Earth Science and Empty Milk Bottles:

Small Science for Big Results

My older brother is a professor of Atomic Physics at Tulane University. Several years ago he told me that the days of big science might be coming to an end. What he meant was that it appeared that the government would not continue to fund the multi-billion dollar Superconducting Supercollider (subatomic particle accelerator) project in Texas. "You know," he mused, "a lot of good science can be done on a small budget." I think he's right. Although I don't think he meant the paltry budgets that some science teachers have to live with. Many science teachers have equipment and supply budgets that will not allow them the purchase the equipment and materials they really need. Never the less, some excellent science activities can be done with minimal expense.

PHOTO: The "Raw Materials."

I've enlisted the lowly and much maligned plastic milk bottle to make my point. This illustrated article will show you the real value of objects too often relegated to the junk pile. (Sorry, to be politically correct I need to think ecologically. Today they're recycled;

whatever that means.) These ideas remind me of creative French country cooking. A few eggs, a few leftovers and olla; omelet!

Of course, to make an omelet you'll also need fresh milk, but please, don't throw out the plastic bottles. Now, on to more than a dozen ideas to elevate the status of plastic bottle and Earth science at the same time.

PHOTO: Transformed Milk Bottles at Work in Guidance and Transportation

To appreciate some of these uses, it would be helpful to have experience with the classic labs made popular by E.S.C.P. in the 1960s. (The Earth Science Curriculum Project was funded by National Science Foundation and organized by the American Geological Institute.) Remember measuring porosity, permeability and water retention of various materials in the long, transparent tubes? Getting plastic beads or small stones into those tubes could be a messy affair. How about a funnel; one made from the top of the milk bottle? (See the illustration.) What to use to hold and carry the stones? Naturally it's the bottom part of the bottle. When the tiny, circular screens to hold the stones out of the outlets in the long plastic columns get lost, they can be replaced by the bottle cap pierced many times with a hot iron nail or a coat hanger wire. I obtained my stones from an ocean beach composed of rounded quartz pebbles. You can sort the stones with sieves made from wooden two by fours (or 1 by 4s) and several screen sizes from the local hardware store. Or, you can pay the money to get those commercial beads from your favorite lab supplier.

PHOTO: Recycled Milk Containers Showing What They Can Hold

The bottoms of these bottles make useful containers in which to store student sets of minerals, rocks, fossils, beach materials, or density sets. I keep many of my geological lab samples in student sets, which fit nicely into these milk bottle containers, which are then placed snugly into printing paper boxes. Those boxes conveniently hold 12 half gallon plastic bottles. (See the illustration.).

