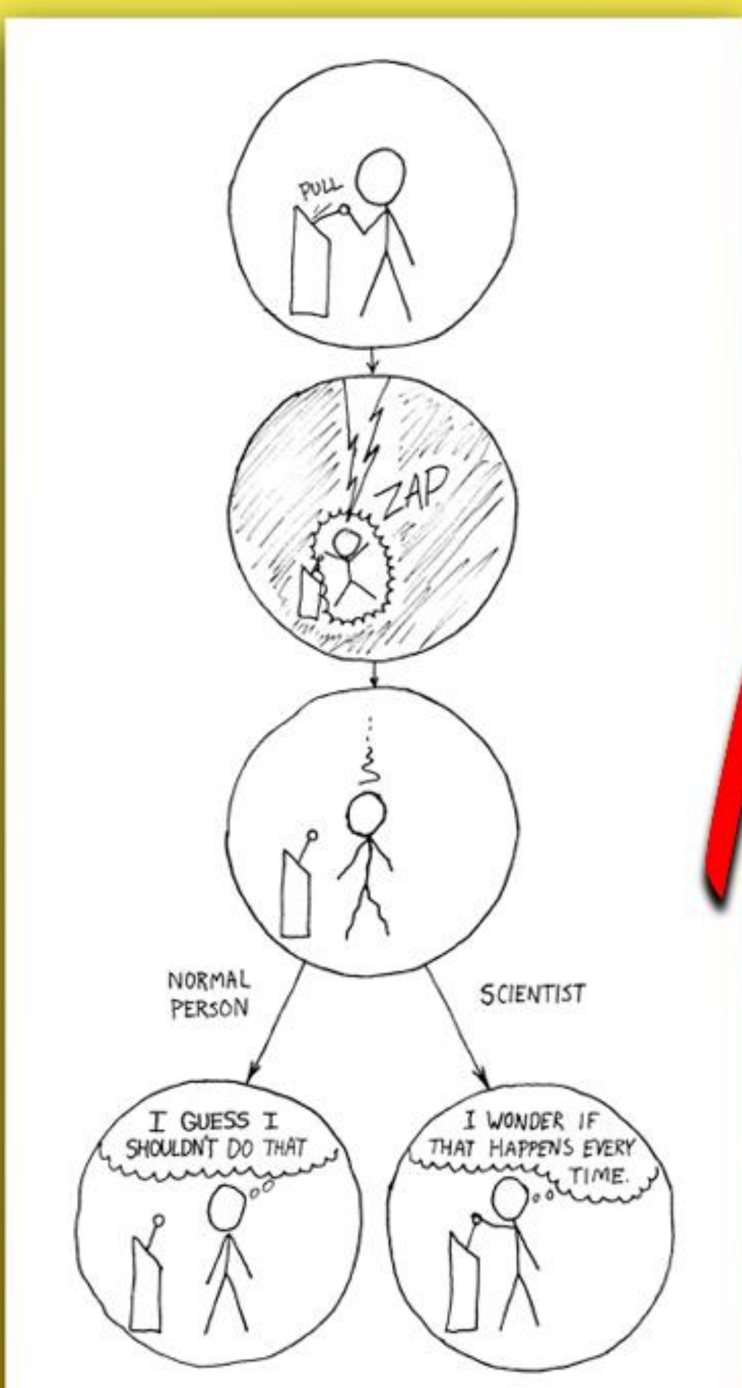
Kids Country

YOU Belong, YOU Explore, YOUnique

The lab of MR.Q

Southland Conference - Scott McQuerry

2012-2013



Simplified Simple Machines

SCIENCE PIONEERS

Star wars video

You can find the video clip used within our workshop at:
http://eequalsmcq.com/star%20wars%20clip.wmv

Vacuum Packed Students

Materials:

Vacuum cleaner
Large trash bag

THE FOLLOWING DESCRIPTION IS OFFERED FOR EDUCATIONAL PURPOSES ONLY. PLASTIC BAGS ARE NOT TOYS AND SHOULD NEVER BE PLACED OVER ANYONE'S HEAD. THIS DEMONSTRATION MUST BE PERFORMED BY ADULTS.

