Biosystems Engineering and Soil Science

RAIN GARDENS FOR TENNESSEE: EDUCATORS' TOOLKIT

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The purpose of this toolkit is to provide educators guidance on how to incorporate props and visuals into educational sessions to increase audience understanding and make rain garden implementation attainable for homeowners. This publication contains a list of materials and suggestions on how to use them during a session at a rain garden demonstration site or in a classroom setting. This material is generally targeted for adult audiences but may be adapted for middle school to high school students.

Tennessee Rain Facts for Introductory Materials

- On average, a rooftop in Tennessee gets about 48 inches of rainfall a year. That's about 10,000 gallons of rooftop runoff coming from a single downspout at your home (assuming the downspout drains 350 square feet of rooftop)!
- We experience intense rainfall in parts of the state — sometimes up to 4 inches per hour! The runoff from the rooftops and driveways of a neighborhood of just 100 homes would fill an entire Olympic-sized pool from that rainwater runoff (assuming the average roof/driveway area is about 2,400 square feet)!
- Tennessee has immense water resources. Up on the Plateau, annual rainfall reaches 70 inches in some years, as compared to some areas in the southwest United States that get less than 10 inches annually. Take advantage of this resource to reduce your need for irrigation in your yard.
- A 1-inch rainfall on a typical house (1,400 square feet of roof area) will produce about 850 gallons of rainwater runoff.

Props and Visuals for Presentations

Materials

- 6 wooden rectangular blocks, roughly 4"x 4"x 2" painted blue
- Hand spade shovel and soil sample box
- 3 clear plastic cups, water pitcher, blue food coloring and dish washing sponge (preferably tan color)
- Clear container with media layers (oversized mason jar, at least 12 inches tall)
  - Bottom layer, clay (or native soil), 1 inch
  - Washed sand or gravel, 2 to 3 inches
  - Fluffed topsoil, 4 to 6 inches
  - Top layer, triple-shredded hardwood mulch, 3 inches
  - Plants (optional)
- Colored construction flags, hanging bubble level, wooden stake, and thin rope or twine
- 2 plastic clear bottles with a 3-inch layer of cobble/gravel/sand layer (or relevant substrate that mimics the bottom of a local stream) filled with water; add fine sediment (i.e., clay, silt) to one bottle.

How to Implement Props

Two prepared bottles show comparison between a healthy stream (left) and a stream impacted by sediment pollution (right).

Two gravel/water bottles show impacts of urban runoff on water quality: Explain that sediment is the number one pollutant across the state and country, and streambank erosion is a large source of sediment. Explain that when it rains in developed watersheds, runoff from impervious surfaces flows quickly to streams, compounding in volume and velocity as it moves downhill. This energy causes channel incision and erosion. Point out that sediment creates turbid water that holds less oxygen and more heat, settles to the bottom and fills benthic habitat, and carries attached toxins and excessive nutrients that degrade water quality.

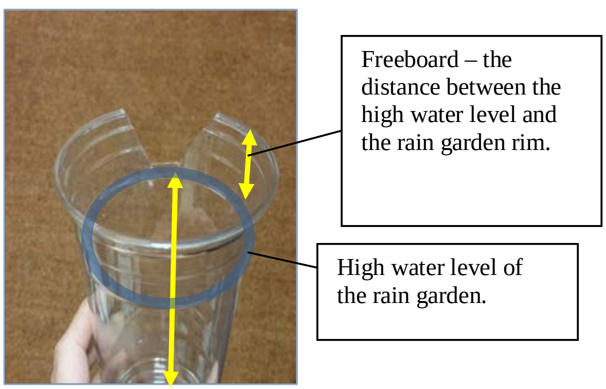
Bubble level, stake and rope measures percent slope: Explain how rain gardens need to be located in flat areas, preferably less than 12 percent slope. Place a chair at one end of the room and the wooden stake at the other end (measure this distance ahead of time, ideally 15 to 20 feet apart). Ask the audience to envision a land surface that slopes from the seat of the chair to the bottom of the stake. Run the rope from the seat to the stake in a level line (use the bubble level). Measure how high up on the stake the rope hits the stake in straight-line distance. Do the easy calculation of rise of run and multiply by 100 to get percent slope. If you use a standard chair and a 20-foot distance, then your result should come out about 5 to 10 percent (reasonably low for a rain garden!).

