

We don't know
how to split an atom
but as to whiskers,
let us at 'em!

Burma Shave

Dan's Pretty Good Science #4

MSTA March 6, 2009

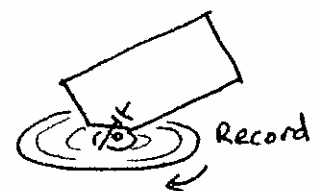
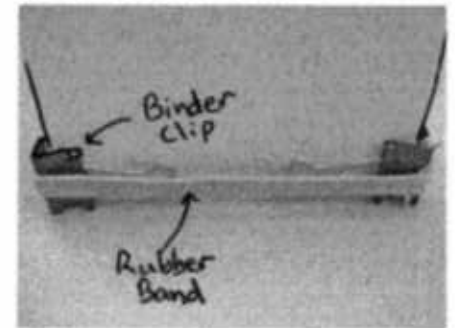
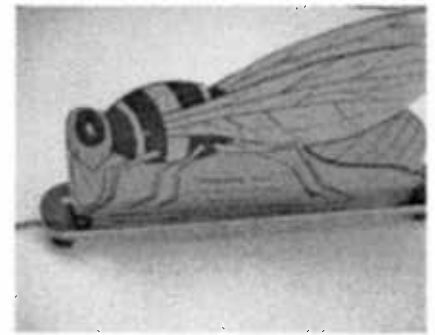
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Buzzing Bee Here is a very old toy that is easy for every student to make and take that is very interesting. Needed: Index card, tongue depressor, string, rubber band (size 64 works well), and two spacers (Binder clips, corks, wood, popsicle stick parts). Cut the stick and card the same length (about 5") and tape together along the long edge. Put the binder clips on each end of the stick and tape the arms into place. Attach a sting about 3 ft. long. Put the rubber band on the binder clips and center it along the stick or so that the rubber band will be held about 3/4 " away from the card. Spin in a large circle vertically. As the thing goes through the air the rubber bands vibrate. You can experiment with different lengths of rubber bands, which changes tension, and with the thickness.

Phono with Index Card The original phonographs were made using sound to drive a cutting tip into the soft surface of the record material. You could play the sounds back by spinning the record and then putting a needle into the track. The needle would vibrate according to the depth and number of ridges cut into each part of the groove. Since it was only vibrating the needle, there was not much sound. However, the needle was attached to a thin, flat disk such as a piece of mica. The mica vibrates many more air molecules than the needle alone. Because more air molecules are being vibrated the sound is louder.

Demo: 1. Put a needle into an index card that has one corner cut off. Hold the card lightly and perpendicular to any record. The sound from the record will be greatly amplified. As with the really old record players, there is no way to adjust the sound level. However, you can increase the volume by directing most of the sound towards the listener by the use of a megaphone. 2. In our demo, just tape a bottomless cup to the card!

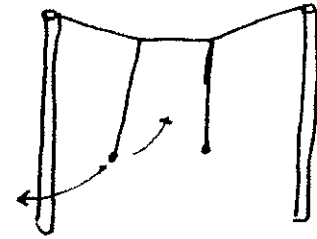
You probably recognize the purpose of the horn on the old phonographs now! Just like the old "Ear Horn" hearing aids but in reverse. The next generation of phonographs had the horn built into the cabinet to protect it and to enable you to open and close the doors on the front to vary the loudness.



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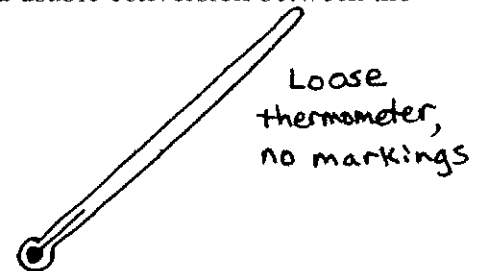
Coupled Pendulums A simple but very interesting demonstration involves two pendulums of equal mass and length (to start with). Hang the two pendulums about 15 cm apart on a tightly stretched string. Pull one of the pendulums back and let go. It will swing normally while the other one sits still - for a moment. Some of the energy from the first pendulum is transferred to the second pendulum until the first pendulum stops swinging all together! They keep trading back and forth for a long time. Variations include changing the lengths and masses. There is another variation where the two strings are coupled in a second way with a rubber band between them somewhere in the middle.