Procedure:

1. In this experiment, you will need the assistance of two people to help you by either being shrink wrapped or to help you shrink wrap.
2. Have one of your assistants step into the plastic bag feet first. Have your other assistant help bring the bag up around the shoulders of the person being shrink wrapped. REMEMBER, NEVER PLACE THE BAG OVER ANYONE'S HEAD.
3. Feed the nozzle of the vacuum cleaner into the plastic bag and have your assistant hold it in their hands. Remind them not to let the opening of the nozzle suck in their clothes or the bag. Tell them to use their hands to partially shield the nozzle from their clothes and the bag.
4. Hold the open end of the bag just tightly enough around the back of the assistant's neck to form a seal. Do not pull too tight, as it can restrict their breathing.
5. Turn the vacuum on and remove the air from the inside of the bag. In seconds, the bag will mold around the assistant inside of the bag.

6. Ask your assistant to try moving around inside of the bag... it's nearly impossible!
7. Turn the vacuum off and release the seal on the bag. Now you will see air refilling the bag.

Explanation:

When presenting this demonstration in a science class, students may have the misconception that the air is "sucked" out of the bag. This is a good time to remind students that Newton talked about forces as a "push" or a "pull" and never referred to a motion of "suction." Here are a few important things to remember:

- Air occupies space. Prior to starting the experiment, the bag was filled with air.
- Before turning on the vacuum cleaner, the air pressure inside the bag was the same as the pressure outside the bag.
- The vacuum cleaner pulled the air from the inside of the bag and created a situation where the pressure outside the bag was greater than inside the bag. The atmospheric pressure outside then pushes the bag from all sides, forming to the contours of what is contained inside.
- In light of your new discovery, explain what happened to your assistant using the terms "push" and "pull" in place of the word "suction." The practical applications for this experiment include vacuum packaging of food such as coffee and peanuts or cryovac packaging in the meat packing business to reduce spoilage of meats.

Additional Info

Wayne Goates is credited as the creator of this science demo in 1969, and he's been using it to illustrate the dramatic effects of atmospheric pressure. Wayne's original demo consisted of an arm being placed in a small plastic bag to simulate how a sphygmomanometer (blood pressure machine) works and was later expanded to the one with the student's arm being "shrunk." He revived the demo when his wife purchased a plastic bag from QVC that was to be used for storing sweaters and blankets so that several articles could be placed in the bag and the contents could be reduced by pulling the air out of the bag. He explained that she had spent too much money on the bag, and her reply was to come up with something better... and he did.

Bernoulli Bags

Materials:

Diaper genie bag (aka "Windbag")
2 students

What to do:

Tie a knot in the end of the 2 meter (8 ft) bag and stretch it out on a smooth surface. Blow into the bag with your face approximately 1 foot from the opening and your Windbag inflates with one breath.

What's going on?

The long bag quickly inflates because air from the atmosphere is drawn into the bag from the sides along with the stream of air from your lungs.

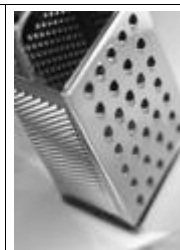
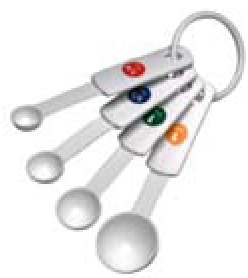
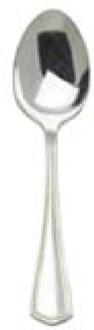
For you science enthusiasts out there - here's the technical explanation... In 1738, Daniel Bernoulli observed that a fast moving stream of air is surrounded by an area of low atmospheric pressure. In fact, the faster the stream of air moves, the more the air pressure drops around the moving air. When you blow into the bag, higher pressure air in the atmosphere forces its way into the area of low pressure created by the stream of air from your lungs. In other words, air in the atmosphere is drawn into the long bag at the same time that you are blowing into the bag.

