WHEEL WORKS

How many wheels do you have around your house? 10? 20? 100? Take a look and see how many you can find.

There are wheels on cars, bicycles, roller skates, toy cars and trucks, wheelbarrows, lawnmowers, and children's pull toys. You might also find wheels in surprising places. A car steering wheel, a pottery wheel, and a doorknob are all examples of wheels.

Discovered almost 6 000 years ago, the wheel is one of the greatest inventions of all time. Wheels were first used for transporting things. Drawings found on stone tablets from about 3 500 BC in ancient Mesopotamia (now Iraq) show chariots with wheels. Ancient people also found that it was a lot easier to roll things on wheels than to slide them along the ground. When the Egyptians built the pyramids, they used wheels as rollers to help them move huge stones.

See for yourself how builders in ancient times moved huge, heavy stones.

ROLL ALONG

You will need:

- A heavy book
- 15 strong plastic straws
- A flat table top

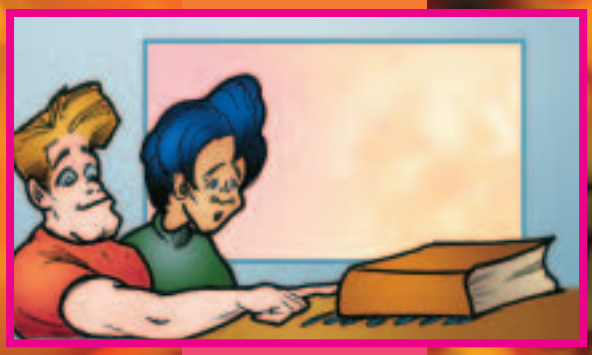
Lay the book on the table. Gently start pushing against the book with the tip of one finger. Increase the force of your push until the book starts to move.

Now lay the straws down next to one another, about 2 cm apart. Place the book on the straws and give the book a gentle push with one finger. Were you able to move it more easily with the rollers than without them?

Builders and engineers in ancient times had the right idea, didn't they?

Today, wheels come in different sizes, patterns, and are made of a variety of materials. Some wheels, like a Ferris wheel, are really BIG! Other wheels, like the tiny wheels inside a watch, are very small. Wheels are often made of wood, metal, rubber, plastic, or a combination of these materials. They may be solid like a skate board wheel, hollow like a car tyre, or spoked like a wagon wheel.

A wheel attached to a cylinder so that both can turn together is a simple machine called a wheel and axle. A wheel and axle can make it easier to lift heavy objects.



EASY SCIENCE

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GET A LIFT

See for yourself the amount of force needed to lift a cup of coins with a wheel and axle, compared to lifting it without that machine. Build your own windlass and discover how using this special wheel system can make it a lot easier to lift heavy things.

You will need:

- Two unopened cold-drink cans
- Two flexible straws
- Four paper clips
- A small paper cup
- String or thread
- Sticky tape
- 20 five-cent coins

A windlass is a special kind of wheel and axle that is used to lift heavy objects. Old-fashioned wells often used a windlass to raise a large wooden bucket of water.

To make your windlass, first open the paper clips to make a handle for the small cup as shown in the sketch, and tie the string to this handle.

Place 20 five-cent coins in the cup. Lift the cup by the string. Feel how much force you have to use to lift the cup this way.

Tape the two cold-drink cans together, one on top of the other. Tape two paper clips on opposite sides of the upper can. The large end of each paper clip should stick up above the edge of the can.