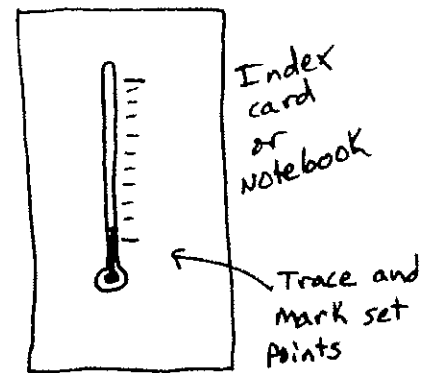
Toward and away from the reader (since my drawing is poor)

Old Thermometers I have many old thermometers that came bound in a piece of aluminum or plastic, which acted as the scale for the thermometer. Many of these types of thermometer do not hold up well to classroom use and come loose from the holder and slide around, which makes it worse than useless. A new purpose is to remove the thermometer from the holder and have students calibrate it using various set points. The two set points that we have for the Celsius scale are 0 and 100 degrees for the melting point and boiling point for water. Another couple of set points that have been used is the temperature of the human body (98.6 degrees F) and the coldest thing you can easily produce - salted ice water. Fahrenheit has been credited with measuring his wife's body temperature at 100 degrees F and everyone thinks that she must have had a fever. It turns out that the Fahrenheit scale was slightly modified in later years so that there would be a usable conversion between the Celsius scale and the Fahrenheit scale.

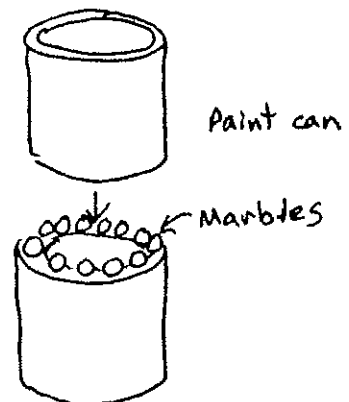
The procedure is that students take a bare thermometer and choose their set points, or their temperature scale, or they make one up on their own. In any case, the thermometer might get immersed in boiling water and the student marks that point with a wax pencil. At that point, the student should take their thermometer and closely trace it and mark the point where water boiled. They then measure their other set point and make a mark and then transfer it back onto the paper. Using a ruler, students then divide the space between the two marks into, say, 10 divisions representing 100 degrees.



After setting up their scale on paper, I had students go and measure an unknown with their thermometer and make a new wax pencil line on the side. They then compared it to their paper scale. With the whole class involved, the top student groups in my 9th grade class came within .6 degrees in both Fahrenheit and Celsius. The Fahrenheit group won since those are smaller graduations. The unknown was just a beaker of water that had been sitting in class over night.



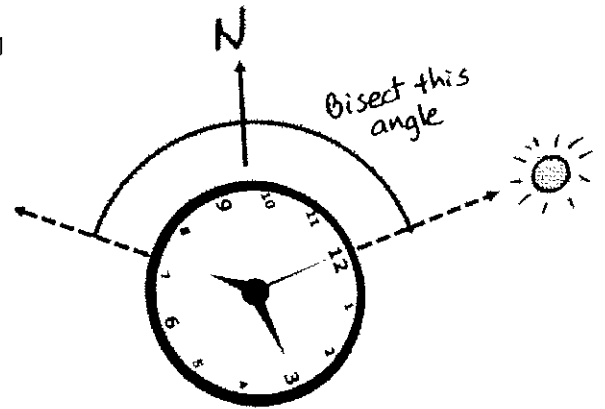
Ball Bearings on Cans One way to show how useful ball bearings can be is to take a closed paint can and put marbles of the same size around the edge of the lid. If you take another can of the same size and put it on top of the marbles, the top can is really easy to turn. There are BALLS, and they are BEARING some load.



