EASY SCIENCE

SCIENCE FRICTION

Whenever two materials rub against one another, there is a force between them called friction. There is friction when the tyres of a speeding car rub against the road, when a towel rubs against your wet skin, when air rubs against a falling apple, and when water rubs against a swimming fish.

You can feel the difference in the amount of friction when you wave your hand through the air compared to when you move it through water or thick mud.

Sometimes friction is a bad, undesirable force, because it slows things down or makes them more difficult to move. At other times, friction is very helpful. It helps start thing moving, and is also used to make things stop moving.

Friction usually makes things hot. When a moving thing is slowed down, much of its energy of motion is converted to heat. Rub your hands together and see for yourself how friction makes them warm.

Compare the amount of friction between a marble and other objects

You will need:

- Two rulers
- Metre stick or measuring tape
- One marble
- Book (about 3 - 4 cm thick)
- Wax paper (about 60 cm long)
- Several sandpaper sheets taped together, about 30 cm long
- Bath towel
- Aluminium foil, about 30 cm long

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SAASTA

Find a long, smooth surface like a smooth floor or long countertop. Make an inclined track by leaning two rulers next to each other on a book as shown. Be sure there is plenty of flat space at the end of your "track".

Place the wax paper at the end of the track. Release the marble (don't push it!) from a point near the top of the track and watch as it rolls down the track and along the wax paper. How did the speed of the marble change as it rolled across the wax paper? How far did it go?

Measure the distance from the bottom of the track to the place where the marble stopped, and write it in the chart. Roll the marble down the track two more times, measuring the distance the marble travels each time. Be sure to release the marble from the same place each time. Write your measurements in the chart.

Add your distance measurements together and divide this answer by three to find the average distance the marble rolled on the wax paper. When scientists do experiments, they always make several measurements like this and then average their results. Why is it a good idea to do this?

Do you think the distance the marble travels will change if you replace the wax paper with a towel? Try it and see! Repeat three times, writing down and averaging your distance measurements as you did before. What is the name of the force that stops the marble? All forces have direction. What is the direction of this force? See the answer at the bottom of the page.

Try placing other materials, such as sandpaper or aluminium foil that has been crumpled and then flattened out at the end of the track. With which material is the force of friction the greatest?

Name of Material	Trial 1	Trial 2	Trial 3	Average
Wax Paper				
Aluminium Foil				
Sandpaper				
Towel				

Reducing friction

Friction does not only cause the things rubbing together to heat up. It also causes them to wear down. Cars, boats, trucks, airplanes and industrial machines all have many mechanical parts that rub against each other all the time. These parts would heat up, wear down and completely stop working if it weren't for lubricants. That is why you need to check the oil level in a car regularly.

The job of any lubricant is to lessen the amount of friction between two surfaces that move against each other. You experienced how rubbing your hands together produces heat. Now squirt a little dishwashing detergent on your hands and rub them together again. Your hand will not get as warm this time, because the detergent acts as lubricant. The detergent fills up and covers many of the tiny bumps, cracks and ridges on your hands. The chemicals in a detergent slide over each other and reduce the amount of friction.

There are many different types of lubricants. Because of their different chemicals, some lubricants work better in cold rather than hot temperatures or in dry rather than wet weather. Some lubricants are made especially to work in tiny machines, like wristwatches, rather than in big machines like a train engine. There are even some lubricants that are not used to lubricate mechanical parts at all. Some, such as certain oils, are used to make moisturisers or soap.

Most lubricants are liquids. Oil from plants, animals and the oil pumped from under the ground can all be made into liquid lubricants. There are also solids than can be used as lubricants. The talc found in baby powder, graphite used in pencils, and certain types of wax are all solids that can be added to lubricants or used as lubricants themselves. There are also lubricants that are a little bit like a liquid and a little bit like a solid, such as thick grease or petroleum jelly.

Even gasses can be used as lubricants. A thin "cushion" of air blown between two surfaces can reduce friction very well and act as an excellent lubricant.

See for yourself

You will need:

- Lightweight disposable plastic dinner plate
- Plastic straw
- Balloon
- Rubber band
- Pencil
- Blunt-end scissors
- Very smooth table or counter top

Ask an adult to help you use a pencil to make a hole in the centre of the plate.

Cut a 5 cm piece of straw. Put about half of this piece of straw into the opening of a balloon and attach the balloon to the straw with a rubber band. (Do not put the rubber band on so tightly that it crushes the straw.)

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Turn the plate upside down on a smooth table or counter top. Inflate the balloon by blowing into the piece of straw that sticks out from the balloon. Pinch the balloon just above the straw to keep the air from escaping.

Without letting the air escape, push the straw through the hole in the back of the plate. Now let the air out of the balloon. Gently push your plate and see how easily it moves with air as a lubricant!

Thick or thin - who will win?

One important feature of a liquid lubricant is its thickness and its ability to flow. This quality is called a lubricant's viscosity. Try these two activities to see which lubricant is more or less viscous than the others.

You will need:

- Three tall, narrow jars with lids, such as spice bottles
- Vegetable oil
- Transparent shampoo
- Transparent dishwashing liquid
- Three colourful chocolate sweeties (of equal size and weight)
- Watch with a second hand

Fill each of the jars about 4/5 full with one of the following: vegetable oil, shampoo or dishwashing liquid. Put the lids on tightly.

