Simple machines info...

I have a question for you... can you name all of the tools that you have used since you woke up this morning? Go ahead. Take your time. I'll wait...

How many could you count? Five, ten, twenty?

I would guess that you probably have used many more tools than you know. Some of these tools are very simple, like a spoon or a fork. Others may be very complex, like a computer or a television. A more important question to ask is, "Why did you choose to use all these tools today?"

I would guess because you needed to make something move! And the ability to move something is what scientists call work. Most of the time, we think that work is something we do every day to earn money. But scientists have a different definition for work. Whenever an object is moved, work is being done!

The forks or spoons that you used with your breakfast today are tools that helped you move your food closer to your mouth. Did you need to use those tools? Not really. But it would be very messy trying to eat your cereal without a spoon!

Another name for a tool is a machine. All machines are objects that help you do work (move something) in an easier way! In this unit, you are going to study all about simple machines that help you do work! A simple machine is "simple" because it does not have more than one moving part! Some simple machines, like your fork, do not have any moving parts!

So far, we have seen that speed, distance and time act like three brothers living in the same house. They move and act in predictable ways. For example, you cannot change the speed of an object without changing its time.

You have also learned that acceleration, force and mass are connected too! Whenever you change the mass of an object, you also change its acceleration.

Today, you are going to study a new relationship! This one is between... Force, Work and Distance

Before we move on, let's see if you understand our new definition of work...

Imagine going outside and finding the biggest tree you can. Then, you put your hands on the tree and push as hard as you can! In fact, you keep pushing until you knock that tree over! It doesn't happen that way, does it? Nope! Nobody on the planet could do that! But the big question is, did you do work on that tree? No you didn't!

Remember... the only way you can do work is if you move something! You would do more work by walking out to the tree (because you are moving your body) than on the tree itself!

Now you did use a lot of force! You pushed on that tree very hard. However, it didn't move any distance at all, did it? No. So you didn't do any work. Force and distance are related by how much work needs to be done. When the force used on an object is increased, the distance you need to do work is decreased. And, when the force used on an object is decreased, the distance you need to do work is increased.

How about an example? Let's say you need to drive a nail into a block of wood. You have two choices; you can use a hammer or a fried chicken leg. (This is a little silly, I know! Who would waste a good piece of fried chicken? Geesch!)

I think you already know that using a hammer would be much easier than the chicken leg. You may have to hit that nail three or four times with a hammer before the nail is driven into the wood.

But imagine how many times you would have to hit that nail with the chicken leg! You would be smacking that nail with the chicken for hours before the nail was driven into the wood. Every time you swing that chicken leg in the air increases the distance you have to move to get your work done!

Since the force of the chicken leg is much smaller than the hammer, you would have to move the chicken leg a greater distance to get your work done. (Remember, your work is to drive the nail through the wood!)

Throughout this unit, you need to remember one very important rule:

Simple machines spread out the amount of force needed to get work done over a greater distance.

There's always a trade-off with using simple machines! Remember this as you read our next chapter on three of the six simple machines!

