

# Hydrogeology Model Assembly

## Tools:

- Drill
- 13/16 bit
- PVC pipe cutter
- Two pliers that can easily grip ½ inch pipe
- caulk gun

## Materials: (per tub)

All materials initially purchased at Lowe's Home Improvement

### In Plumbing

- 1 plastic tub
- Length ½ inch PVC pipe
- 1 [LASCO 1/2-in Dia 45-Degree PVC Sch 40 Slip Elbow](#)
- 1 [LASCO 1/2-in Dia 90-Degree PVC Sch 40 Tee](#)
- 1 [LASCO 1/2-in Dia 90-Degree PVC Sch 40 Elbow](#)
- 2 [LASCO 1/2-in Dia PVC Sch 40 Coupling](#) (At least one side needs to be threaded internally)
- 3 [LASCO 1/2-in Dia PVC Sch 40 Adapter](#) (male threaded, female slip)
- 3 15/16<sup>th</sup> v 3/4 x 3/32 O-ring (Danco brand, #14)
- 1 [Danco 1/2-in White Shank Nut](#)

### In caulk and adhesives

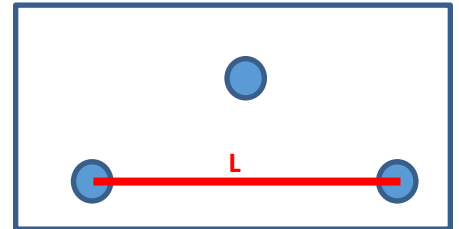
- [Construction Adhesive](#)

Sandpaper or other abrasive

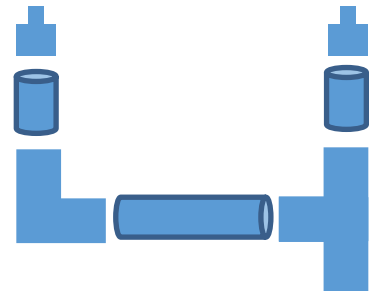
Rubbing Alcohol

## Instructions

1. Drill three holes in one long side of the tub, one centered and just below the lip the other two close to the bottom. Do not drill on curves.
2. Using the pipe cutter, cut some of the threads off of two of the adapters. You should leave about 4 threads.
3. Place an o-ring on each of the adapters, the two cut and one whole.
4. Assemble the runoff spout:
  - a. Cut a short length of PVC pipe (an inch or so)
  - b. Use the length to attach the 45 degree elbow and the UNCUT adapter
5. Assemble the recharge spout:
  - a. Cut two short and equal lengths of PVC pipe (again, about an inch or so).
  - b. Attach a cut adapter to one end of each length.
  - c. Attach one to the 90 degree elbow and one to a side of the T.



- d. Cut a length of PVC pipe the same length as the space between the centers of the two bottom holes (**Length L**).
  - e. Attach this pipe to the stem of the T and to the other side of the 90 degree elbow.
  - f. Check to be sure the ends of the cut adapters line up and pass through the two holes and that there is enough threading poking through to tighten down the coupler. If there is too much threading the coupler will not tighten sufficiently, too little and it can't connect.
6. Abrade the surface of the tub around each of the holes, interior and exterior with sandpaper.
  7. Wipe the abraded areas and all three adapters, the shank nut, and the threaded side of the coupling with rubbing alcohol and allow to air dry.
  8. Ring the interior and exterior of each hole with construction adhesive.
  9. Insert the two cut adapters of the recharge spout through the lower holes and tighten the coupling on the adapter. You may need to use the pliers to tighten, but be careful not to overtighten.
  10. Insert the adapter on the runoff spout through the upper hole and tighten the shank nut (with the metal part)
  11. Allow the adhesive to cure according to directions.