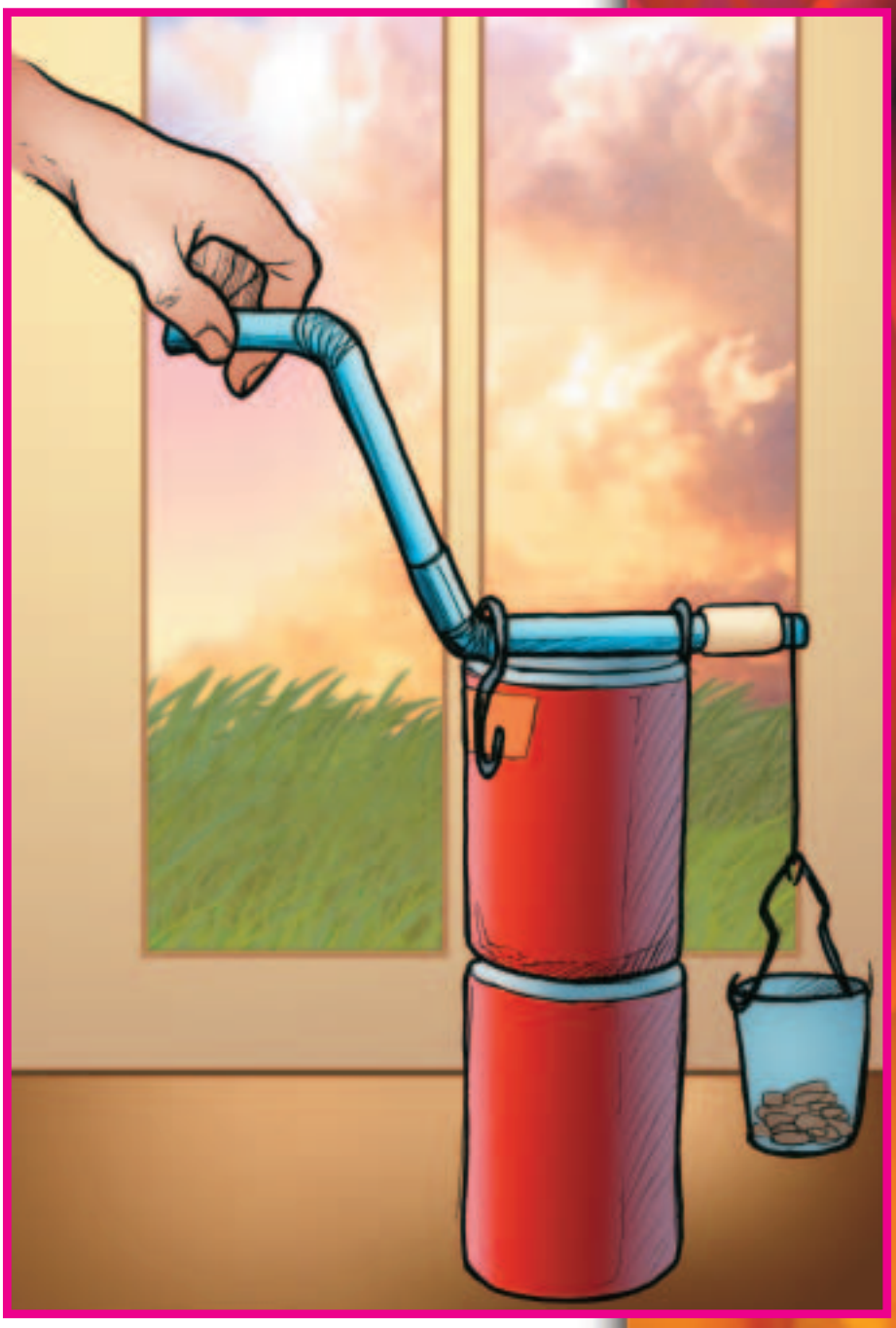
Place the long end of a flexible straw through the paper clip loops so that the straw rests on top of the can. The straw is the axle of your windlass. Bend the short end of the flexible straw upwards.

Bend the second straw at the flexible joint. Attach the long end of the second straw to the short end of the first. The second straw is the handle or wheel of your windlass.

Now you can hang your cup of coins from the windlass. Tape the end of the string to the straw about 2 – 3 cm from the end opposite the handle. Turn the handle of your windlass and watch the cup of coins rise! How does the force needed to lift the coins compare to lifting the cup of coins before?

Try lifting the cup by using your fingers to turn the axle at the end near the string. Is it easier or harder than using the handle?

Experiment with your windlass to see how many coins you can lift.



BALL BEARINGS

Did you know that the wheels of many cars, trucks and even bicycles have small hard steel balls inside them? These steel balls are called ball bearings. These balls help a wheel spin more easily by reducing friction between the wheel and the axle. Try this activity to see how ball bearings work.

You will need

- A plastic coffee can lid
- Six to eight marbles
- A large, heavy book

Turn the plastic lid upside down so that it forms a little bowl and place 6 – 8 marbles in the ridge along the inside ledge of the lid. Place the book on the marbles. Using one fingertip, see how easy it is to make the book spin. Watch the marbles move as the book spins. Do you thing the book will spin as easily without the marbles? Try it and see!

Just as the marbles keep the book and lid from rubbing together, ball bearings keep a wheel and axle from rubbing together and slowing the wheel down.

Make a Wonder Wheel

Astonish your friends with this mysterious Wonder Wheel that returns to you like a boomerang when you roll it away!

You will need

- A coffee can with both ends removed. Ask an adult partner to remove the ends of the can and to carefully press down any jagged edges with the back of a spoon. The rims of the can must then be covered with masking tape.
- A hole punch
- Three or four long rubber bands
- Six metal washers
- Two short pieces of string (each about 10 cm)
- Masking tape

Use a hole punch to make two holes in each plastic lid. The two holes should be on opposite sides of the lid, the same distance from the centre.

Cut the rubber bands and tie their ends together to make one long rubber string about 45 cm long.

Ask your adult partner to help you run the rubber band through the four holes in the plastic lids as shown. Tie the rubber band together on the outside of one of the lids.

Tie the rubber band together at the centre with a piece of string as shown and then tightly tie five or six washers to this centre spot.

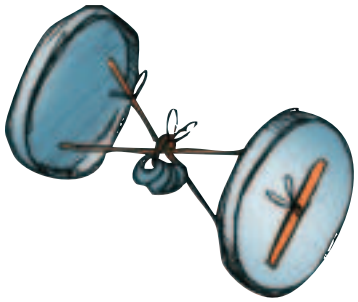
Your adult partner should now bend one of the lids and push it through the can so that the lids can be attached to the opposite ends of the can. Your rubber band should be stretched a bit, but not too tight.