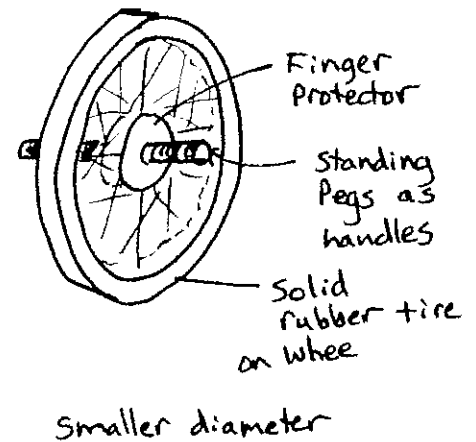
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Compass with your Watch You can use your watch to find North if you can tell where the sun is during the day. Hold the watch horizontally or place it on a flat surface. Point the 12 o'clock position towards the sun. You may even want to line it up with the shadow of a twig stuck in the ground. Half way between the 12 o'clock position and the actual hour hand will be an imaginary line that points North.

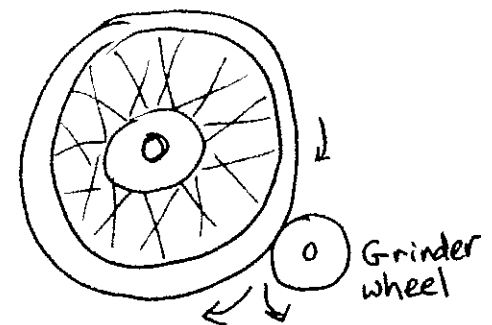


Gyroscopic Bike Wheel - Make your own that is better I love doing the bicycle wheel gyroscope with my students. I cannot afford a "store bought" version and actually found a solution that I like better than most versions for sale. I found an old exercise bike and took the whole wheel from the front of it. It turns out that it is solid rubber and has good mass, which is important when you want it to keep spinning for a long time. Two other points in it's favor is that it is smaller than a regular bike wheel and will not be as close to kids' bodies as a regular wheel will be. Another point is that they usually have a smooth tread, which minimizes any accidents that might occur when a larger, knobby wheel comes in contact with a kid's shirt. You do have to put a circular guard around the axle between the handles and the spokes. A small Tupperware lid or other plastic lid works pretty well for this. For the handles, I found some of those pegs that screw on where kids can stand on the axle area. These are usually less than \$10 at your local big, department store.



Gyroscopic Bike Wheel turned with a Bench Grinder (Safety Alert)

I find that when I want the wheel to turn really fast, I have some trouble getting as fast as I really want. This year I borrowed a grinder, the tabletop kind, and took part of the guard off on one side. I then got the wheel turning pretty fast and then touched the edge of the wheel to the grinding wheel. I got it to go really fast then! I plan to trade out the regular grinding wheel with something non-abrasive and I am considering asking the local metal shop if they will make a metal one for me on their lathe that has the same dimensions as a grinding wheel. I would only do this on your own the first time that you try it. I really had no problems with the equipment that I used but I cannot vouch for whatever situation you might have. I did get a little rubber dust left on the table that we used, but it was pretty minimal.



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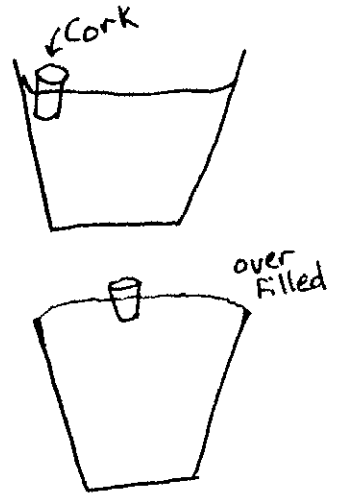
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College (Bar) Tricks I will sometimes challenge my students with what I call a "College Trick" (wink wink) in class. These are basically Bar tricks that are science based. I am planning on including a few of them with each new presentation that I make from now on.

Float a Cork in the Center of a Glass of Water I really like this one and it is one that students can experiment with in class without much trouble.

The Challenge: *"I'll bet that I can float a cork stopper in the center of a glass of water and you cannot!"*

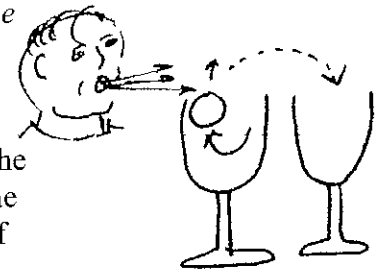
When you put a cork into a glass of water it will always go right to the side. This is because the water is going up the side of the glass and is a little higher there. The cork will not stay in the middle. However, you can OVERFILL the glass and the top surface of the water is now mounded and the cork will float in the middle. I am not sure how this will work with other liquids commonly found on college campuses.



