

## How to Build Surface Runoff & Groundwater Recharge Hydrogeology Models



### Materials (for building one model)

- These instructions were written for building the models using Sterilite 7-quart hinged-lid storage boxes, but updated versions of the models use the 3 Liter Really Useful Boxes; the container should be sturdy and have flat sides
- Two  $\frac{3}{4}$ " 45° elbows
- One  $\frac{3}{4}$ " coupler (cut in half with a ratcheting PVC cutter to make two)
- Two pieces of  $\frac{3}{4}$ " PVC tubing (cut  $1\frac{1}{2}$ " in length)
- Four # 18 O-Rings
- 1" spade bit and drill
- Ratcheting PVC cutter

### Procedures

1. Drill a hole near the top left of the box using a 1" spade bit (so the center of the hole is about 1" from the top of the container and 1" from the far left of the container). This hole will be for the surface runoff spout. Next drill a hole near the bottom right of the container (so the center of the hole is about 1" from the bottom of the container and 1" from the far right of the container). This hole will be for the groundwater recharge spout. If the holes have jagged edges they can be shaved off using a Pocket Knife, X-Acto Knife, or file in order to have a clean cut. Try to make as tight of a fit as possible in order to maintain a waterproof seal.
2. Slide a  $1\frac{1}{2}$ " long tube cut from  $\frac{3}{4}$ " PVC through each hole so half of the PVC tube is sticking out of the hole. Note: this is a very tight fit in order to prevent water leakage.
3. Place # 18 O-Rings around each side of both PVC tubes.
4. Attach a surface-runoff spout made of  $\frac{3}{4}$ " 45° elbow onto the tube on the outside of the box. On the inside of the box, slide a  $\frac{3}{4}$ " coupler (that has been cut in half) onto the tube, and push together for a tight fit. Tip: hold an object with a hard flat surface against the couple while you push the elbow toward the coupler. Attached the groundwater recharge spout using the same procedures.

## Pictures to help identify parts and how they fit together



$\frac{3}{4}$ " PVC tubing with #18 O-Ring (black) and coupler cut in half (on left).



Same picture as above with another #18 O-Ring and the  $\frac{3}{4}$ " 45° elbow added. Note: the coupler and one O-Ring should be on the inside of the container and the other O-Ring and  $\frac{3}{4}$ " 45° elbow should be on the outside of the container. All parts should be pressed together tightly to make a watertight seal.

### Additional Materials for Experiments (using four models)

- Four watering cans (can be made out of plastic containers such as 266 mL (9 oz) – 709 mL (24 oz) plastic cups with holes poked in the bottom)
- Eight clear containers (large enough to hold at least 250 mL – 500 mL of water) are needed to catch the surface runoff and groundwater recharge (measuring cups, large graduated cylinders, pitchers, or plastic cups could be used)
- Plants, soil, and limestone gravel (can be obtained from your own yard, the schoolyard, or a local garden store). Avoid using potting soil, for it does not accurately model real-world conditions. It is better to use local soils or a landscaping, garden, or compost mix.
- Bag of Quikrete

Instructions for creating four ecosystems: concrete, compact soil, nonnative grass, and native plants. Line the bottom of the containers with limestone gravel up to the middle of the bottom spout. Fill one of the boxes with soil to the surface-runoff spout



(slightly above the bottom of the spout, but below the top of the spout). Use the same soil to plant grass and native plants in boxes so that the surface level of the plants is slightly above the bottom of the surface-runoff spout (but below the top of the spout). For the container with concrete, fill in soil to 2" below the bottom of the surface-runoff spout. Quikrete should be prepared outdoors (or in a well-ventilated area) as the instructions on the bag indicate (add water to the powder in a mixing bucket with a mixing stick). Then add a 2" layer of Quikrete on top of the soil up to the surface-runoff spout (slightly above the bottom of the spout, but make sure not to clog the spout with concrete). Allow 24 hours to dry. Place the boxes on a table (or box or crate) with the back ends slightly elevated (small blocks of wood can be used to create the desired slope). Next, place containers under the spouts to catch the surface runoff and groundwater recharge.

**Additional tips:** Have towels handy to clean up any spilled water. If soil clogs the runoff spout (especially for the model with only soil), then use a pencil or poking stick to unclog the spout. If the containers develop leaks, try using a silicone sealant between the O-Rings and the container.