Name _____

Friction

Friction: "The resistance one surface experiences as it moves over another surface."

Did you know that without friction, you could not pick up an object, like this cup, or even walk? Essentially, without friction, you wouldn't be able to do much at all!

Demonstration: Moving Furniture

Following the instructions from the video, try moving various pieces of furniture around the room.

Which pieces of furniture were the hardest to move?

_____

Which surface made it more difficult to move the furniture – the carpet or the tile?

_____

Experiment 1: Inclined Plane

Based on what you know of friction so far, write out a hypothesis using if, then, and because, explaining what will happen to the wooden block when placed on sandpaper.

Hypothesis

IF … the wooden block is placed on sandpaper and then both block and plank are inclined,

THEN … _____

BECAUSE … _____

In this experiment, you will determine which of the five surface pairs have the greatest amount of friction.

Place the long wooden ramp flat on the floor and place the short wooden block at one end. Then one student starts to lift the long wooden object up (from the same end where the short wooden block is located). All the students must watch for the object to *begin* moving down the ramp. At this point, the students **record the slope of the incline** using a protractor. Alternatively, use the **height**. Have the students do this five times then take the average (add up all five protractor readings and then divide by five or add up all five height readings) and use the average in the table below.

Now place any of the other surfaces on top of the long wooden ramp and repeat with the same short wooden block. Do this for all five surfaces (see video).

Types of Surfaces (wood is paired with another surface)	Average Slope of Incline or Height of Ramp	Greatest Friction. (Number from 1 to 5 with 1 being the most friction. This and next column is completed after the experiment)
Wood/		
Wood/		
Wood/		
Wood/		
Wood/		

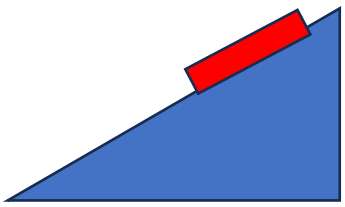
Friction and Gravity

What force is pushing the wooden block down the ramp? _____

Draw the gravity force arrow on the red block

Is “friction” a force? _____

Draw the “friction” force arrow on the red block.



Review:

- ✓ What does friction *do*?
- ✓ How many surfaces are required to get friction?
- ✓ Is friction a force?
- ✓ Why is friction important when walking?

Teacher Notes

Friction

Friction: "The resistance one surface experiences as it moves over another surface."

Did you know that without friction, you could not pick up an object, like this cup, or even walk? Essentially, without friction, you wouldn't be able to do much at all!

Demonstration: Moving Furniture

Following the instructions from the video, try moving various pieces of furniture around the room.

Which pieces of furniture were the hardest to move? *The heaviest and those with more surface in contact with the floor.*

Which surface made it more difficult to move the furniture – the carpet or the tile? *The carpet was much more difficult than moving an object over the tile.*

Teach

To get a "feel" for friction, have the students move around different pieces of furniture, and if possible, have them move the furniture around on different surfaces, like tile and carpet. You should be able to demonstrate that all the furniture "resisted" being moved. Great! Friction is real!

But what is happening physics-wise!? It turns out that friction is dependent on two major factors. First is the kind of materials that make up the two surfaces in contact. Every surface, even smooth surfaces have small pits and bumps. The rougher the surface, the more pits and bumps. Carpet does not have pits and bumps, but it has lots of fibers that form a very uneven surface and that can get entangled around elevated areas on the other surface. So, it's going to be harder to push a wooden object over carpet than it is if you push the same object over tile because tile has a "smoother" surface.

Illustrate this by drawing two rectangles on the board that represent to different surfaces in contact with each other (see video). Then draw "teeth" on the two surfaces that are in contact with each other and show the students that when these teeth (pits and bumps) interlock, the two surfaces will not slide past each other very easily. You can also demonstrate this using two flat pieces of Lego. Have the kids play with the pieces making sure they put the studs in contact with each other, and then have them try to slide the two pieces past each other. Then turn them over and have them slide the "smooth" sides past each other. Which is easier?

