



November 2009 – Gears!

All big machines are made up of combinations of smaller parts, including lots of gears. Experiment with gears and simple machines in this issue!

Simple Machines Science Projects

Experiment with Gears

Gears can help us do work by speeding up or changing the direction of motion. To see how this works, make a model set of gears!

What You Will Need:

- [Gears pattern](#)
- Scissors (or an X-acto knife)
- [Styrofoam tray](#) or plate
- Thumbtacks or pins
- An adult to help

What To Do:

1. Print out the pattern for the gears and color them however you like. You can cut them out if you want, or just tape the whole paper to the Styrofoam tray.
2. Have an adult cut the Styrofoam around the pattern to make Styrofoam gears. (The easiest way to do this is to cut out a circle along the outside edge of the teeth, then make the cuts around the teeth.)
3. Once you have your gears cut out, use thumbtacks to pin them to a piece of cardboard or another tray. Pin them so that their teeth fit together.
4. If you want to, you can make a small turning handle on the big gear by taping a little piece of Styrofoam so it stands straight up on the gear.



You've just built a **gear train**. The big gear is the driver. Try turning it slowly. What happens to the little gear? Which way does it turn? Draw a big colorful dot on each gear, and position the gears so that both dots are at the top. As you turn the big gear, have one person count how many times the big gear turns all the way around and another person count how many times the small gear does. Do they turn the same number of times?

What's Happening?

Gears work to change the direction of motion. When you turned the big gear one way, the little gear turned the other way! Gears also change speed of motion. When you turn the big gear slowly, the smaller gear turns faster. This helps save energy, because you don't have to work as hard to turn the big one slowly as if you had to turn the small one quickly.

You can also try this project with water bottle caps that have ridges, or with gears from a building set like Lego or K'Nex.

See How a Screw Works

An inclined plane, such as a ramp, is a kind of simple machine that helps do work. A screw, just like the ones from a hardware store, is also a simple machine! A screw is made from an inclined plane being wrapped around and around. To see how this works, you will need notebook paper, and a pencil or marker.



1. Cut 2.5 inches off a piece of printer paper to make a square.
2. Fold the top corner over until it meets the opposite bottom corner - you've now made a triangle! The long edge looks like an inclined plane, although the paper is too thin to do any real work.
3. Starting from one of the short sides of the triangle, wrap the paper once around the pencil or marker, then start rolling until the whole piece of paper is wrapped around the maker.
4. Put a finger on the end of paper to keep it from unrolling, and carefully pick up the screw you have made. Do you see how the long edge of the triangle is now traveling around and up the marker? This is just like the inclined plane wrapped on a screw!

Because of the inclined plane, screws can hold all sorts of things together. If you like, try making different shapes and sizes of triangles, and wrap them around a marker or pencil to make different kinds of screws.

Fun Facts

- Did you know that scissors are a type of machine? The blades move back and forth because of a lever.
- Baseball bats and tennis racquets are a kind of simple machine! When you swing to hit the ball, the bat or racquet acts as a lever.
- Old clocks used gears to make the hands turn slowly, and they would have to be wound up to work. Now clocks use a motor to turn gears.

Silly Science

- What kind of jewelry do machines like to wear?
 - Gear-rings!
- What did the dentist say to the gear?
 - Brush your teeth!
- Knock knock.
Who's there?
Dishes.
Dishes who?
Dishes a job for gears!

Way Cool Websites

- Learn about levers, pulleys, and more with this fun [activity](#)! Click on objects in the house to see what simple machine they use.
- Have an older sibling or adult help you find simple machines like levers and screws that are in a [lawn mower](#).
- Watch this video to see how a [square-wheeled bike](#) could work, using simple machines.

Teacher Tidbits

Types of Simple Machines

When you think of a machine, you probably think of something big like a washing machine or car or bulldozer. Those big machines are made up of smaller parts called **simple machines**. Simple machines are made of one or two parts, and they help us do **work** like making things move. There are several different kinds of simple machines:

- **Inclined planes** are like ramps that help you move something upward without lifting it. You can push it up the inclined plane instead.
- **Levers** make it easier to lift a load. (A teeter-totter or see-saw is a lever. Is it easier to lift a friend up in your arms, or by riding the teeter-totter?)
- **Wheels** help you move something across the ground.
- **Pulleys** allow you to pull down on a rope to lift a heavy load. (It's easier to pull down than up, because you can use gravity and your weight to help.)
- **Screws** are simple machines that move in a straight line (into a piece of wood, for example) when you turn them. It works a lot easier than just trying to push something into the wood!
- A **wedge** is used to help split things in two. An axe used for chopping firewood is a wedge.