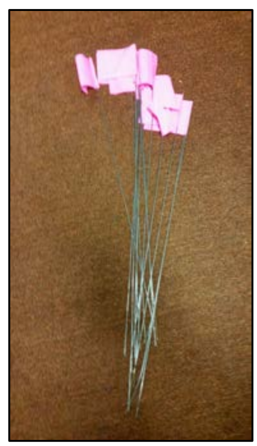
Shovel and soil sample box used for perc test: Explain the steps for performing a perc test: dig a 12" by 12" hole, scrape the sides rough, fill it with water and let it drain, and then refill the hole and time how long it takes the hole to empty. This will evaluate the saturated soil infiltration rate. A rate of 0.25 inches per hour or greater is acceptable (empty in 48 hours). Tell the audience to fill a soil sample box with the soil removed for the test and send it to the soil-testing lab for analysis. Bring in a sample soil test analysis report. Discuss the critical aspects of the soil test results such as the pH, percent organic matter, texture, and fertilizer recommendations. Discuss possible soil amendments to help neutralize pH and improve drainage (such as peat moss, wood chips or coir fiber).

A soil sample box that can be filled and sent to the UT Soil, Plant and Pest Center.

A cup with holes punched in the bottom represents porous soils that allow water to drain through while a cup with no holes represents compacted soils that don't allow water to drain.

Water pitcher and two clear cups to show the difference in how water moves through (or doesn't move through) compacted clay soils compared to porous, amended soils: After discussing how to obtain perc test results, emphasize the importance of knowing that your soils will infiltrate the ponded volume within 48 hours. Fill the water pitcher with water and add blue food coloring for easy viewing. Fill the cup with no holes about halfway and explain that compacted, clay soils will result in a bathtub situation where water will just stand and create potential mosquito habitat. Then pour water into the cup with holes. The water will run out the bottom (if you're indoors, use a catch pan). Explain how porous soils will allow the water to drain into the subsoil and eventually recharge the water table. You could also use a circle cut out of a sponge at the bottom of the cup and discuss soil-moisture holding capacity. Alternatively, you could use actual media in the cups to show the difference in percolation through clay and a mixture of washed sand and topsoil. A cup could also be used to demonstrate the function of an outlet structure and freeboard. Cut a shallow notch in the rim of the cup. Fill the cup with water until it pours out of the "outlet." Show how this outlet elevation dictates the high water level in the rain garden. Discuss the importance of planning for this outlet to guide overflow to existing drainage infrastructure without impacting adjacent property or causing erosion.

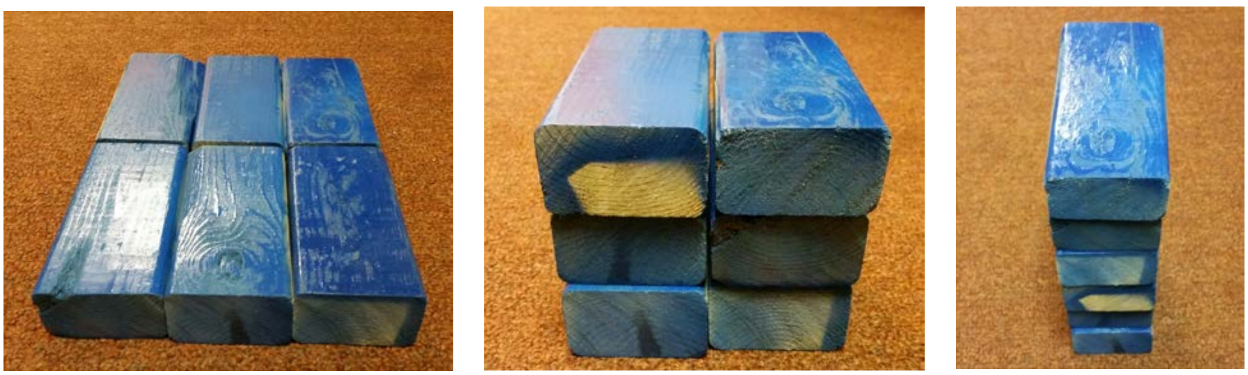




Colored flags or construction spray paint can be used to delineate the garden boundaries to visualize the shape and placement in the context of the surroundings.