*Thank you Steve Spangler for this idea!

Simple kitchen machines

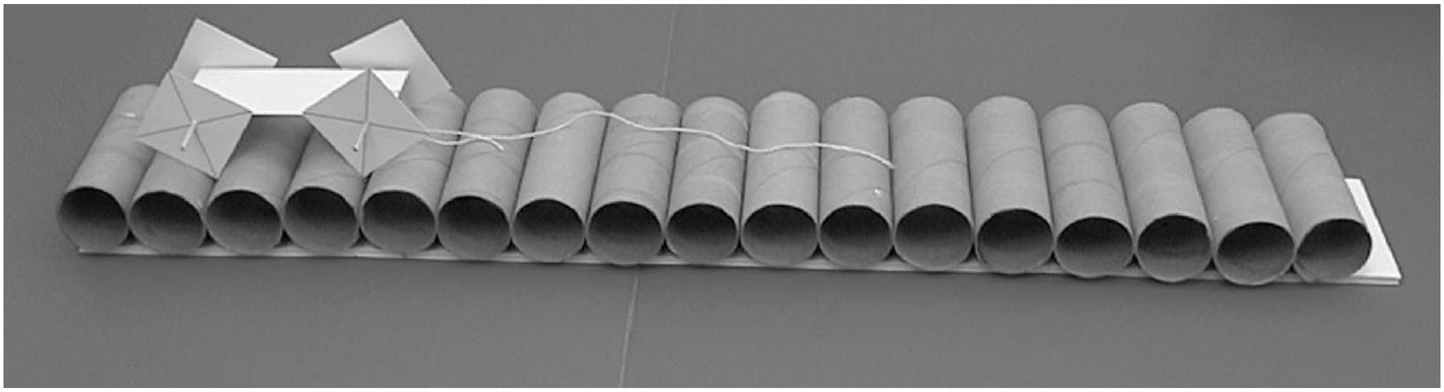
Adapted from the handout from:
http://www.tryengineering.org/lessons/simplekitchenmachines.pdf

Simple Kitchen Machines

 A knife is a wedge.	 Scissors include both a wedge and a screw.	 The blind is controlled by a pulley.	 A cheese grater is a wedge.
 This pizza cutter contains a wedge, a wheel, and an axle.	A can opener contains  four simple machines… a screw, a lever, a wedge, and a wheel and axle.	 These spoons are levers.	 A spoon is a lever.
This cheese slicer is a wedge. 	 A bottle opener is an example of a lever.	 A fork is a lever and can also serve as a wedge.	

"A Car with Square Wheels? Yeah, right!"

Children will construct a vehicle with an unusual twist.



Materials:

Stapler
Drinking straw
About 20 cardboard toilet paper rolls
Sheet of cardboard (about 2' x 8")
2 bamboo skewers or similar objects
5-6 index cards or similar amount of heavy stock paper
Pencil or pen
Paper clip
String, about 12 in
Ruler
Scissors
Glue

Activity:

1. Line up the toilet paper tubes alongside each other and staple them down to the rectangular sheet of cardboard. Be certain each tube is touching each other.
2. Measure the diameter of the cardboard tubes. If they are around 1 $\frac{3}{4}$ inches, then cut out four (4) two-inch squares out of the index cards. These will be your wheels.
3. Cut a 2"x5" piece of paper out of an index card. This will be the body of your car.
4. Cut two (2) two-inch pieces of straw and glue them to the body of your car at exactly 3/8" from each side of the paper.

5. Cut the bamboo skewers into two (2) five-inch pieces. Poke one through the center of the square wheel, continue to slide it through the drinking straw on the body of your car and through the center of a second square wheel. (You can find the center of the square wheels by drawing a diagonal line between the corners of the wheel!)
6. Repeat this last step with another pair of wheels.
7. Poke a paperclip on the end of the body of your car and attach the string to the paperclip. This will be used to pull your car.
8. Place the car onto the "track" of toilet paper tubes. Be certain that the points of the square wheels fit into the grooves of the tubes.
9. Gently pull your car across the track. It should move smoothly across the tubes.

