

## FRICTION

**Friction** is a force that is all around us. This force resists or even stops motion between two surfaces that are in contact. Whenever two objects rub against each other, they cause friction. Why are some surfaces easier to slide across than others?

When you rub your hands together on a cold winter day to warm them, you are using friction.



Have you heard the tires of a car screech and squeal because the driver has to stop suddenly? That sound is caused by the friction of the tires rubbing against the road.



When you slide down a sliding board, friction between you and the surface of the slide keeps you from going too fast!



Whoosh!

Scientists use a tool, a mathematical formula, to measure friction called the “**coefficient of friction**”:

$$\mu = F/N$$

**μ (mu)** is a Greek symbol that means **coefficient of friction (COF)**. **F** stands for the amount of **force that resists motion** and **N** is the **normal force**. Normal force is the force of one surface is being pushed into another. For example, if a rock weighs 50 lbs., then the normal force is that 50 lbs. of force.

Friction depends on the type of materials that are in contact, the weight of the object, and the amount of force on the surface by the object. Higher COF values have a lot of friction. Lower values have less friction. Rough surfaces have a higher coefficient of friction values and smooth surfaces have lower values.

**Four types of friction: static, sliding, rolling, fluid**



**Static friction** occurs when two objects are not moving. There is static friction between the sole of your shoe and the sidewalk each time you put your foot down. Without friction, your feet would slide out from under you. This is what happens when you try to walk on ice, which has very little friction. Oil or water on a surface also decrease friction, which makes it easier to slip. *The amount of force needed to overcome static friction, or to start an object moving, is always more than the force needed to continue the motion.*



**Sliding friction** is the resistance between two objects when they are sliding against each other. An example of this is sliding a box across the floor. Sliding friction is weaker than static friction. This is why it is easier to push a box across the floor once you get it moving compared to the force necessary to start moving it.

When one object is sliding against another object, it will begin to slow down because of friction. It loses energy, but that energy doesn't disappear. It changes from the energy of movement (**kinetic energy**) to heat energy. That is why your hands get warm when you rub them together.



**Rolling friction** is the weakest kind of friction. It is the force that resists the motion of an object rolling across a surface. This is why wheels are used for most types of ground transportation including bicycles, cars, and skates. Friction between the tires and road help prevent skidding.



**Fluid friction** is the friction that acts on objects as they move through a fluid, including liquids and gases. You can feel fluid friction when pushing your hand through the water in a swimming pool. When a skydiver is falling toward the ground, fluid friction (in this case, the resistance of the air against the parachute) slows the fall. The larger the moving object and the faster it travels, the greater the fluid friction that resists the motion.



Friction is everywhere! Can you spot friction happening around you? Keep in mind that it is the force that reduces motion between two things.

**ACTIVITY: Friction Scavenger Hunt**

- camera
  - old magazines
  - printed copy of scavenger list (see below)
1. Look around your home and neighborhood and find five examples of the four types of friction. If you have a camera, you can take pictures of the things you discover.
  2. No camera? You can cut out pictures from old magazines, if you have some that you have permission to cut up. Feeling creative? You can even make a friction collage!
  3. If you prefer, make a list of things that you found and write them down on this list:

Static Friction	Sliding Friction	Rolling Friction	Fluid Friction



Friction is very helpful and makes possible many activities that we do every day. Here are just a few examples:

- ◇ We can only walk if there is static friction. Tennis shoes and hiking boots have treads on the soles to increase friction and help keep you from slipping and sliding. Friction is also the force that eventually causes the soles of your shoes to wear out!
- ◇ When a matchstick is rubbed against a rough surface, friction and heat are generated. This creates a series of chemical reactions, which **ignites** (starts) a fire. Sliding friction is at work here.
- ◇ Friction between the brakes and wheels of your bicycle help to slow you down. If the streets are wet and your brakes get wet, it will be harder to stop because there is less friction. This is why there are often many accidents when it rains.
- ◇ Friction is the force that allows us to hang things on our walls. The friction between the nail and the wall holds it in place.



- ◇ Brushing your teeth involves the friction of the toothbrush moving over food particles on your teeth to remove them.
- ◇ When you use a pencil eraser, the friction caused by rubbing with the eraser is greater than the friction holding the lead particles to the paper, and this removes the particles.
- ◇ If you wear glasses, they stay on your nose because of static friction.
- ◇ If you are playing tug-of-war, the friction between your hands and the rope helps you to hang on.
- ◇ Fluid resistance slows down all moving objects. Boats, cars, planes, and even fish have streamlined bodies to decrease fluid friction and allow them to move through air and water easier. The resistance of air on airplanes is called **drag**.
- ◇ As a space shuttle enters the atmosphere, the collision between the air molecules and the shuttle creates friction that heats the air and the shuttle itself. Shuttles are built with heat shields to protect them against extreme temperatures.
- ◇ Scientists have discovered that there is less friction in our joints than in Teflon!

## ADDITIONAL RESOURCES

### **Books available from the Washoe County Library System:**

[\*All About Forces\*](#) by Angela Royston

[\*Extreme Physics\*](#) by Dan Green and Simon Basher

[\*Forces and Motion: From Push to Shove\*](#) by Steve Parker

[\*Forces Make Things Move\*](#) by Kimberly Brubaker Bradley

[\*Friction\*](#) by Matt Mullins

[\*How Do You Stop a Moving Train? A Physics Book About Forces\*](#) by Lucy D. Hayes, Madeline J. Hayes, Srimalie Bassani

[\*Kinetic and Potential Energy: Understanding Changes within Physical Systems\*](#) by Jennifer Viegas

[\*Motion\*](#) by Ben Morgan

[\*Physics: Investigate the Mechanics of Nature\*](#) by Jane P. Gardner

[\*Physics: The Story of Forces and Energy\*](#) by Bryson Gore

[\*Pushes and Pulls\*](#) by Anna Claybourne

[\*Queen Of Physics: How Wu Chien Shiung Helped Unlock the Secrets of the Atom\*](#) by Teresa Robeson

[\*Stephen Hawking: Extraordinary Theoretical Physicist\*](#) by Karen Latchana Kenney

[\*What are Newton's Laws of Motion?\*](#) By Denyse O'Leary

### **Videos:**



Alex Dainis, "The Science of Matches: Bite Sci-zed" [The Science of Matches: Bite Sci-zed](#)

MooMooMath and Science, "Real Life Examples of Friction" [Real Life Examples of Friction](#)

PBS, Science Trek. "Force and Motion" <https://www.pbs.org/video/science-trek-force-and-motion/>

SciShow Kids, "The Fastest Sled Ride Ever" [The Fastest Sled Ride Ever!](#)

SciShow Kids, "Slipping, Sliding Science! Physics for Kids" [The Fastest Sled Ride Ever!](#)

**Website:**

PBS, Explore Gravity and Friction with Marble Runs (PBS) <https://www.pbs.org/parents/crafts-and-experiments/explore-gravity-and-friction-with-marble-runs>