Gears Are Machines

Gears are also important simple machines. A gear is just a wheel with teeth, sometimes called a **cog**. To do any work with a gear, you need to have at least two cogs with their teeth fitting into each other. Because the teeth fit together, when you turn one gear, the other one turns too! Gears come in many different sizes, which help them do work. If you connect one big gear with a small one, you can turn the big gear slowly and it will make the little gear turn quickly. Since it takes less energy to turn the big gear slowly than it would to turn the little one quickly, you are saving energy and making work easier by using gears.



One gear can make another one turn faster, but it can also make it turn in a different direction. When you turn a big gear to the right, the little one will move to the left. This is good for many machines where the direction needs to change in order for the machine to work.

When two or more gears are connected, it's called a "gear train." The gear that you turn is called the "driver" and the last gear that you are trying to move is called the "driven" gear. Sometimes there will be several gears in between the driver and the driven—those are called "idlers."

Big Gears, Little Gears!

Gears are everywhere! Some rides at an amusement park or fair use large gears which make them spin in circles (like the spinning teacup ride at Disneyland). Huge wind turbines use gears to convert the slow motion of the blades into much faster motion to make electricity.

Gears are in small things, too, like tiny music boxes or remote controlled cars. They are used in clocks to make the minute and the hour hand go around. They are used in motors: big car motors, and little motors that make your toys move. Most of the time they are hidden away inside so you can't see them, but if you look at a can opener, you will be able to see two gears. Turning the handle will make one of the gears move, and the other one will move in the opposite direction. You can also see gears on a bicycle. With some bikes, the wheels will move at different speeds when you pedal because of gears connected by a chain.

Printable Worksheet

Use the worksheet below to help review the concepts of how gears change speed and direction. The bottom half is the pattern for the "Experiment with Gears" project.

You can make different gear patterns using this [gear template generator](#).

Learn about Gears!

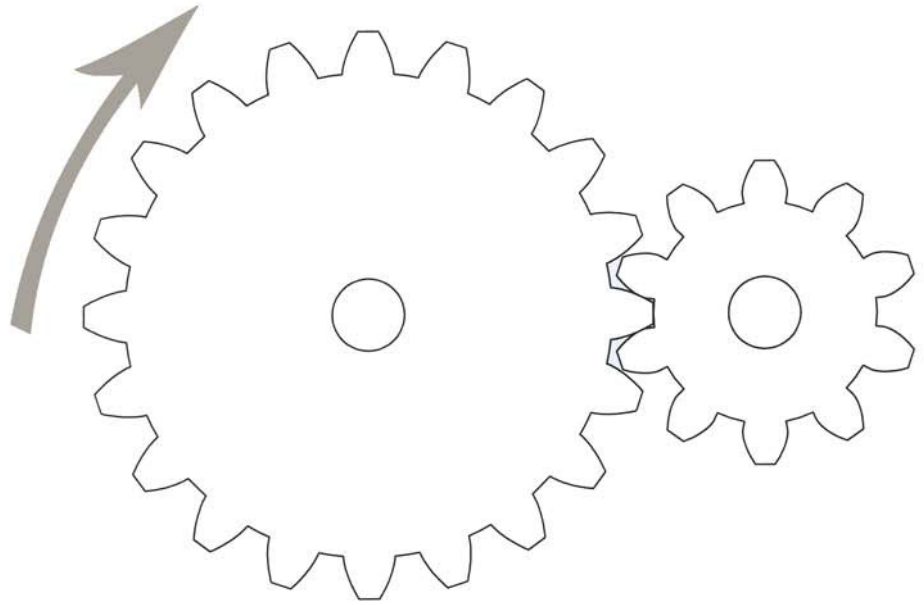
How many teeth does the big gear have? _____

How many teeth does the little gear have? _____

Which one do you think will turn the fastest?

Big Little

The big gear is turning in the direction of the arrow. Draw an arrow to show what direction the little gear will turn.



Make a Gear Model:

1. Cut along the dotted line
2. Color the gears
3. Tape the paper on a styrofoam tray
4. Have an adult cut the gears out
5. Pin them to a piece of cardboard with their teeth interlocking

