Pocket science

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Article:

Although changes are constantly occurring in the world of science, [ouch of what we are asked to teach in middle-level science is tried and true. We tend to work with a variety of packaged products like Chemical Education for Public Understanding Program (CEPUP) kits or Activities integrating Math and Science (AIMS) activities. Usually these packages well-thought-out lessons that demonstrate specific concepts. I believe, though, that we do a disservice to our students when we spend so much of our time in a prepackaged world and do not give children the opportunity to experience the amazing science of everyday objects.

Simple works best

One day while I was trying to decide how to present a lesson on Newton's three laws of motion, I came across a length of fishing line and a lead sinker in my jacket pocket. These remnants of my weekend fishing trip brought to mind the graceful arc created by the line during casting. Suddenly, it came me. I could demonstrate the concepts of force, motion, and gravity thing the line and sinker.

My state-adopted textbook, Prentice Hall's The Nature of *Science,* provided me with an outline of the topic on mechanics and the points to covered, but I wanted to impress my students with a visual presentation. I wanted them not only to hear the words but also to experience the feelings of what an object in motion would do. I'd use a small mass and a lire as a plumb bob, I thought, or even better, as a pendulum.

A plumb bob is a line used by builders and surveyors dating back to Egyptian times to determine verticality. The line has a small mass called hob at the end that directs the line toward the Earth's center of gravity. A pendulum is nothing more than a plumb bob suspended from a fixed point, swinging to and fro. I now had my class demonstration complete with a bonus history fact.

I pulled my "plumb bob" from my pocket again and tied the line to a ring stand to demonstrate resting inertia (the tendency for an object at rest to remain at rest unless acted upon by other forces). Then I swung the plumb bob and we discussed the motion of a pendulum and why it slows down (friction) and the fact that the pendulum tends to swing back and forth along the same line (inertia and gravity). Then we talked about the pendulum as a time-keeping device. Although it works accurately on land, before the clock was invented, other methods had to be found for estimating time while traveling across the seas. On a wavy ocean, a pendulum will not swing evenly. Furthermore, the force of gravity varies at different elevations and also the Earth's density varies with subsurface composition. For instance, the period of a pendulum decreases when it is moved from sea level to the top of a mountain because the force of gravity becomes slightly weaker at greater heights.

Lastly, we discussed what would happen to the period of the pendulum if we shortened or lengthened the pendulum. We looked to see how the length of a pendulum influenced its motion. Before the class was over, I had spent more than the time I had allotted for the demonstration, and I had to change my lesson plans for the following day.

More simple ideas

As another example of "pocket" science, a simple demonstration of the property of inertia requires only everyday materials: a penny, a business or playing card, and a cup. Place the card over a small beaker or coffee mug with the coin resting on top of the card and ask students to speculate what would occur if the card is flicked from the top of the cup. All kinds of answers will be offered. As you thump the card on its end with a hard flick of your finger, students will be amazed to see the card go flying off and the coin drop into the beaker. We conclude the demonstration with a discussion of which object had a force applied to it—the card—and which did not—the coin (even though an instant later when the card was no longer supporting it, the coin fell because the force of gravity pulled it downward).

I once saw a great demonstration on transformation of energy using a walnut. A walnut tree absorbs light, which it converts into food through the process of photosynthesis. It then stores the energy throughout the tree and in the concentrated form of fat in the nut. After this brief discussion of how plants assimilate energy, the teacher asked students whether the most energy is stored in the nut or the shell. To find out, the simple test of burning a nut reveals that the nut burns more brightly and with more intensity than the shell because energy has been stored in more concentrated form in the walnut oil.

Sometimes the most obvious items or artifacts can be used to illustrate scientific principles. The pencil in your pocket or on your desk held in a glass half full of water illustrates light refraction. Many of you have noticed this before, that the pencil appears broken. Light rays traveling from the pencil through the water bend when they pass out of the glass and into the air on their way toward your eyes. The pencil appears to bend where the air meets the water inside the glass.

Your or a student's glasses can show focal points by passing sunlight through the lens to create fire or heat by holding the lens at different distances from a piece of paper. Dollar bills are not a common item around my house but they can be used to demonstrate Bernoulli's principle. Just place a crisp, new bill between two books and try to blow it off by blowing under it; even your strongest students can't overcome that kind of air pressure. Keys on a key ring can be used to demonstrate dichotomous classification using their similarities and differences. Keep your eyes and ears open, and your pockets will become a whole new science-teaching resource.