 minutes)

Supplies

- piece of paper and pencil
- computer, phone, tablet or other device that connects to the internet, to watch the following short videos

What to do

Watch one or more of these short videos of mechanical banks in action:

Dentist Pulling a Tooth Bank

<https://www.youtube.com/watch?v=9VSFKmZCf5Q>

Kicking a Football Bank

<https://www.youtube.com/watch?v=prQMaPW2BZo>

Elephant Swinging Trunk Bank

<https://www.youtube.com/watch?v=JhSTsudys5o>

Happy Trick Dog Bank

<https://www.youtube.com/watch?v=447YOkLOTio>

Bird Feeding Her Young Bank

<https://www.youtube.com/watch?v=Hlq1OxEBJ7E>

What to notice

The mechanical banks all use levers that are visible on the outside of the banks.

What can you see happening?

What causes the first movement of the bank?

What happens next? And after that?

Can you identify all the levers on the outside of the bank?

Can you draw a sketch or write out all the ways you see those levers working together?

There are other mechanical parts hidden on the inside of the banks that help to work these levers. What do you imagine is happening inside to make the levers you see on the outside work?

Sketch a picture of what you imagine the inside of these banks look like and how the mechanism works. Share your sketch with someone in your house and explain how you think the inside of the bank works. Do they agree with your ideas or do they imagine something different?

Science can help us to make sense of the world and how it works, but it doesn't always provide clear-cut answers. More often it leads to new questions, ideas, and theories. Scientists often build models to represent and test out their theories and ideas about how things work. Maybe you would like to take on the challenge of trying to build such a bank to test out your ideas!

Going Further 1: Design a Mechanical Bank

Using a shoebox or other form, design a system to move coins from one part of the box to another. Use everyday materials you find around the house such as paper and tape to design and build a model of your bank that uses at least one lever. The recycle bin in your house can be a good source for materials, but you might also consider some of the materials you used in the Bull's Eye Challenge and Build a Catapult activities earlier in this lesson.

Going Further 2: Toy Exploration

Many mechanical toys use simple machines to function. With an adult's permission, take apart an old toy and sketch what you see. How do you think the different parts work together to make the toy work? Toddler toys are often great for taking apart. Maybe you can try putting the toy back together or building something else from its parts.

Share your discoveries with us

We want to know about your simple machine explorations. Share your experience with us in any of the following ways:

- Draw a picture
- Take photos of your levers
- Write down what happened, what surprised you, what didn't surprise you, or anything else that was fun or interesting about your experiences.

Then email us at myhomediscoveries@discoveryacton.org, we can't wait to hear from you!

Resources

Overview of simple machines: Levers

<https://www.youtube.com/watch?v=lueqE0lxLyc>

Another fun toy that uses levers

<https://www.youtube.com/watch?v=uq93jczijeo>

Even cats can use a lever

<https://www.youtube.com/watch?v=CRtuCtVinC0>

Discovery Museum Make Your Own Exhibit: Linkages

https://www.discoveryacton.org/sites/default/files/Linkages_final.pdf