The second most important aspect in friction is the mass of the object moving over the lower surface. This is because the surfaces are pushed more closely together, causing the pits and bumps on both surfaces to become more interlocked making it more difficult for the two surfaces to move past each other.

Experiment 1: Inclined Plane

You will need a long piece of smooth or painted wood, a long piece of glass, a long piece of smooth metal, a long piece of shaggy carpet (or a rough towel or blanket), and two pieces of rough sand paper. You will also a need a small wooden block about eight inches long with a smooth surface. You can also use other materials with differing textures, go ahead and test just about anything you want out!

In this experiment, you will determine which of the *ten* surfaces have the greatest amount of friction. There are ten surfaces because the short wooden block is used each time and counts as a surface each time (wood) and friction is always determined by comparing *two* surfaces.

Place the long wooden ramp flat on the floor and place the short wooden block at one end. Then one student starts to lift the long wooden object up (from the same end where the short wooden block is located). All the students must watch for the object to *begin* moving down the ramp. At this point, the students record the slope of the incline using a protractor (see video). Alternatively, use the height. Have the students do this five times then take the average (add up all five protractor readings and then divide by five or add up all five height readings) and use the average in the table below.

Now place any of the other surfaces on top of the long wooden ramp and repeat with the same short wooden block. Do this for all five surfaces (see video).

Describe this procedure to the students, but before you start it, have them complete the hypothesis:

Based on what you know of friction so far, write out a hypothesis using if, then, and because, explaining what will happen to the wooden block when placed on sandpaper.

Hypothesis

IF … the wooden block is placed on sandpaper and then both block and plank are inclined,

THEN … *the block will not easily slide down the ramp*

BECAUSE … *the sand paper has lots of pits and bumps which increases the total amount of friction between block and sandpaper*

The order in which the students test the materials does not matter. Have the students fill in the table using a protractor to find the angle of incline (the greater the angle, the more friction). *Generally*, the smoothest surface will have the lowest incline while the roughest surface will have the highest. Ask the students why this is? They will tell you it is because of friction. But ask them to be specific. You will want them to explain to you that some of the surfaces have more pits and bumps than others, and that is why the wooden block resists sliding.

Types of Surfaces (wood is paired with another surface)	Average Slope of Incline or Height of Ramp	Greatest Friction. (Number from 1 to 5 with 1 being the most friction. This and next column is completed after the experiment)
Wood/		
Wood/		
Wood/		
Wood/		
Wood/		

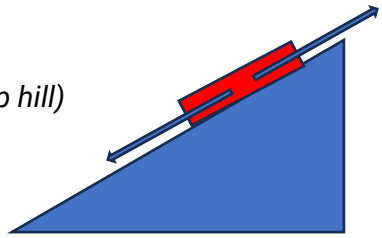
Friction and Gravity

What force is pushing the wooden block down the ramp? *Gravity*

Draw the gravity force arrow on the red block *(gravity arrow faces down the incline)*

Is "friction" a force? *Yes*

Draw the "friction" force arrow on the red block *(faces up hill)*



Teach

From previous lessons we know that gravity is the force that pushes the block down the ramp. But if gravity is *always* working to push the block down the ramp (and it is) then why does the block stop? Yes, it is because of friction. But this must mean that friction is a force that works in opposition to gravity force! This means that it is the same length as gravity force arrow but in the opposite direction.

The Free Body Diagram is simplified. It turns out that because the wooden block is sitting on an inclined surface, a portion of the gravity force is also pointing straight down into the earth. And, because of Newton's third law, that must also mean that there is an equal and opposite force pointing upwards (actually, perpendicular to the top surface of the wooden block). All of this is quite complex and need not be explained to the students.

Review:

- ✓ What does friction *do*?
- ✓ How many surfaces are required to get friction?
- ✓ Is friction a force?
- ✓ Why is friction important when walking?