Moving a Ping Pong Ball from one Glass to another

The Challenge: *"I'll bet that you can't move this ping pong ball from one empty wine glass to another without touching either the glass or the ball with hands or anything else!"*

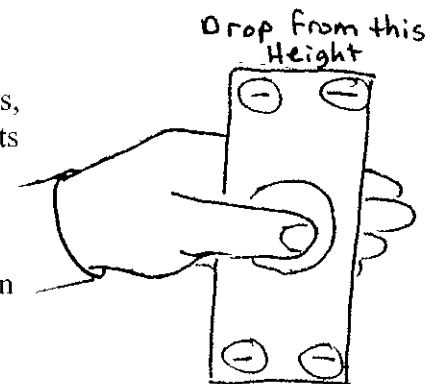
The task seems impossible since you cannot touch anything. However, the wine glasses are next to each other and you can blow across the top of one glass, which will cause the ping pong ball to lift up and into the stream of air. Once it is caught in the stream of air it is blown into the other wine glass. Practice this trick with some wine glasses and with the spacing between them. I have found that a quick, hard puff is what is needed in this situation.



Dropping a Dollar Bill

The Challenge: *"If you can catch the dollar bill after I drop it, you can have it!"*

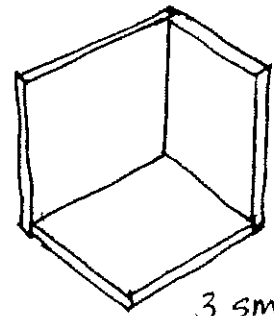
The setup is that you straighten a dollar bill by folding it in half long ways, which will stiffen it. You hold the bill by a short edge and the catcher puts his/her thumb over George's face. Once you let go, the catcher will not have time to catch the bill since the nerve impulses do not travel fast enough for most people. To prevent someone from "diving" for the bill and catching it, have them put their forearm on a table. One thing that can happen is if the catcher anticipates the drop and happens to catch just as you let go. Only use a dollar bill and practice this one first.



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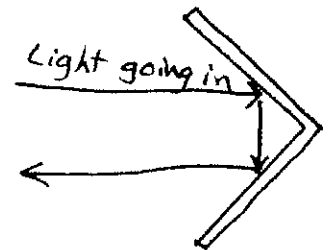
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Corner Reflector This is a very important device! It is basically three mirrors mounted together at right angles. It is the basis for many safety devices as well as measuring and guidance systems. The basic premise is that you can shine a light into the corner from any angle and the light will come right back to you. If you shine a laser into it, you should notice a laser light coming right back to the surface of the laser, or your hand.

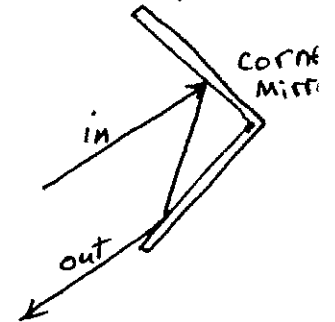


3 small mirrors
Must have 90°
angles

The standard reflectors that have been in use for many years on bikes, cars, posts, and many other places use exactly the same technique. If you could imagine a whole wall covered with these corner reflectors, then you can shine a light from any direction and get a reflection back to your position. Even if more than one person were to shine a light on this wall, there would be a reflection back to the source in all cases. Now imagine this wall of corner reflectors shrinking down to the size of a bike reflector. A bike reflector has the same shape pressed into its surface and then that surface has a chrome spray applied to it. The result is that you have something that will reflect light back to its source from any direction.



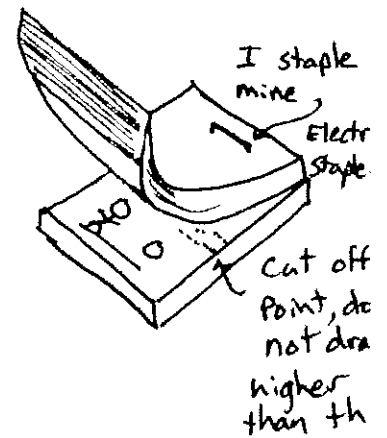
I made my corner reflector using three pieces of Plexiglas mirror which is available at Home Depot and probably Lowes. You do not need much, mine are from squares that are about three inches on each side. You could even use craft mirrors or small mirrors taken out of the cheap compacts you can buy at dollar stores. With anything glass you would want to take special safety precautions, such as taping the edges and then taping the backs with packing tape to hold the shards if it were to break. I glued mine together with hot glue but other glues would work as well.



