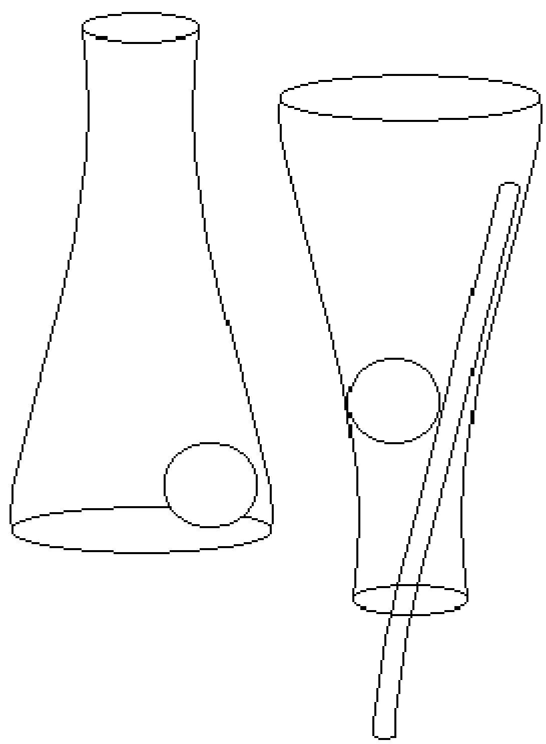
DEMONSTRATIONS EVERYONE CAN USE AT ONE TIME OR 'NOTHER
NSTA National 2000

GENIE IN THE BOTTLE

This is a version of an old magic trick that can still be purchased at magic stores. It is a good example to use when talking about how science works. From a thrift store or garage sale obtain an opaque glass vase similar to the one shown. Carefully use a knife to cut a piece of cork (cork stopper or wine cork) in to a small ball just small enough so that it can be forced through the neck of the bottle and into the bottom of the vase.



To use, show the students that a rope (or piece of plastic tubing) can be inserted and removed as would be expected. However, at certain times the "genie" inside the bottle will grab on and hold the rope tight but you can convince the genie to let go whenever you wish.

To have the "genie' grab hold of the rope turn the vase upside down and gently pull on the rope. This will wedge the cork ball between the rope and the side of the vase and hold it secure. The vase can easily be lifted with the rope without falling off. To get the "genie" to let go, simply hold the vase upright and gently push down on the rope. This will dislodge the cork ball and allow it to fall to the bottom of the vase. Don't tell the students how this works, have them use their imagination and design a way for it to work.

SPEED AND ACCELERATION

While the concepts of velocity and acceleration are fundamental to a good understanding of physics, to beginning students, especially those students with a weak science background, these concepts are often nothing more than memorized algorithms memorized to solve problems in the back of the chapter. The best way to understand these concepts is to also get an intuitive feel for what is actually happening.

Fortunately there are some very simple pieces of apparatus that can help with students with an intuitive feeling for these concepts. In fact, most students have played with some of this apparatus when they were very young. Many preschool toys make sounds as they are pulled or pushed across the ground because the wheels are connected to a noise maker of some kind. Since the turning of the wheels produces the sound, the frequency of the sound produced is directly related to the toy's speed.

Thus, a slow speed might sound like:

pop.....................pop.....................pop.....................pop.....................pop

while a faster speed might sound like:

pop..........pop..........pop..........pop..........pop..........pop..........pop..........pop

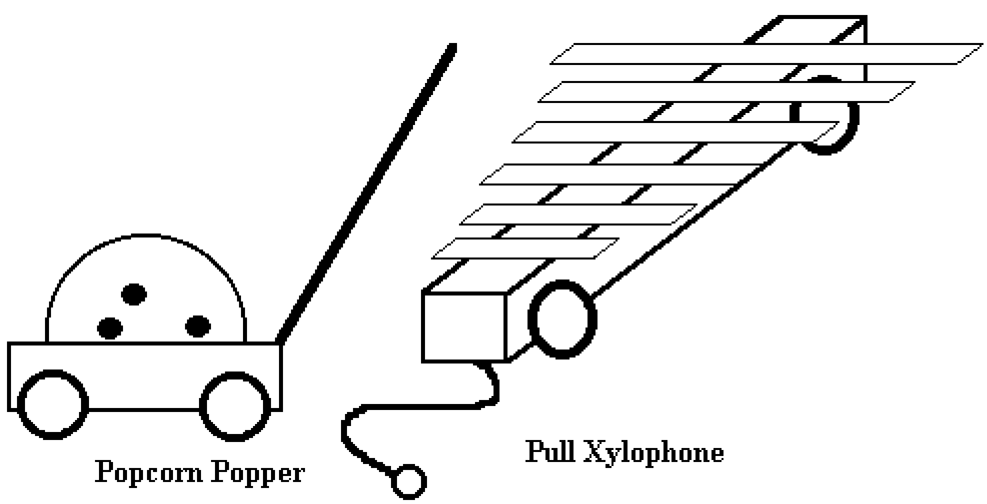
A positive acceleration might sound like:

pop.....pop..........pop..............pop...................pop........................pop

while a negative acceleration might sound like:

pop........................pop...................pop..............pop..........pop.....pop

Asking students to close their eyes while you demonstrate some of these and then have then quickly describe what they think was happening can help them with some of the more complicated concepts later on such as why the distance an accelerating object travels is proportional to the square to the time and NOT to time itself.

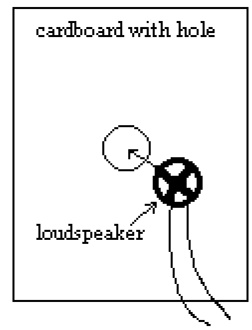


MUSIC BOX

Another nice example of sound being produced by vibrations is a simple music box movement. A music box movement has a number of small lengths of metal reed that vibrate at different rates and produce the different musical notes. Because they are so small, they can not excite much air and thus it produces little sound. However, when placed on a large flat surface, the small vibrating reeds will also cause the surface to vibrate exciting a great deal of air and producing a much louder sound.

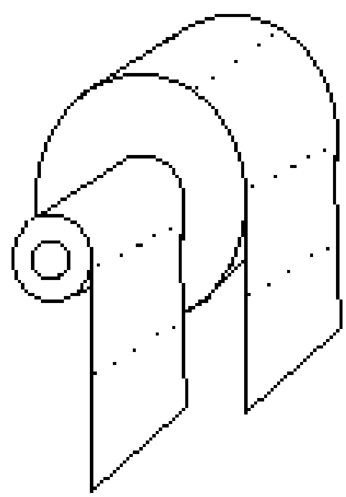
DIFFRACTION OF SOUND

A loudspeaker actually produces sound from both sides of the speaker's cone. The difference is that if there is a high pressure in the front of the cone because it is moving forward, there is a low pressure produce in the rear of the cone. Scientists say these two sound waves are out of --phase" and if they come together, the high and low pressures will cancel one another. If we play a small 2" loudspeaker out in the free air, it sounds very "tinny-" This is because high frequency (short waves) move in nearly straight lines while the low frequencies (long wavelengths) bend or diffract easily, letting the sound from the front and back bend around and cancel each other. If the speaker is held at a small hole (2" dia.) in the middle of a large cardboard (20" x 200) baffle, the sound produced is much richer and more base can be heard because the baffle makes it harder for the long base waves to bend around and cancel one another. This is why stereo speakers are put in a box. It keeps the sound from the rear of the speaker from canceling the sounds coming from the front.



NEWTON'S LAWS AND TOILET PAPER

Newton's first law has two parts. Object at rest tend to remain at rest and objects in motion tend to remain in motion. Most students have no difficulty with the first part but often misunderstand the second. Both parts of Newton's first law can be easily demonstrated with rolls of toilet paper. This also shows the importance of physics in everyday life. Put a full roll of toilet paper on a rod and a nearly empty beside it. Show how a full roll works first. Slowly pull off the desired amount, then give a quick jerk. Because the full roll has a great deal of inertia it is difficult to start moving, therefore, the paper breaks before there is significant motion. This demonstrates the first part of the first law. However, when the same process is tried with the nearly empty roll, the tissue does not break but starts the roll moving and unwinding! The fact that the roll continues to unwind long after you stop pulling is a good example of the second part of the first law.



