Webelos Scientist Badge
Water Rockets!

Cub Scout Twilight Camp 2009
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This takes about 20 minutes.

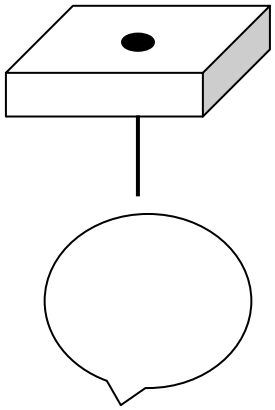
Forces
Give me an example of a force. (push, gravity…)
What happens if I push this rock? (it moves, then it stops)
Why does it stop? (friction)
What happens if I push this small rock and this big rock with the same push?

Have a cub scout read Isaac Newton's first law:
A thing at rest will remain at rest until an outside force acts on it.
A thing that is moving will continue to move at the same speed and in the same direction until an outside force acts on it.

Inertia is a measure of how much force it takes to make something move, or stop moving. The more stuff there is, the bigger force you need.

Demo:
Put something heavy on a long piece of paper. Quickly yank the paper out. The object will stay!
Have each scout do this themselves.
When you pull fast, friction is less, and the object's inertia keeps it at rest.

Force and Pressure
Force and pressure are different. Pressure is the amount of force spread out over a surface.



Demo:
Block of wood with a nail in it and a balloon.
Flat face on a balloon, squishes it. Nail on balloon, POP! Same force (the weight of the board and nail), different pressure.

Atmospheric Pressure
Did you know that the air around you pushes on you, on all sides? Why don't you get squished?

Let scouts give ideas, these are all "hypotheses"! Some will say force isn't big enough, which is like saying our bodies are too strong. Some may say because of air pressure inside us pushing out. These are really both true for our bodies.

Demo:
With a hand vacuum pump, evacuate a water bottle. It crushes because there's no air inside to push back. The pressure outside is higher than the pressure inside. (Stronger bottles, like 2 liters or soda bottles, won't crush as easily.)

So air pressure can push things.

Have a cub scout read Pascal's Law:
For a liquid in a container, if the pressure changes, it changes by the same amount everywhere in the liquid.

Demo:
Push on a balloon: it goes out in every direction.

This is how hydraulic pumps or jacks work, a small force on a small plate will cause a big force on a big plate. This is also how hydraulic brakes and a barber's chair work.

Now we'll talk about moving fluids.

Have a cub scout read Daniel Bernoulli's Principle:
The pressure in a liquid or gas goes down if its speed goes up.

Demo:
Hold a thin strip of paper up to your mouth, and blow across the top.
It will rise! The air pressure on top is lower, and the higher pressure below pushes the paper up.

That's how wings work. They are curved on top, so the air has to go faster, so the pressure on top goes down. The higher pressure below the wing pushes the wing up.

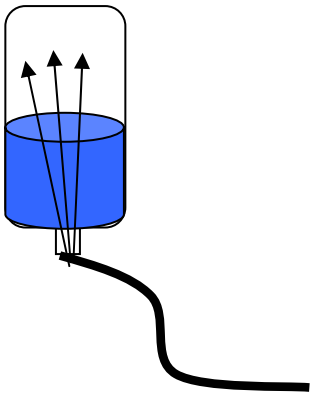
Rockets
If you and your friend are on roller skates and you push your friend, what happens to you? You move too!

Have a cub scout read Newton's third law:
Every action has an equal and opposite reaction.

Demo:
Blow up a balloon, and let it go. It flies around. The balloon pushes air out, which pushes the balloon forward! That is called thrust.

That's how a rocket works, but it usually pushes out gas by making it really hot. (That's why there's usually a flame.)

We're going to make water rockets. We'll fill the bottle about half full of water. Then we'll pump in air at high pressure. The high air pressure will push out the water, and the water will push the rocket forward. Water pushes the rocket faster than air would because water is heavier than air. A few fins on the bottle will help the rocket fly straight and go higher.



So if the water goes down, the rocket goes…..UP!