Use colored construction flags for visualizing footprint and finalizing layout: After the footprint size is determined, use flags and a measuring tape to outline the boundary in your yard. Suggest to your audience that they work with the natural contours of the space and maximize the flowpath of concentrated inflow. Use the flags to help envision the space needed, how it can be shaped to fit your desired aesthetic, and consider how mowing and other needed maintenance may affect the layout. You may also use surveyors' paint instead of the flags, but consider that the paint may take quite some time to wear away if you are not close to installation time.

Blue wooden blocks show rain garden volume relationship: Explain that a rain garden is sized to catch a designated amount (or volume) or rainwater runoff. The size (i.e., footprint) is related to soil perc test results (how fast water will infiltrate into the soil) and how much rainfall depth is collected (generally 1 inch of rain). Assemble the six blocks in a square with two rows of three blocks. Explain that this model represents an inch of rain falling on a portion of a rooftop, and a downspout is draining to the rain garden. Explain that if the perc test showed slow-draining soils, then you can "stack" that water up in the rain garden to about 3 inches and be confident that it will infiltrate (or empty) within two days. Stake the blocks three deep and show that the rain garden footprint is two blocks in footprint size. Explain that if the soils are fast-draining, then you can stack the water up to 6 inches or more. Stake all of the blocks on top of each other, six blocks high. Then compare the footprint that is now one block in size – half of the size of the slow-draining size, but the same volume of water. Emphasize that slow-draining soils need a larger rain garden footprint to spread out the water, and fast-draining soils need a smaller footprint where you can stack the water up higher.



Wooden blocks painted blue represent the volume of water running off a rooftop (1 inch deep) and then stacking into a rain garden (3-6 inches deep) where the depth is dependent on soil texture and infiltration capacity.

The clear glass container with layered media shows a vertical profile of the finished rain gardens layers: Revisit the perc test results and discuss how adding amendments will help improve soil infiltration and overall quality. Use the glass container to show the layers of a rain garden. Emphasize that the greater the need/desire for amendments and layers, the greater the effort in excavation as well as the greater potential for success in infiltration. This is a suggested list of layers and may be adapted to fit your specific recommendations or situation: native subsoils, 2-3 inches of washed sand or gravel, 4-6 inches of fluffed topsoil, 3 inches of triple-shredded hardwood mulch, and 3-9 inches of ponding. You may add additional features such as plant roots, peat moss amendments, underdrain, etc. Discuss using the excavated soil and subsoil. If the subsoil has roughly 10 percent or greater clay content, it can be used for a compacted berm on the lower end of the garden, which may decrease the overall depth of excavation. Suggest stockpiling good topsoil (turf and associated seed bank layer removed) for return back into the rain garden.

A large mason jar is used to show the vertical profile of layers of a rain garden.

Concluding Remarks and Leaving an Impression

Remember that rain gardens and other conservation landscaping practices provide function and benefits on ***multiple scales***. The benefits are compounding for citizens:

- To the *individual* homeowner, their property may increase in value with increased aesthetic appeal;
- To the *neighborhood*, the general aesthetic appeal of the area will be heightened as more grey infrastructure is turned green and less erosion occurs; and
- To the *community*, an overall improved quality of life is realized through clean water and a healthy ecosystem that supports economic enterprises in development and outdoor recreation.

From a hydrological perspective, rain garden functions are cumulative across a watershed. Revisit the concept of rooftop runoff by restating that about 850 gallons of rainwater runoff comes from a typical home in a 1-inch rain event, which means that in a neighborhood of 40 homes, almost 35,000 gallons of water will fall just from the rooftops. Consider translating that to feet of standing water in the presentation room (about 4 feet deep in a room with dimensions 30 feet by 40 feet). That's a lot of water to recharge the groundwater instead of sending it to the creek!

A rain garden web application has been created to showcase the rain gardens of Tennessee. Follow the link to find a storybook created using arcgisonline.com to showcase spatial distribution and photos of the rain gardens of Tennessee.

Web link: tinyurl.com/tnsyraingardens

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