Explanation:

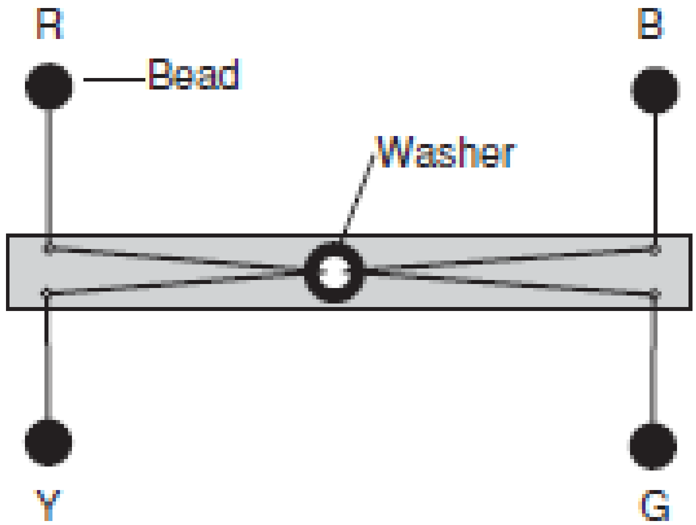
If you were to place a ruler alongside your car as it rolls along the toilet paper road, you would find that the axle of the car (where the bamboo skewer pokes through the wheel) always stays about the same distance from the ground.

To make larger or smaller square wheels for different size "roads" be certain that the size of your wheels are 1.2 times greater than the diameter of the tubes you are using!

The force you apply to the car causes its motion as its wheels rotate along their axles. Depending upon your reference point, the relative motion of this car would probably seem a little strange; however, <u>this activity has real world applications</u>! The construction of machine gears requires a similar approach, but naturally with much greater precision. Gear teeth must connect with each other as perfectly as possible to avoid slipping out of place. This is a common problem in a car when its transmission is failing. When your gears are slipping in your car, too much friction is being generated in your gears. This can cause your transmission to "lock up" and not work anymore.

Think Tube

Adapted from the handout from:
http://www.indiana.edu/~ensiweb/lessons/mhs.pt.pdf



Film Can Racer

Watch a video on its construction at:
http://www.youtube.com/watch?v=6Ygt5p-axRQ

Materials:

Electric drill and 1/4 bit or large nail
Film canister with lid (water bottles work well too)
Utility knife or X-Acto knife
3 rubber bands, a little longer than the length of the film canister (e.g., size 18)
Small hex nut (1/4 in)
Drinking straw (or pencil, wooden dowel, or bamboo skewer)

What to do:

1. Drill or punch a hole in the center of the bottom of the film canister. The hole needs to be large enough for the rubber band to fit through, but small enough that the hex nut does not fit through.
2. Cut a flap in the lid of the film canister.
3. Push one end of a rubber band through the hole in the bottom of the canister. Thread the end of the rubber band that is outside the canister through the hex nut.
4. Push the straw through the loop of the rubber band that sticks out through the hex nut.
5. Take the end of the rubber band that is in the canister and push it through the hole in the lid created by the flap. Slip the loop of rubber band around the flap and move it toward the bend. Put the lid on the canister.
6. Wrap one or two rubber bands around the canister near the bottom of the canister to match the rim created by the lid on the other end.
7. Turn the straw to wind the rubber band, but do not wind it too tightly. Put the racer on the floor and release it. Observe.
8. Complete the Four Question Strategy Worksheet. Be prepared to discuss your answers in class.
9. After class discussion, your teacher will direct you to choose an independent and a dependent variable and create an experiment using the film can racers. Please use the Experimental Design Diagram to document your experiment.

What's Going On?

When you turn the straw to wind up the rubber band, you exert a force on the end of the straw and move it though a distance – which means that you are doing mechanical work. This mechanical work is stored in the rubber band as potential energy. When you let the racer go, the potential energy is transformed into kinetic energy.

