Materials Repurposed

Find a wealth of free resources at your local recycling center.

By Orvil L. White and J. Scott Townsend

Few teachers find themselves with the support to purchase all the materials they ideally need to supply their classrooms. Buying one or two simple, ready-made items can put a serious strain on anyone's budget. However, materials for science in the classroom need not be prefabricated or expensive. By looking at the function and purpose of any piece of equipment, a creative teacher can find a suitable replacement for many premade science materials, sometimes from the most unlikely places. This is not to say we advocate the potentially hazardous practice known in some circles as "dumpster dipping," but with proper caution and common sense—like partnering with your county's local recycling center—you can find some terrific, serviceable materials among what others have deemed "trash."

Our local recycling center offered a community outreach program called "Materials for the Arts," in which public and home school teachers in the county had access to a wealth of materials salvaged from or donated to the recycling center. The center dedicated two rooms at the facility to the program, which stored objects such as clean, sanitized containers of all sizes, including plastic and glass bottles, coffee cans, potato chip cans, baby food jars, and cereal boxes and oatmeal containers; as well as cardboard tubes, carpet squares, compact discs, plastic trays, corkboard, bubble wrap, and other things. All of the materials were required to be completely cleaned with, depending on the material, either anti-bacterial soap or Lysol spray, before being accepted for donation. Use salvaged materials only if they have been thoroughly sanitized.

If there is no such program in your area, you might consider starting one at your school. Local recycling centers are often looking for outreach opportunities. When we conducted a presentation at our state science teacher's conference a few years ago, several outreach personnel from various state recycling centers approached us for ideas about how they could perform the same outreach services to teachers and the community.

Sometimes we visited the recycling center with specific material needs in mind. Other times, though, we simply explored the rooms to see what ideas were sparked by the materials at hand. Of course, not every item at the recycling center can be repurposed into a useful tool for the science classroom, but here we share a few of our favorites.

Students comparing the sediment to the rock sample.

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Timer

Teachers can make a classroom timer from two plastic drink bottles with caps and an old film canister with the bottom removed. Glue the bottle tops together inside the film canister with the tops touching. Trim off the excess canister with kitchen shears, and using an electric drill with a 3/16 bit, drill a small hole through both caps. Place approximately 800 g (for a five-minute timer) of sand, salt, or sugar into one bottle and screw the cap in place. Next, invert the second bottle and screw it into its cap. Test it out and adjust the amount of material as necessary for the time desired. This timer can now be used in a variety of ways, including as a guided-inquiry activity model for students to create other timers of various durations. The timer itself can be used to time speakers, give "time remaining" for a quiz or other assessment, and allow students to better understand the ways in which time has been historically measured.

Air circulation demonstration setup.

Using different models of timers, students can investigate questions such as: Is there a difference in using sand, sugar, or salt? How does the size (diameter) of the hole in the caps affect the rate at which the materials flow? How does the particle size affect the time it takes for the grains to go through the opening? If using a material other than sand, does the flow rate change over time and if so, is it faster or slower? Upper elementary or middle school students could also create a graph to show the relationship between mass (in grams) of granular material versus the amount of time it takes for the material to completely travel through the container. This would

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Student learning to read calibrations.

ultimately allow students to predict how much material they would need to insert for resulting amounts of time in the timer.

Sediment Tubes

Any plastic tube or bottle can be used to show the sedimentation of materials through a water column. We used plastic tubes made from a fluorescent lightbulb cover, a plastic sheath you can buy to cover the bulb, which we cut to size using kitchen shears. The covers are available at most home center outlets. Pour sand or soil into the bottle and fill with water. Know the source of the soil to avoid contaminants. Make sure children wash hands thoroughly after handling soil. Shake and allow the material to settle. The students can observe that the soil will settle into layers based on the density of the materials contained in the soil.

The sediment tube allows students to model and observe the process of deposition of materials in the natural environment. This process is the prelude to the formation of sedimentary rocks in the Earth's crust. The process of deposition of materials can be used to show how, over geologic time, rocks with differing colors of strata are formed. Students can also use this method to separate different soils into parts according to grain size and, by measuring the thickness of the layers, calculate percentage of each part—thereby adding a link to mathematics standards. Also, sediment contamination of streams and rivers is an issue in environmental science that can be better visualized and understood once the students can see how soil breaks down and is deposited when mixed with moving water.

Demonstrating Circulation

Recycled materials can also be repurposed for a teacher demonstration exploring air circulation behavior. Remove the bottoms of two 2 L plastic bottles and connect them with a plastic tube, actually a fluorescent lightbulb cover that was cut to size with kitchen shears. Place a small candle under one bottle and hold a lighted stick of incense over the other (see the air circulation demonstration setup photo, p. 27). Do this as a teacher demonstration only. Use a tea candle and keep matches, etc., out of reach of children. The heated air should rise out of the top of the bottle and produce a low-pressure area, drawing the air from the higher-pressure area of the other bottle. This will cause the smoke from the incense to flow down, across, and rise with the heated air out of the top, demonstrating the process of air flow in weather systems.