Ask a partner to help you shake the jars hard and fast to create little bubbles in the liquids. You can shake two jars, while your partner shakes one. Shake the jars for the same amount of time and then place them in a row on a table.

Look at the smallest bubbles in each jar. Find the jar where these bubbles are moving the fastest. Is this liquid the most viscous or the least viscous? Now find the jar where these tiny bubbles are moving the slowest. Is this liquid the most or least viscous? What about the jar where the bubbles are between the slowest and the fastest? How does the viscosity of this liquid compare to the other two?

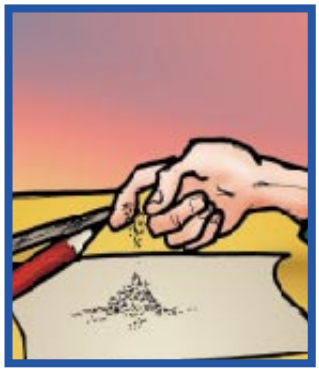
Now take off the lids and give each bottle a gentle bump against the table to get rid of the bubbles. Carefully place a chocolate sweet in one of the liquids and time how long it takes to reach the bottom. Record this number of seconds in the chart.

Do the same thing with the other two jars. Can you figure out which is the most viscous liquid from the time the chips take to reach the bottom?

SECONDS TO REACH BOTTOM		
Oil	Shampoo	Dish Detergent

Test your aim with a graphite game

NOTE: With powdered graphite on your fingers, do not touch walls, clothes or furniture!



You will need:

- An old smock or apron
- A cardboard box
- Seven clear plastic cups
- Glue
- Three ping-pong balls
- A dark crayon
- A pencil
- Masking tape
- Paper
- Emery board or sandpaper

Put a five centimetre piece of masking tape on each cup. Using your crayon, mark two cups "25", two cups "50", two cups "75" and one cup "100".

Glue the bottoms of the seven marked cups to the bottom of the inside of the box as shown. Place the box on the floor, about one metre (three steps) from where you will be shooting.

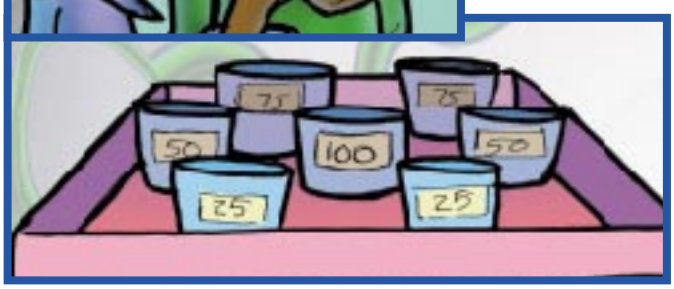
Place an emery board on a piece of paper and rub the point of the pencil on the emery board. Tap the emery board on the paper so that the graphite dust falls onto the paper. Rub the pencil again until you have collected a little pile of graphite.

Put your index finger in the graphite and rub your finger and thumb together for about one minute to thoroughly coat them with the graphite powder. See how your thumb and finger get slippery as the graphite acts as lubricant.

Put a ping-pong ball between your thumb and index finger. Aim the ball at the cups in the box and squeeze your index finger and thumb together. If your fingers are well lubricated, the ball should shoot out towards the cups.

If the ping-pong ball lands in a cup, you get the number of points on the cup. Play against a partner and see who scores the most points in three shots.

REMEMBER: All players must use the powdered graphite lubricant! The graphite will wash off your fingers easily with soap and warm water.



Your body's super lubricant

Lubricants are even important inside your own body! Wherever two or more bones come together so that they can bend, you have what is called a joint. Your elbow, knee and hip are examples of large joints that help you move. What keeps the bones in a joint sliding against each other so smoothly, rather than scraping against each other and wearing down? Synovial fluid, a very special lubricant made by your body, does the job!

This fluid is clear, viscous and one of the best lubricants known. It is made, right where the bones in your joints come together, by a thin layer called the synovial membrane.

Using bearings to reduce friction

Bearings are very small machines that, together with lubricants, are used to reduce friction. You will find them in your inline skate wheels and bicycle wheels.

Bearings reduce friction by providing smooth metal balls or rollers, and a smooth inner and outer metal surface for the balls to roll against.

Bearing work because things roll better than they slide. The wheels on a car are like big bearings. If you had something like skis instead of wheels, your car would be a lot more difficult to push down the road. That is because when things slide, the friction between them tends to slow them down. But if the two surfaces can roll over each other, there is less friction.

Try the following experimenting with bearings.

You will need:

- Soup can (empty or full)
- Marbles (about 12)
- Pencil
- Plasticine clay
- A lid that fits over the bottom of the soup can

Add balls of clay to the ends of the pencil, and attach the pencil to the lid with clay. Place the lid on the can and try to spin it. How well does it spin?

Now remove the lid and place the marbles on the can. Replace the lid and spin again. What has changed? What would happen if you used more or less marbles? What if you use ping-pong balls in stead of marbles? Now take a closer look a bicycle wheel. Can you guess where the bearings are?

(Answer: The direction of the force of friction is opposite to the direction in which the marble is rolling.)

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