When you rotate the straw, you are exerting a torque, or twist. The farther out on the straw you push, the less force you need, but the greater the distance through which you must move the force. No matter where you push, the work done (the product of force times distance) is the same-but you can choose whether you want to use a large force through a small distance or a small force through a large distance.

When you release the racer, the straw exerts a force on the floor. The floor exerts a reaction force back on the straw, so the straw itself can't rotate. This forces the canister to rotate instead (provided the rubber band is wound tightly enough to overcome friction), and the racer moves. (Remember that when you wound up the straw, held it, and then released the canister, the canister rotated.)

The wound-up rubber band produces torque on the lid. This torque originally consists of a relatively large force located a short distance from the center of the canister. The torque remains constant and reappears at the edge of the canister as a smaller force located a larger distance away from the center. This force acts perpendicular to the radius of the canister – that is, tangent to the edge-where the canister is in contact with the floor. The reaction to this force is the tangential force that the ground in turn exerts back on the racer and it is the force that propels the racer forward.

When you take off the rubber bands that form the rim at the bottom end of the canister that end of the can has a smaller circumference than the other. Every time the canister makes one revolution, the lid end goes farther than the bottom end, causing the racer to travel in a circular path rather than in a straight line.

*Thank you Paul Doherty for this idea!

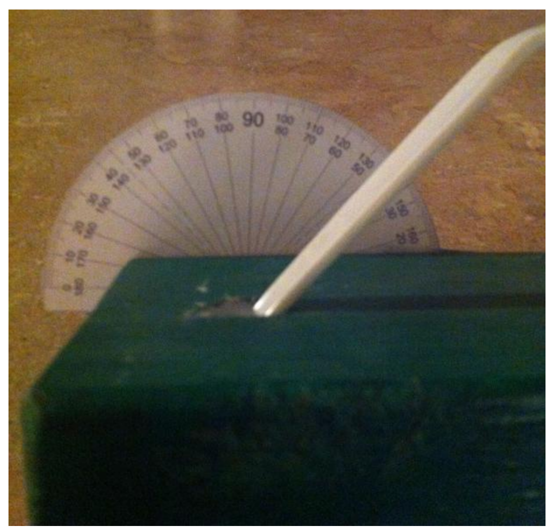
Spoon catapult

Materials:

8" section of a 2"x4"
Electric drill with a 1/4 " drill bit
Plastic spoon
Hot glue
Protractor
Cotton balls
Meter stick

What to do:

1. Drill a 3/4 inch hole on the surface of the 2x4 block. This hole should be centered and approximately one inch from the end.
2. Fill the hole with hot glue and insert the handle of the plastic spoon into the hole at an angle. The mouth of the spoon should be facing the block of wood.
3. Glue a protractor at the corner of one end of the catapult. The center point of the protractor should be level with the hole. See the picture for more detail.



4. place a cotton ball in the mouth of the spoon and pull back. Be certain to measure the angle in which you pull the catapult back to complete your analysis.

What's going on?

Catapults use projectile motion to move objects across distances. A couple of factors can affect the distance an object can be launched, such as the mass of the object, and the amount of force used to move the object.

Force - a push or pull
A force can make something start moving, stop moving, or make change direction.

Work – work is done when we use a force (a push or pull) to move something over a distance.

Energy - the ability to do work. If I have no energy, I can't use force to make something move!

Simple machines make our lives easier by allowing us to use less energy & force to do work. Simple machines can be combined to form compound machines, allowing simple machines to be used in greater variety of ways.
There are six simple machines for performing work. The lever is one of these simple machines. A lever consists of a plank that is free at both ends, and a steady object on which the plank can rest. The object that does not move is called the fulcrum. The object that one is trying to move is called the load. The distance from the load to the fulcrum is called the effort arm.

If you are looking for a more sophisticated catapult, check this out:

http://www.instructables.com/id/How-to-make-a-spoon-catapult/