NOTE: Next time we make these, I'd like to try doing a single point of runoff and a single point of recharge on the narrow end. No change would be made to the runoff except for the change in location, but the recharge would be in the bottom, with a shank nut on the interior and just the adapter and o-ring on the exterior. The models would be placed with the runoff spout hanging over the edge of a bench, and something under the other side to give them a slight tip forward. This would capture more of the recharge and decrease the cost and time required to create the models.

Have option to connect flexible hoses to the outlets so that models don't need to be used when making systems out of the models. 9/18/14

Filling and using models:

A set is composed of four tubs assembled as outlined above, each filled with a different ground surface: Concrete, soil, grass (like a lawn), and native plants. The plants need to be in place for at least 6 weeks after germination (grasses can take 2 weeks to germinate), 8 weeks is preferable for fully established growth. In other words, grass seed need to be spread NO LESS THAN 2 MONTHS before use.

Filling hydromodels:



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Since the object is to have water both soak into the model (if permeable) for groundwater recharge and to runoff the surface, it is important to keep several things in mind when filling the models:

- **Drainage in the base is essential!** Using something with large particles (gravel and perlite have been used successfully, next experiment is styrofoam peanuts), fill three of the tubs to a depth of at least an inch. The fourth will be for concrete, and can be filled more deeply. At least one inch of concrete is needed, but the rest of the tub can be filled with a lighter material.
- **Do not block outflow openings.** If the material covering the recharge outflow pipe is small enough to get into the pipe, a porous covering needs to be applied. We simply secured small pieces of window screen over the opening when using the perlite. Gravel and packing peanuts should be large enough that no cover is necessary. The surface runoff outflow needs to be level with the surface of the finished tub, but not blocked.
- **Make the surface just off level** - with the down slope at the runoff outflow. Alternatively plant to tip the models slightly to avoid pooling.
- IF making more than one set, then it's wise to fill all of the same kind at once.

Concrete:

WARNING: Concrete contains chemicals that can irritate skin, eyes, and lungs. Take appropriate precautions.

TIMING: Many varieties of concrete set up quickly. Be sure you are ready and have adequate time before making the mix. Working with a partner helps with time management. The multiple curings can take up to 2 weeks. Allow yourself plenty of time!

Materials

- Quickrete
  - porous substrate
  - rubber gloves
  - mixing bucket/container
  - Construction adhesive
  - caulk gun
  - popsicle stick or other small manipulative for smoothing sealant.
1. place all assembled tubs that will be surfaced with concrete on a surface with a slight tilt. Make sure the runoff outflow is on the uphill side.
  2. Pour porous substrate into all tubs to a depth of about 1 inch below the top of the concrete height. Smooth the surfaces.
  3. Wearing gloves to protect hands, mix concrete according to instructions on the package.
  4. Quickly pour concrete into each tub. It should flow slightly. Even it out and make it slope slightly to the surface outflow. Add or remove concrete as necessary.
  5. Allow to dry and cure according to package instructions.



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6. When thoroughly dry, squeeze a bead of construction adhesive around the edge of the concrete surface where it touches the tub, pay special attention to the outflow pipe now imbedded in the surface.
7. Smooth the bead using the popsicle stick. The object is to create a water-tight seal between the concrete and the plastic parts.
8. Allow to cure according to adhesive instructions.

#### Soil

#### Materials

- bare soil - we have generally used the clay-like soil found at Blandy. If the soil at your location is loamy or sandy, your results may differ
  - porous substrate
1. place all assembled tubs on a surface with a slight tilt. Make sure the runoff outflow is on the uphill side.
  2. Fill the tub between an inch and halfway with the porous substrate.
  3. Fill the remainder of the tub up to the surface runoff outflow with soil.
  4. Gently smooth the surface of the soil so that it has a slight tilt towards the outflow when the tilt is removed.
  5. We recommend dampening the soil so that it dries in place.