Screw, Ramp, Wedge

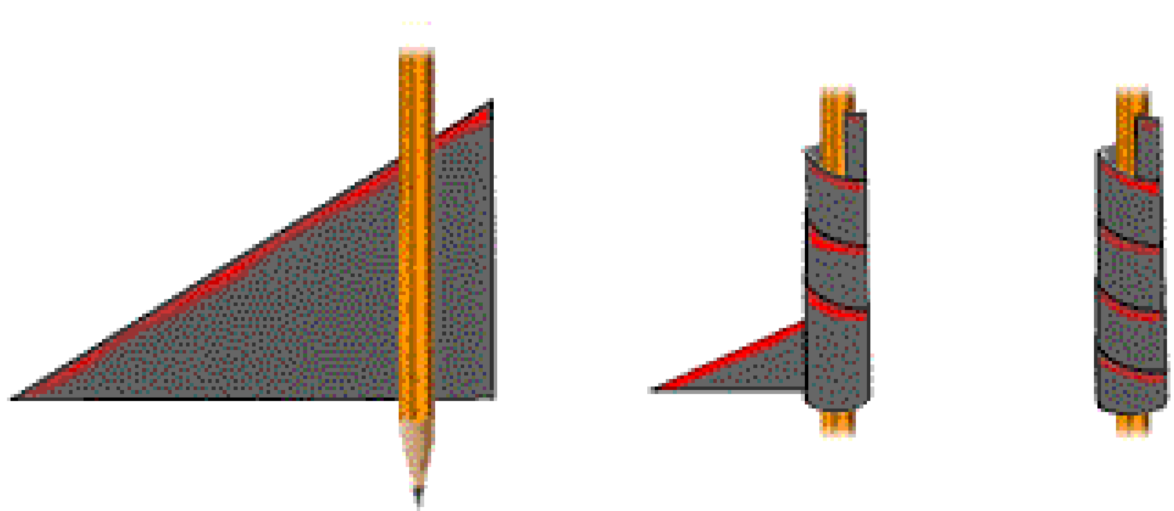
Materials:

- Pencil
- Paper
- Colored felt tip marker
- Scissors
- Tape and Straws (needed for extension activity)

Your will begin your study of simple machines by examining the screw, inclined plane, and wedge. The screw is really an inclined plane in the round with a wedge at the tip. Think of a typical screw. The wedge is the pointed end. The inclined plane is the thread that wraps around the screw. Screws are used in many different places to hold things together.

Here's the trade-off: If you've ever had to put in a screw with really narrow threads, you've probably found that you have to turn it a really long time to get it to go anywhere. Just like in a ramp, the easier the effort, the longer the distance you have to move something!

This simple demonstration shows how a screw is actually an inclined plane (ramp). You may want to do this as a demonstration for your class or have every student make their own.



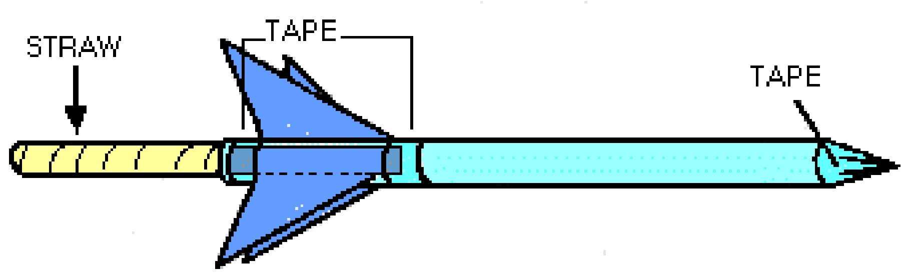
Procedure

1. Cut a right triangle from the paper.
2. Use the felt tip marker to color the longest edge of the triangle.
3. Position the shortest side of the triangle along the side of the pencil and then evenly wrap the paper around the pencil by rolling the pencil.
4. Inform the students that they made a screw out of a ramp when they wrapped the triangle around the pencil.

Follow Up Questions

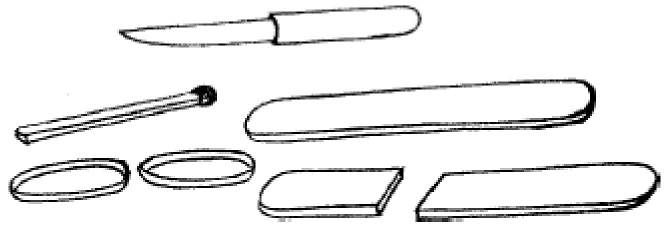
- What simple machine is the right triangle?
  Ramp
- What simple machine was created when you wrapped the pencil around the triangle?
  Screw
- Name some examples of this simple machine.
  Jar Lids, Light Bulbs, Stools, Clamps, Jacks, Wrenches, Key Rings, Spiral Staircases, etc.