It is important that each of the surfaces are actually 90 degrees to each other to get the light to come right back.

Uses that I know of: reflectors, radar reflectors for boats and bridges, measuring distance from the Earth to the Moon (yup, we left one on the Moon).

Flip Books with Post-it Notes You can make a simple animated flip book using POST-IT note pads. Start about 5 pages from the back for your first picture. Draw it with a dark pen and then let one page fall down on it. You can still see the first picture and can use it as a guide while drawing your next picture. Make the drawings change no more than the width of your pen for each page. Only draw on half of the page since that is all you see when flipping through the book. Be careful not to bend the pages.



The eye does not immediately recover when an image strikes the eye (similar to when a flash goes off). Since this is true, we can have single images look like moving images if we change them fast enough. We see this in movies and television. Movies change pictures 24 times in one second.

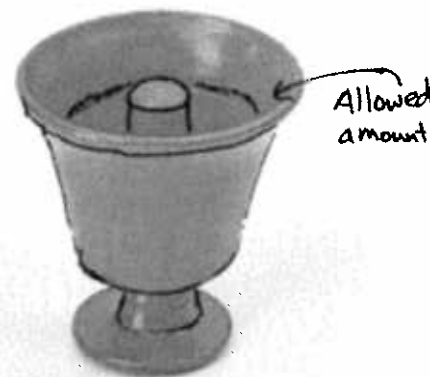
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Pythagoras Cup This is one of the really neat demonstrations of all time, as far as I am concerned. I have a cup that is called a Pythagoras Cup and the story goes that Pythagoras would allow his workers to have one glass of wine during their break, or at the end of the day. He told the workers that they could fill the cup up to the line but no more. If a worker filled the cup above the line, the cup would drain through a hole in the bottom of the cup! (*I can think of a way around this after the first time*).

The version of this cup that I have actually came from Greece and I bought it on eBay for about \$13 and about \$10 for shipping from Greece. I have seen hand-blown versions of this in the science catalogs for something in the \$200.00 range.

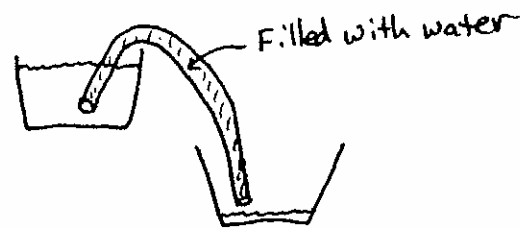
Students are really amazed with this one. My original cup is not transparent and the draining comes as a real surprise. I have planned one that will be transparent to go along with my one made from pottery. I will have plans on my web site soon but illness in the family has put me behind on this project. By the way, you should make both an opaque version for the effect and a transparent one for the explanation. Be sure to check out the cool demonstration of this at the site www.Grand-illusions.com in the toy section. They do not sell it but they do have some other great stuff. If you have never been there, it is really cool.



Siphon We have all heard of someone siphoning gas out of a car, but how does that work? It is easy to understand that water will flow from a higher place to a lower place if a straight path is provided, such as from a water tower to the ground. But if this is all that was required, then we could just hang a piece of hose from a kiddy pool over the side and it would drain out, and this does not happen.

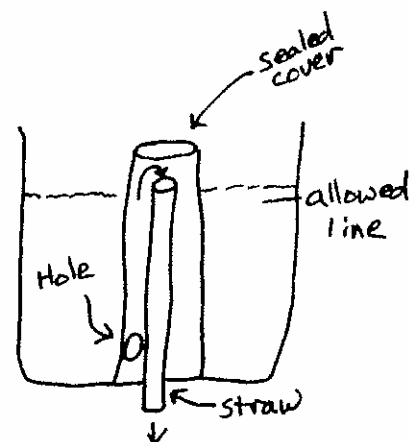
With a siphon, we have to have a hose filled with the liquid that reaches between the higher and lower portions. Once the water starts flowing out of the hose at the bottom part it will cause a low pressure throughout the hose. The low pressure is lower than the atmospheric pressure on top of the kiddy pool and the water flows into the hose to replace it. This continues until the two levels are equal height, or the water is drained from the pool (or at least until the level is lower than the top opening of the hose).