#### Grass

**TIMING:** Grass can take up to two weeks to germinate, and need at least 6-8 weeks to establish strong root systems. Be sure to construct these tubs **AT LEAST 2 MONTHS BEFORE USING THEM.**

#### Materials

- grass seed
  - potting soil
  - porous substrate
  - watering can or hose with watering attachment
1. place all assembled tubs on a surface with a slight tilt. Make sure the runoff outflow is on the uphill side.
  2. Fill the tub about an inch with the porous substrate.
  3. Fill the remainder of the tub to just under the surface runoff outflow with potting soil.
  4. Gently smooth the surface of the soil so that it has a slight tilt towards the outflow when the tilt is removed.
  5. Sprinkle grass seed evenly over the entire surface and cover with a very light layer of soil.
  6. Water with quantity and frequency recommended for the grass variety being used.
  7. Allow up to 2 weeks to germinate, and 2 months from planting to be fully established.

#### Native Plants



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TIMING: If using seeds, check germination time and add at least 6 weeks for the plant to become established. If using transplants, allow at least one month for plants to become established.

## Materials

- plants: We have used *Caltha palustris*, commonly called Marsh Marigold. This plant tolerates a wide range of water conditions, and is therefore useful in this situation. We order small plants (plugs) from [North Creek Nurseries](#) and place 6 to a tub (they come in flats of 50). If using another plant, adjust quantity and timing accordingly.
  - potting soil
  - porous substrate
  - watering can or hose with watering attachment
1. place all assembled tubs on a surface with a slight tilt. Make sure the runoff outflow is on the uphill side.
  2. Fill the tub about an inch with the porous substrate.
  3. Fill the remainder of the tub to just under the surface runoff outflow with potting soil.
  4. If planting seeds, plant according to package directions (depth and spacing).
  5. If planting transplants, insert into the soil at healthy spacing. This may change the level of the soil surface. Add or remove soil so that the top of the soil is just at the outflow pipe.
  6. Gently smooth the surface of the soil so that it has a slight slope towards the outflow when the tilt is removed.
  7. Water as recommended for the plant variety.



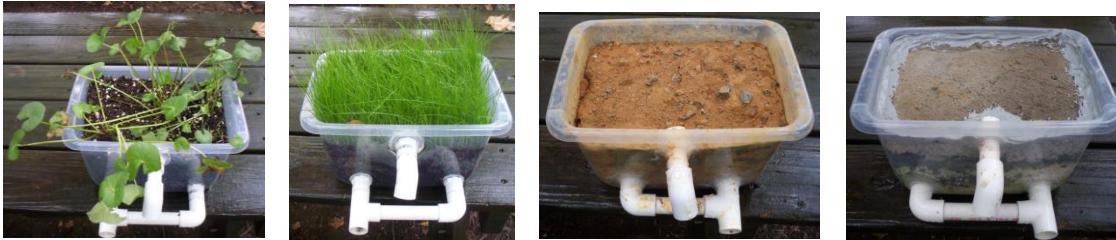
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## HYDRO-GEOLOGY MODEL CARE

These hydrogeology models are used to demonstrate how water moves over and through different surfaces and to explore these ground surface type effects on surface runoff and groundwater recharge.



To keep the models at their best for years to come:

- ❖ Always **pick up** models with **two hands**
- ❖ **Do Not** Stack the containers
- ❖ When not in use, keep the grass and the native plants **watered** (not saturated but keep the soil moist). Check the plants at least **every 3 days**.
- ❖ **Do Not** wiggle or pull on the pipes/spigots. This can cause the seals to leak.
- ❖ When **storing**, make sure that the **spigots do not hit against one another**. This will break the spigot seals.
- ❖ Keep the **surface level** of models (all except concrete) **even with the opening in the runoff pipe** (add soil as needed; do not use potting soil as this will clog the pipes; use local soil from the ground).
- ❖ Check to be sure the **runoff pipe is clear** before every use (a pencil poked through the pipe works well).

If you have **any questions** about the use and/or care of these models, please contact Blandy Education staff at: 540-837-1758 x. 242; [schprog@virginia.edu](mailto:schprog@virginia.edu)