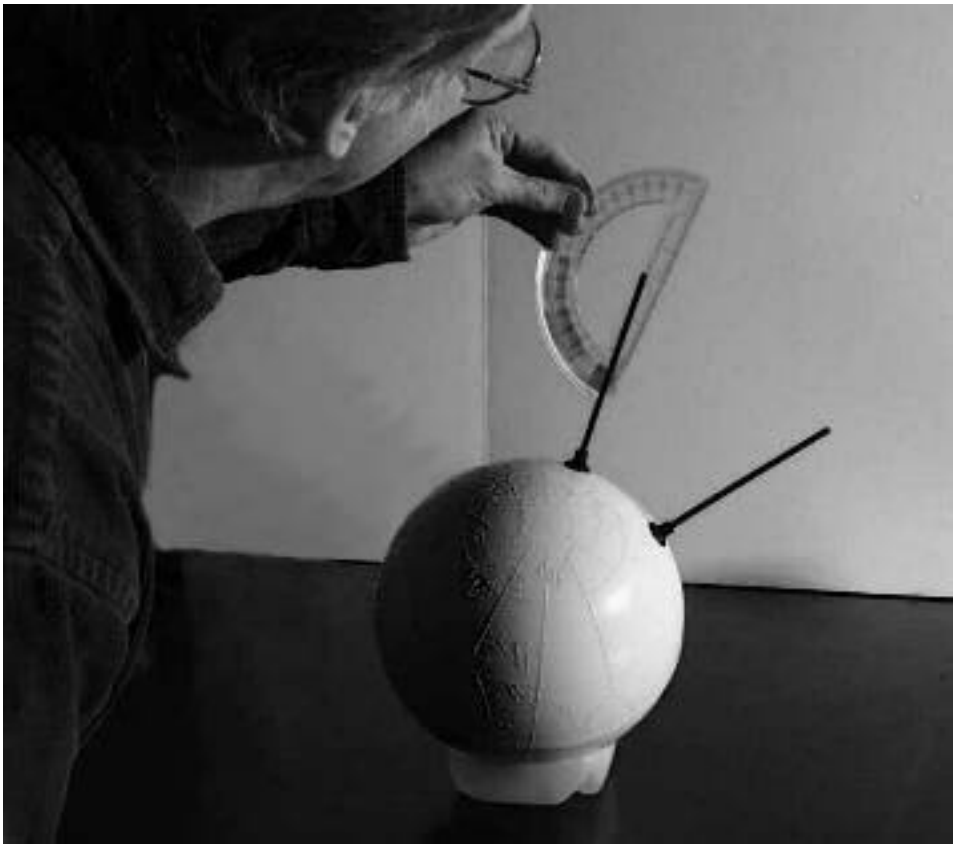

PHOTO: Bottle Bottom Supports a Measure of Planet Earth

The bottoms are also good holders for the E.S.C.P. lab modeling Eratosthenes' (era TOSS then ease) method for finding the size of planet Earth, This technique was first used about 200 BC. (Believe it or not, two of Eratosthenes scientific colleagues (Aristarchus and Hipparchus) also determined the size of the moon and the distance to the moon based on data from Eratosthenes' experiment. This was several generations *before* the birth of Christ.)

Basic measures require basic equipment. Make shallow trays from the bottoms of the bottles to hold liquid or sand samples on mass scales; either electronic or balance beam scales, You can also make volume measuring overflow devices from the bottom of a milk bottle. (See the sidebar: Home Made Overflow Devices.) Do you know what overflow cans cost in supply catalogs? Of course, you can also use the milk bottle bottoms to carry or store water, and other spillable samples.

PHOTO: Milk Bottle Goes Topless in the Name of Science.

Rock abrasion is one of the classic ESCP labs. As long as you use fairly small rocks (like limestone and marble chips) you can probably use these bottles for the shaking/rock abrasion lab. Be sure to save the tops and watch for bottles that crack in this procedure.

You can show how a gas (enclosed air) responds to changes in temperature by tightly

sealing the top while you hold the "empty" bottle in hot water . Then hold it under cold water and watch it crush. This also helps to illustrate atmospheric pressure. How about making a water clock by making a pin hole near the bottom of the bottle? You can calibrate the water clock with a wall clock or watch. You can even use these little gems as desk organizers for all those rubber bands and paper clips you have in the top drawer.

If your school values your services, they need to show it in a reasonable annual equipment and supplies budget. Use the money you saved by being inventive, to purchase a new computer with Internet access and a means to display computer sites for your classes, some really good samples of minerals you can't find yourself like large quartz crystals or pyrite samples, or a digital camera like the one I used to take these pictures. Researchers seeking NSF funding are often asked to show alternate, or "in kind," sources to justify their worthiness for financial support. The effort you use to save on supplies should be rewarded by giving you the funds you need to purchase the other things for a quality program. Cheap supplies don't necessarily make a cheap course of study.. But cheap treatment, by decision-makers, who do not recognize your needs and talents, may cheapen your professional outlook.

I hope you've discovered some ways to use readily obtainable resources you already have to create laboratory devices. You may wish to think of other ways you can use disposable household paraphernalia in the science lab. Be sure to observe safety precautions in building and using these devices. And please, don't tell the accountants at Tulane University about this article. It's one thing to find new uses for common materials in the secondary Earth science lab, but I don't think it's possible for my brother to do a whole lot of atomic physics with empty milk bottles.

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How to Make the Overflow Container

You'll need:

(A high school Chemistry lab should have the specialized lab supplies.)

Plastic 1 Qt Milk Bottle (or a 1 L Soda Bottle), Large (#5 or #6) Cork Stopper,

~ 10-12mm Glass Tubing to fit into the stopper, Triangular File for glass cutting,

Cork Borer Set

Procedure:

Safety Notice:

This procedure involves the use of heated or freshly broken glass. Handle these materials with care! Be certain the heated gas is cool before you touch it!