Lay the can on its side on a smooth uncarpeted surface. Give it a gentle push so that it rolls away from you. What happens? It comes back to you!

Challenge

Find out what happens if you tie a different number of washers to the rubber band, or if you use a rubber band of a different length or thickness. See if you can design a Wonder Wheel that:

- Goes a longer distance before returning
- Rolls back at the fastest speed
- Rolls back at the slowest speed
- Will roll back up a ramp after you roll it down!



A WHEEL THAT MEASURES UP

Another important use for wheels is to measure distances. The wheels on a car are used to measure the distance that the car has travelled, and the distance is recorded on the car's odometer. If you know the distance around a car's tyre and the number of times the tyre has turned, you can figure out the distance that the car has travelled. Try this activity and see if you can go the distance.

You will need

- A bicycle or wagon or large toy truck
- Masking tape
- A cloth tape measure

Wrap the measuring tape snugly around the front tyre of the bicycle. The distance around the tyre is called its circumference. Write down the circumference of the tyre in the chart.

Find a long, flat surface, like a sidewalk, that you can roll your bicycle along. Have a friend help you mark a starting line and, at least two paces away, a finish line.

Position your bicycle so that the front tyre is right on the starting line. Ask your friend to put a piece of masking tape on the side of the wheel where it touches the starting line and to count how many times the wheel turns as you slowly roll your bicycle towards the finish line.

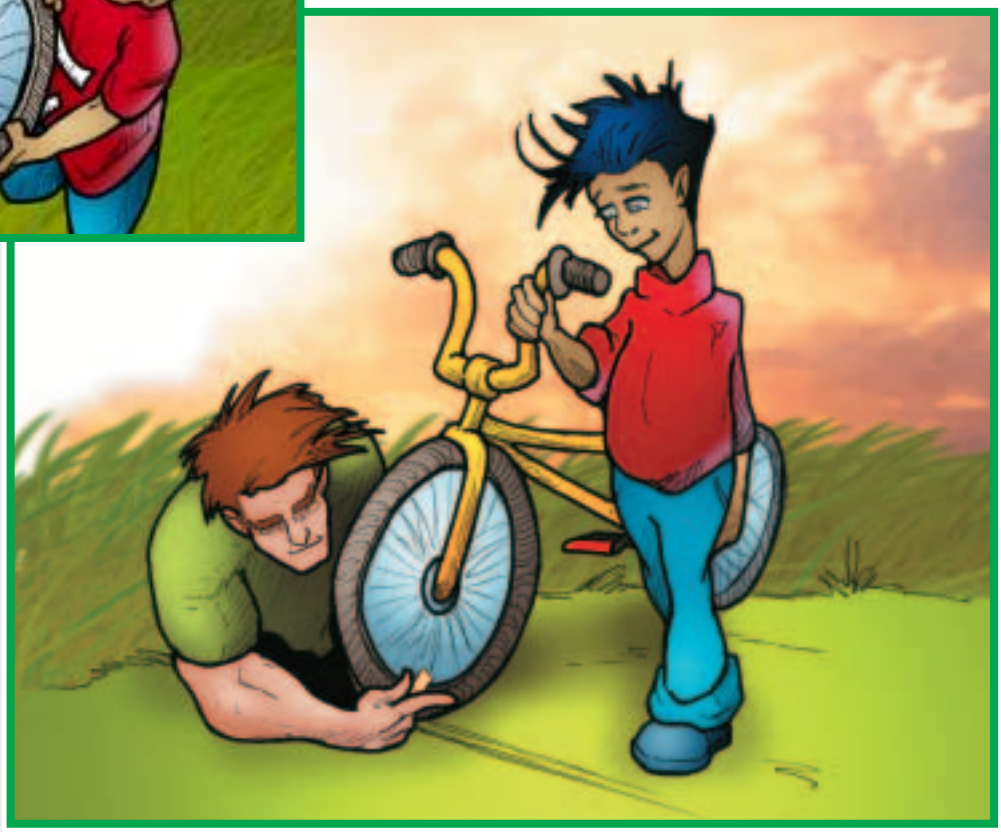
To find the distance that your bike travelled, multiply the circumference by the number of turns of the wheel. Write your answer in the chart under "Distance".

You and your friend can check your result by measuring the distance using only your tape measure. How accurate was the wheel measuring method?

Circumference	Number of turns	Distance

Let's see how good your maths skills are!

1. If your wheel has a circumference of 2 metres, and its turns 25 times, how far will it travel?
2. If your wheel has a circumference of 2 metres and it turns enough times to travel 20 metres, how many turns did it make?
3. If you travelled 100 metres and your wheel turned 50 times, what was the circumference of your wheel?



1. 50 metres
2. 10 turns
3. 2 metres