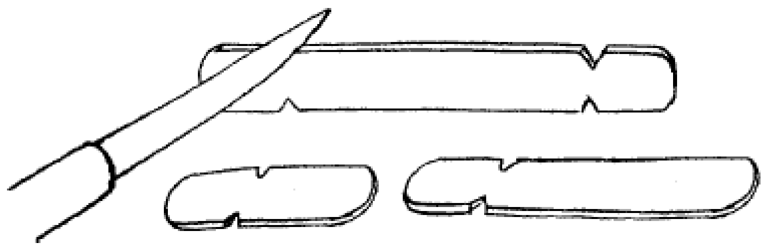
Extension Activity:
With the paper screw that your students have created, instruct them to fold over one of the ends and tape it shut. With scissors, carefully cut out fins in any shape you like and glue/tape them to the end other end of the tube. Insert a straw into the open end and blow through the straw to launch your rocket.



Popsickle Catapult

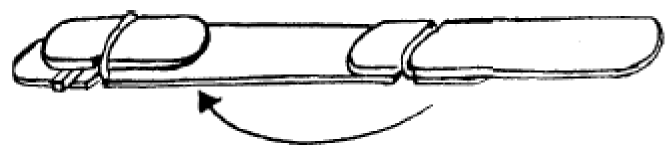
1. To make the device you will need two wooden ice-cream sticks, two small rubber bands, a matchstick and a paper knife or blade. Cut one ice-cream stick about 3-cm from one end.





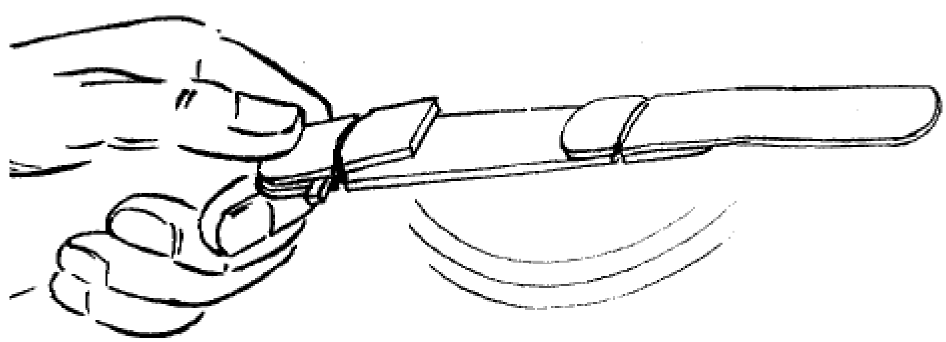
2. Cut notches in the pieces as shown. Cut notches on the other ice-cream stick too, as shown.

3. Join the cut pieces on the big ice-cream stick by putting a rubber band in each pair of notches. Slip in a piece of matchstick between the small piece and the big ice-cream stick. This is the fulcrum and is part of the locking system. You can open and close it by pressing it.



4. Now swing the blade and lock it under the small piece.

5. Now, if you press the left button, the device will flick open in a fraction of a second.

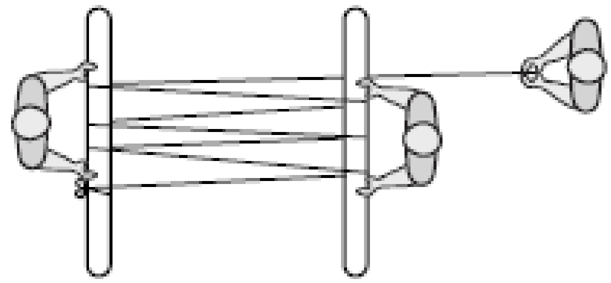


Block and Tackle Pulley

This simple pulley system will explain the usefulness of a block and tackle pulley.