When siphoning from a tank that only has a small opening, you would put a hose into the tank deep enough to be in the water. You then suck on the end of the hose that is lower than the tank water. This causes a temporary low pressure in the hose and starts things off. Once it is started it will continue on its own.



You would NEVER want to try to siphon gas from a tank by mouth since it is very dangerous. If you need to drain an aquarium, you would not want to have the "fishy toilet water" breath associated with that. Just take a hose and submerge it into the aquarium and let it fill with water. Put your thumb over one end of the hose and take it out and lower it into a bucket and take your thumb off. The water will siphon all by itself.

Diagram
of
Pythagorean
Cup

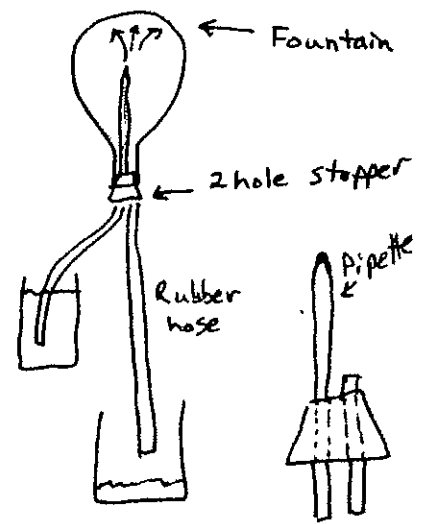


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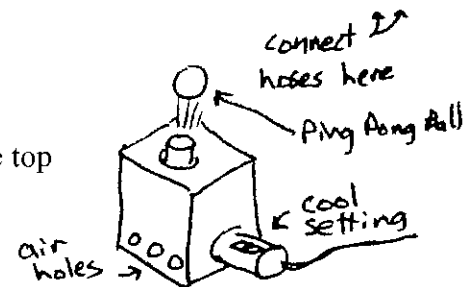
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Siphon Fountain When you siphon from a higher container to a lower one, the liquid flows out of the upper container. Naturally air will flow in to replace the missing water or it will leave a low pressure area. If you utilize that low pressure area in the upper container, it can produce a fountain if water flows into it from another source instead of allowing air to replace the missing water.

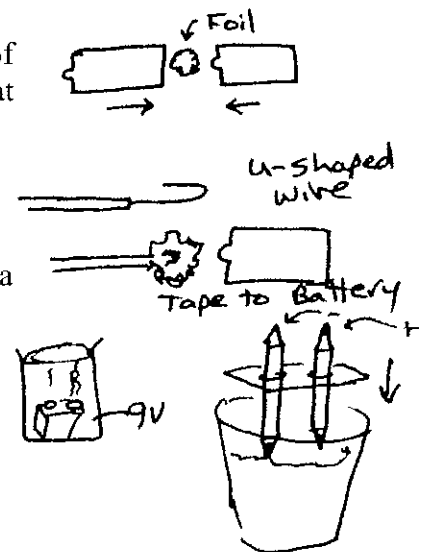
Just use a two-hole rubber stopper inserted into a flask. There should be two hoses attached to the outside of the stopper. On the inside of the flask should be a piece of tubing or glass tubing to become the fountain. Once you get the siphon started you will have the added feature of having a fountain. The drawing probably shows it best.



Bernoulli Ball with a COOL Hair Dryer A nice and easy way to show Bernoulli's Principle is to use a ping pong ball and a hair dryer that has a cool setting. I place mine in the box that the hair dryer came in and put a hole at the top where the air comes out and holes around the bottom where air can go in. Do NOT do this with a hair dryer that does not have the cool function.



Connecting Batteries with Foil When you need a battery pack, or just to connect two batteries, the connection is usually very poor if you just tape them together. However, you can join two batteries with a ball of aluminum foil about the size of a marble. Just squeeze the foil ball in between two batteries and then tape them at the joint. You can also tape wires that have their ends bent into a U-shape and then fold a 2 inch square piece of foil around the U-shape and then taping it onto the battery. It has to be intertwined to work well.