The demonstration models the movement of air in the environment. Air that has been warmed rises, and cold or cooler air moves in to take the place of the warm air. Using this demonstration as part of a unit on weather enables students to see a process that is generally unobservable and will help explain the shifting wind patterns they can feel. It is useful in exploring sea and land as well as mountain and valley breezes, and the displacement of warm air when a cold front moves across the landscape. Additionally, this is a good model of how other fluids react when heated. Ocean currents and the movement in a pot of boiling water are other concepts linked to thermal circulation.

Graduated Cylinder and Scoops

You can make a graduated cylinder by measuring a known volume of water into an old plastic bottle with the label and bottom removed and marking the measurement with a permanent marker. A clear 1 L water bottle works best for larger volumes, and any smaller straight-sided bottle will work with lesser amounts.

Cutting the bottom of the bottle of a 1 L container will create a scoop that is both easy to use and pour material from. Scoops can also be made from old salad-dressing bottles cut along the bottom and side. The caps should be glued in place to prevent accidental spills.

Funnel and Cup

A simple funnel can be made by cutting the top off a 2 L bottle and inverting it so the small opening is at the bottom. Aside from their usual use, funnels can be used as part of an inquiry challenging students to design the "most effective" water filtration device. Give students a choice of materials (e.g, coffee filters, paper towels, sand, activated charcoal, shelf liner [the puffy, nonslip type], gravel, cotton balls, and sponges, and so on) to design a three-layered water filter within the plastic funnel to remove a small scoop of potting soil from a water sample. Follow all safety rules when working with soil. Know the source of the soil to avoid contaminants and wash hands thoroughly with soap and water after working with soil. The goal for the student groups is to design a filtration system that will result in "clear" water being produced in a timely manner. This activity can be used as a stand-alone inquiry or as part of a larger unit on soils/Earth materials, water quality, or a unit on mixtures and solutions and the separation of their component parts.

CAUTION

Mystery Boxes

Mystery boxes are a favorite tool for teachers to introduce the meaning of observation/inference and various aspects of the nature of science. Often they are made by purchasing small cardboard boxes from the local jewelry store and placing common classroom or household items in them so students can shake and listen as they try to conclude what is hidden inside. Our local recycling center had a large supply of small cardboard boxes that hand soap came in—Voila! We found an ample supply of free mystery boxes! Mystery boxes work well as beginning-of-the-year activities. Using the box, students should first make observations—things they hear or feel. Then they can make an inference—based on the observations, what do you think the object is? Is there any way to know for sure without opening the box? How is this like what a scientist does? This process can help students begin to understand something of the nature of science and what it means to be a scientist.

Hovercraft

Our local recycling center always carries a steady supply of CDs and closable water-bottle tops of different varieties—these materials can be used to make inexpensive hovercrafts. Teachers should build the hovercrafts before presenting them to students for exploration. Using a hot glue gun, teachers glue the base of a water-bottle top that has been cleaned with rubbing alcohol to the center of an old CD (we use the type that pull up to open and push down to close because balloons fit easily over these spouts). When the glue is dry, it is ready for use.

CAUTION

To operate the hovercraft, students place an inflated balloon over the closed water-bottle top. When the student pulls up on the bottle top, air from the balloon begins rushing out, causing the craft to move.

We've used these models to introduce such concepts as Newton's laws of motion, friction, and force. For example, before the lid is pulled up (and opened), we have the students try pushing their devices across the tables. They note how far each device travels without the air rushing through the lid and under the CD. We then have the students pull open the lid and try the same process. They quickly observe how much farther the device travels when a force—in this case a push—is applied. We then give the students the option to add washers or other weights to see what happens to the distance the hovercraft travels when the same amount of force (once again a push) is applied. This exploration leads easily to discussion about Newton's laws of motion.

To extend learning beyond exploration with the simple hovercraft, we often challenge students to find ways to make the hovercraft travel without the students pushing it, or we challenge the students to design a hovercraft that will travel furthest when set in front of a fan in the hallway.

These are just a few of the recyclable items we have adapted for use in our classrooms. We encourage our fellow teachers to visit their local recycling centers to see what types of reusable science teaching treasures they may find. After all, the only thing better than an effective science teaching tool is a FREE science teaching tool! ■

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996).

Teaching Standards

Standard A:

Teachers of science plan an inquiry-based science program for their students.

Standard B:

Teachers of science guide and facilitate learning.

Standard D:

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.

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Reference

National Research Council (NRC). 1996. *National science education standards.* Washington, DC: National Academy Press.