Materials:

Two (2) Broom handle 2–3 feet long
Rope, strong, 25 feet long
Three people



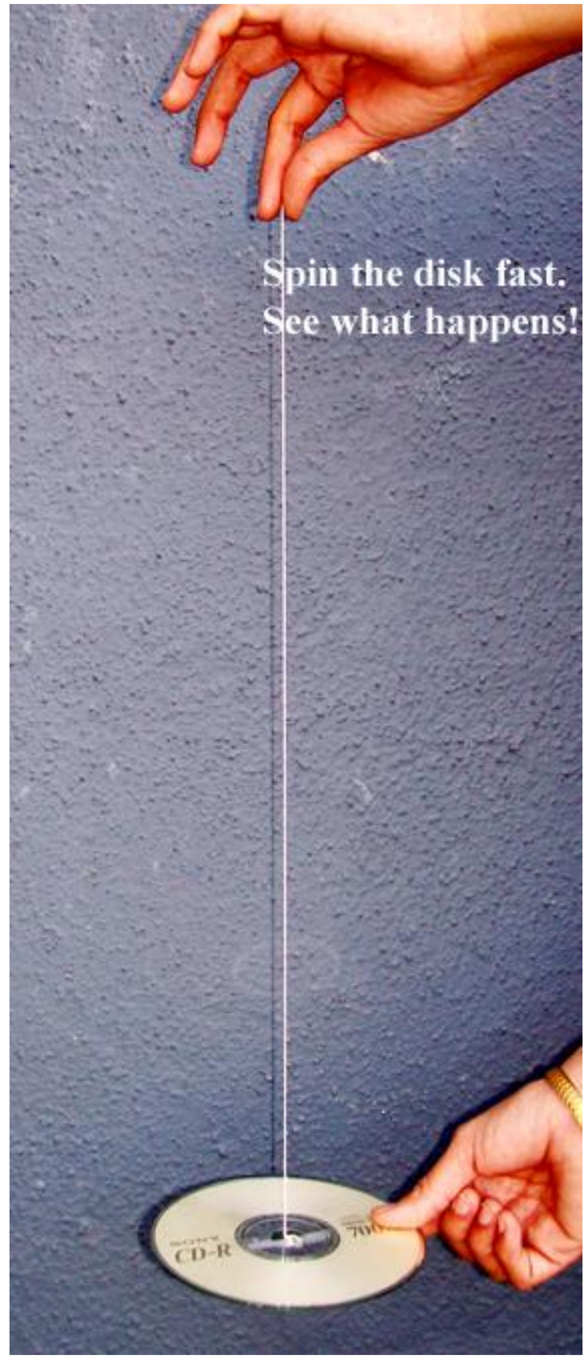
Procedure:

1. Two people will need to hold onto the broom-handles while the other will be the rope puller.
2. Have the two broom-handle holders stand about 5 to 6 feet apart and extend their arms to hold the broom handles parallel to the floor at waist level.
3. Tie one end of the rope to the middle of one of the broom handles.
4. Wrap the rope around the middle of the other broom handle and back around the first broom handle again several times as seen in the picture. Give the free end to the rope puller who will be standing according to the picture.
5. Have the two broom handle holders try as hard as they can to prevent the broom handles from coming together as the rope puller gently pulls on the rope. They will not be able to keep from moving together.

Explanation:

Pulleys are used extensively when heavy objects need to be lifted, especially in cranes in shipping and construction areas. The advantage of a pulley is its ability to change the number of "ropes" lifting an object. This gives a lifter a greater ability to spread the force needed to get work done. For a block and tackle pulley system, the effort needed to move an object is determined by the number of support ropes that are lifting the object Therefore, the more times the rope is wrapped around the broom handles, the easier it is for the puller to move the people. The trade off for the pulley, like all simple machines, is a greater distance for the puller to have to move. The general rule for simple machines is this: As force decreases, distance increases.

Gyro Wheel



* Many thanks to arvindguptatoys.com/toys.html for several of these ideas and images!