Simple Electrolysis – Want a cool and easy way to show electrolysis? Just drop a 9 volt battery into a small beaker of water. You will immediately see the two streams of gas rising – Hydrogen from one terminal and Oxygen from the other. You can even connect a 9 volt to a couple of pencils sharpened on BOTH ends. Insert into water and you get the same reaction.

You can really show an increase in electrolysis by adding some salt to the water. In the whole scheme of things, distilled water does not work as well as tap water. Tap water does not work as well as salted water.

Kill-A-Watt Meter from Arbor Scientific: With increased attention at school over cutting costs, many districts have told staff that they cannot have any “non-educational” appliances at school. My district allows appliances but has clear guidelines on safety issues, including age, and that you can make coffee but you have to pour it into a carafe and turn the machine off. Sounds reasonable. Many times that kind of convenience is just too far away from the classroom or supervisory duties do not allow it. Teachers usually do much more than is required and if the district refuses any of these conveniences then teachers are less likely to go that extra mile. It is false economy to just cut all of that out. (Get off of the soapbox, Dan!)

My wife's district has a different approach. They are charging teachers a yearly electrical fee for each item they bring into the classroom. This device, the Kill-A-Watt is something that you plug into the wall and then enter the price per kilowatt-hour that is charged in your area. Once entered it stays there even when unplugged. You can now plug something into the meter and it will keep a running total of how much energy you have used and what it has cost so far. You can even project daily, weekly, monthly and yearly costs.

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Kill-A-Watt Meter (cont.)

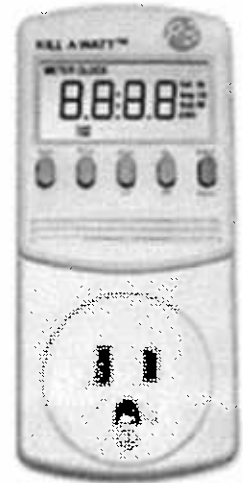
I use an example with my students on leaving a light on in their closet to keep away monsters. If it is a 60W bulb and it runs for 8 hours at a rate of around 11 cents per kilowatt-hour...

I pretend to be the dad that is giving the speech about "Electricity costs money! You don't have to pay it but I do! Turn the light off when you are not using it!" and it goes on. Once we figure it out I tell the students that they can respond to the speech by slapping 7 cents down on the table and saying "There's the money for that electricity, and keep the change!" I expect some students might actually try this and end up on the next episode of Jackass with a red mark on their forehead where the coins suddenly land.

I got the fancier version which runs \$50.

Simply connect appliances to the Kill A Watt EZ™, and it will assess how efficient they are. The large LCD display shows consumption by the Kilowatt-hour, just like the power company, and also displays voltage (V), line current (Hz), current (I) and more. Students can calculate the cost to run any device with this inexpensive and easy-to-use meter.

Kill A Watt EZ™ adds the ability to project the cost for you - by the day, week, month, or year - and includes a battery backup.



Fun Fly Stick (Door prize) - Static Wand from Arbor Science

I really like Arbor Scientific and they usually ask me if I would be interested in giving away something of theirs that relates to my presentation. I actually do not have any electrostatics in this presentation but I really liked this item. I got it in the mail this week after seeing it online and we really gave it a work out. This is a cool piece and I will be ordering one for myself and one for my intern. They run about \$25 which is a really nice way to get some cool electrostatics into the classroom. Students walking down the hallway with it certainly get the attention! www.arborsci.com

This cool little device is actually a van de graaff levitation wand and is the latest electrostatics phenomenon.

Fun Fly Stick is a must have electrostatics experiment that is as easy to demonstrate as it is fun. Turn on the levitation wand and toss one of the five flying toys included into the air. Touch the wand to the toy once and shake it off. You now have complete control over the flying toy.

Make it float! Make it dance! You can even make it levitate as high as the ceiling allows. Fun Fly Stick is an electrostatics experiment that they will not only not forget but will be begging to try themselves.

Fun Fly Stick comes with one FunFlyStick levitation wand, five flying toys and manual. The name says fun!

