

Helping Kids Learn – Post #13 5/4/20

May the 4th be with you!

STEM: Science – Physical Sciences

This is Part 1 of a two-part lesson.

Everything in the *built world*, all the things we have outside of the natural world, is made using tools. Tools make work easier. Some things have tools in them when we use them: like screws that hold together parts of a bike; others are made using tools: oranges squeezed with a tool to make orange juice, for example. This investigation explores 3 of the 6 tools that make up all other tools in the built world. It can be adapted for many learners. See [Lift the Level](#) below.

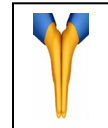
Be a Physicist or Mechanical Engineer – Exploring Simple Machines Part 1

Think about tools and machines: no matter how ordinary – a screw and a screwdriver – or complicated – an AI robot in a car assembly factory – they all contain one or more of 6 simple machines. A scientist who studies the properties of machines is a **physicist** (fīz'ī-sīst).

Investigation 1: Wedge A wedge is used to separate something, such as an axe splitting a log, or to hold two things together, such as a nail holding two boards together.

Here's a tip to remember the shape: "edge" is inside "wedge"

Put your hands together like the picture shows. They form a wedge. Push your hands into a soft pillow. What happens to the pillow stuffing? That's similar to an axe chopping through a log.



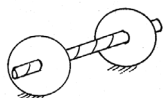
Investigation 2: Lever A lever is used to lift something. It is used with a support called a *fulcrum*. A fulcrum can be almost anything solid and stationary, such as a smaller rock used with a crowbar to lift a heavy rock.

Keep one hand flat and stiff on a table. Don't curl your fingers. Put a book on your fingertips. Keep your wrist on the table. Lift the book. What is the lever and what is the fulcrum in this investigation?

Investigation 3: Wheel and Axle A wheel is a circle; an axle is a rod. The circle can be solid or have spokes to fasten it to the axle through the center of the circle. The wheelchair in the picture uses several wheels and axles.

You'll need a sheet of any kind of paper at least as stiff as copy paper, a small can or jar with a flat base (or lid), a straw or thin, straight stick, a pencil and a pair of scissors.

Ask an adult if you need help



Trace around the can base to make two circles on the paper. Cut them out very carefully following the line (circumference) so the edge is smooth. Find the center of each solid circle by folding in half, making a tiny crease in the center and then folding in half again (fourths) and making a tiny crease. The tiny creases will keep the circle smooth. Make a small cut to put the straw or pencil through the hole so it looks like the picture.

Turn one wheel and observe what happens to the other wheel. What would be different if you had only one wheel and no axle? [Note: Save the wheels and axle for Investigation #14.]

Lift the Level You can make this lesson deeper and/or suitable for older students by any of the following (you may want to use some of the [STEM Online](#) resources below):

1. Explain how airplane crews use wedges against the tires of jumbo jets.
2. In the natural world animals use some simple machines to do work. Research how an animal uses tools to solve problems. Create a slide show to share with others that summarizes your research. Two species you might not think of are crows and honey badgers.
3. The fundamental concepts in physics of **force**, **motion** and **work** are at play with simple machines. Explain how force, motion and work apply to one or more of the simple machines.
4. "Leverage" is a synonym for "power." Explain how *leverage* and the simple machine *lever* are related.

STEM Online These are suggestions only and no endorsement is implied. Although they have been screened for appropriateness before posting, parents should vet the websites their children use as they may change over time.

Wedge: <https://en.wikipedia.org/wiki/Wedge>

Lever: <https://enchantedlearning.com/physics/machines/Levers.shtml> (good animated illustrations)

Animals using tools: <https://www.youtube.com/watch?v=cbSu2PXOToc>
<https://www.youtube.com/watch?v=EryZPmOxwCO>
<https://www.pbs.org/wnet/nature/are-honey-badgers-one-worlds-smartest-animals/21144/>
<https://www.livescience.com/9761-10-animals-tools.html>

Archimedes Screw: [https://kids.kiddle.co/Archimedes' screw](https://kids.kiddle.co/Archimedes'_screw)
[https://en.wikipedia.org/wiki/Archimedes' screw](https://en.wikipedia.org/wiki/Archimedes'_screw)

NJ Student Learning Standards

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

4-PS3 Energy: ETS1.A: Defining Engineering Problems

HS-PS3-2, HS-PS3-5: Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Solutions

Investigation 1: The pillow stuffing is moved or rearranged by the wedge pushing on it. The same amount of stuffing is in the pillow as there was before you pushed.

Investigation 2: Your hand is the lever; your wrist is the fulcrum. Levers are identified by *class*, depending upon where you place the fulcrum and the load (book, in this case). In this case, you made a Class 3 lever.

Investigation 3: With a fixed axle, the second wheel turns with the first wheel. A single wheel can be used without an axle but must be turned by hand, greatly reducing the effort-to-work ratio.

Lift the Level 1: A wedge, or chock, is pushed against the wheels when the airplane is stopped. Even though the wedge is small compared with the size and weight of the plane, it prevents the wheels from rolling or the plane from moving. This is an example of a favorable force to work ratio. The energy is potential energy.



Lift the Level 2 and 3: Responses will depend upon which subject is chosen.

Lift the Level 4: Leverage is used to gain an advantage in an argument, in stock or other financial transactions, and in politics. The object of applying leverage is to use a small amount of human, monetary or political capital to gain a big advantage. A lever used with a fulcrum positioned in the most advantageous way (see <https://enchantedlearning.com/physics/machines/Levers.shtml>, for example) allows you to do use a small amount of energy to do a lot of work, such as lifting a heavy object, jacking up a car, etc.