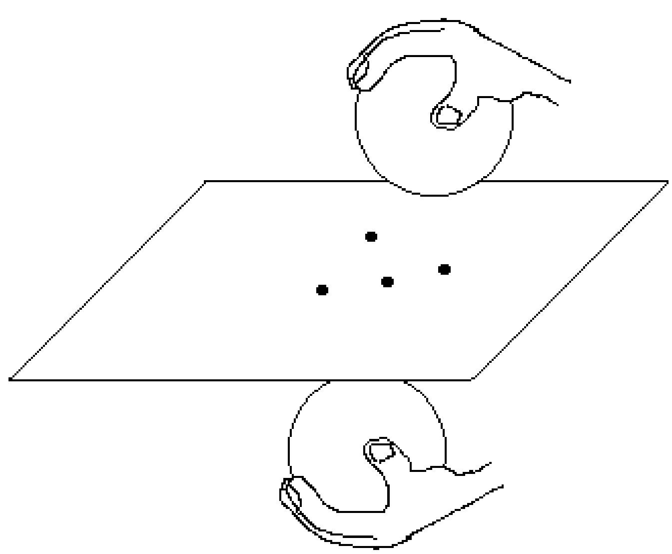
COLLIDING SPHERES - CONSERVATION OF ENERGY

In this demonstration you will look at the conservation of mechanical energy. While the conversion of mechanical kinetic energy to mechanical potential energy and back again is relatively easy to demonstrate it is often much harder to demonstrate the transfer of mechanical energy into other forms. This is an especially important concept to demonstrate and discuss, especially since it took so long to understand historically.

If a small rubber ball is dropped, it is easy to discuss the transfer of potential at the top into kinetic at the bottom. However, after a few bounces the ball will come to rest on the floor. It no longer is moving so it has no kinetic energy and it does not have a special position so it no longer has potential energy. Where has the energy gone has it disappeared? The answer of course is that it has been converted into thermal energy. The ball and the floor are a bit warmer at the end of the demonstration than they were at the beginning. While this is true, it is often hard to convince students of this since they cannot feel the increase in temperature.

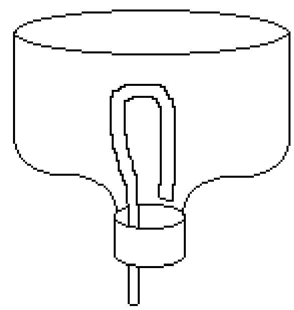
This can be demonstrated by using two large steel ball bearings (4 to 6 cm. in diameter)* and some paper.
If thermal paper of the type used in FAX machines is available, the two balls can be smashed together with moderate amounts of energy and the thermal paper will leave behind a discolored mark where the two spheres collided showing the thermal energy was created in the collision. (The students will also be able to hear the collision showing that a bit of sound energy was also created) The demonstration can also be performed by forcefully smashing the two spheres together with a piece of normal paper between them. In this case, small holes will be made in the paper. On close examination these holes will often have brown scorched marks around the edges and a definite odor of burning paper can be detected.

* Two such spheres can be purchased from Education Innovations, 151 River Road, Cos Cob, CT 06807, (203) 629-2739.



TANTALUS CUP

In Greek mythology, Tantalus was the son of Zeus (Jupiter in Roman mythology) and the nymph Pluto. After serving his son, Pelops, to the gods as food, Tantalus was punished in the Lower World. He was forced to stand under the threat of a hanging rock up to his chin in water. Whenever he tried to drink, the water level would always stay just below his mouth. The fruit and grapes that grew just above his head would always be blown just above his reach whenever he tried to roach for them. The word "tantalize" is derived from this myth and the chemical element "tantalum" (atomic number 73) is named after Tantalus. An ancient example of an automatic siphon is a tantalus cup. If not over filled with liquid, a tantalus cup will hold the fluid like any other cup. However, when filled too full, it will punish its owner by draining until it is completely empty. A modern application of a tantalus cup can be found in nearly every home. A flush toilet is an example of an automatic siphon like a tantalus cup. To make a demonstration Tantalus cup, drill a hole in a plastic soda pop top smaller than the diameter of some plastic tubing. it should be large enough so that about 2" of tubing can be just forced through the hole. Screw the bottle top on a soda pop bottle that has had its bottom removed then bend over the long end of the tubing. (see diagram)



MONKEY AND THE HUNTER

One of the most famous demonstrations of physics is the monkey and the hunter. The way it is usually preformed requires a great deal of set-up however it can be done quite simply. All that is needed is a toy plastic dart gun, some string and a piece of cardboard. Draw the monkey on the cardboard. Attach the string to a dart and to the cardboard. If the string is looped over a rod it can hold the cardboard in place until the dart is fired. Then gravity will take over and it will begin to fall. The questions is where does the dart have to be aimed to hit the falling monkey (cardboard)? The answer of course is directly at the monkey to begin with. Since both objects, the dart and the

monkey will be pulled form their original positions for the same length of time and with the same acceleration you must aim at the monkey not ahead of him.