When breaking glass tubing or handling the broken pieces, hold the glass in a piece of thick cloth or paper towelling to avoid cuts.

If you haven't worked with glass tubing and these techniques before, it is suggested that you seek the help of another teacher who can guide you.

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1. With scissors (or a box cutter), cut off the top of the plastic milk bottle to make a tall, straight sided container.

2. Measure the stopper diameter(s) to determine the proper hole size in the plastic.

3. Use a cork borer (See the photograph) to cut a hole on one side within about a centimeter

   of the top.

4. Select a piece of glass tubing about 10-12 mm in diameter. Notch it with the file and break it into a piece about 4 cm long. Place the notch on top and hold it over an edge of the file.

   Holding the tubing at both ends in a cloth or paper towel, gently press the ends downward until it breaks cleanly. (If you have not used this method to cut glass tubing before, you should seek the help of someone who has.)

5. Carefully polish the ends with a hot burner flame or with a file.

6. With the cork borer, make a hole in the cork to fit the glass tubing snugly.

   Then, insert the tube while holding it with a cloth or paper towel in case it breaks.

6. Insert the cork in the hole in the container, bending it down a little so water will drip

   from the end.

7. Round the cut glass edge with the file or with a hot burner flame.

(Take care with hot glass!)

8. Try the overflow container. Holding the tube outlet with one finger, add water above the stopper. Does it flow freely and drip from the outer end of the tube?

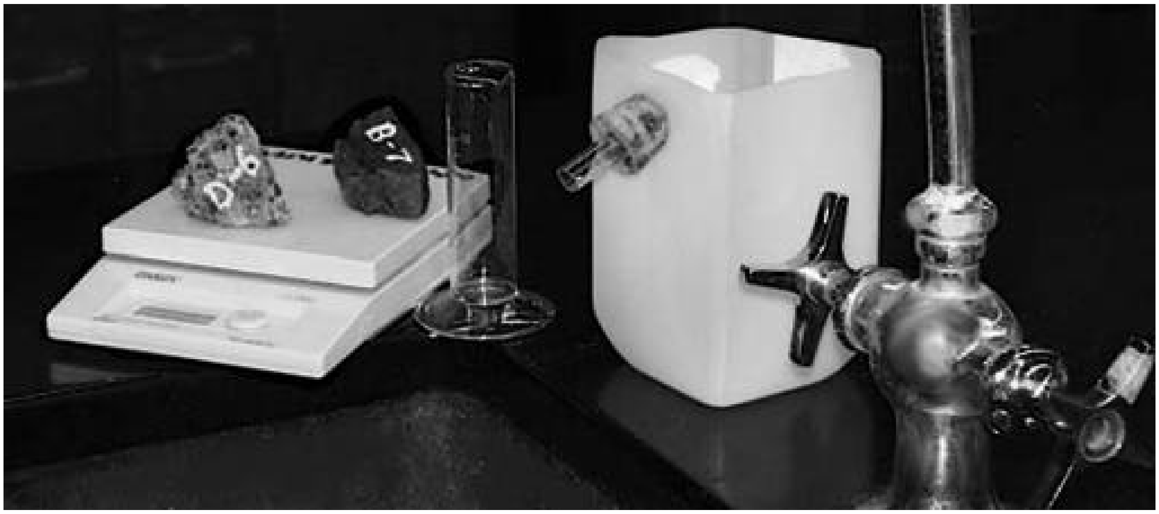

PHOTO: Converted Milk Bottle At Work.

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Teacher notes for the lab that follows:

You will need 15-20 samples of basalt about the size of golf balls (depending upon the capacity of your mass balances) and an equal number of similar sized samples of granite. Paint them with sample numbers. Mass scales can be electronic or balance beam. Volume can be measured with commercial overflow cans or home made overflow containers like the devices suggested in this article.

The lab takes about one 40 minute period. Some students will need extra time on their own to finish the questions as homework.

Teacher Tips: A. This is an excellent lab to stress accuracy.

Let your students know that sloppy work will cause problems.

B. Labeled samples will allow teacher to check students' work with others who measured the same samples.

C. It will be easier to check results if you make the granitic rocks odd

numbers and basaltic rocks even numbers; or use some similar, less obvious system.

(Insert the lab: Continental and Oceanic Crust)

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