Rain Garden Siting and Design

How do you determine the best location to build a rain garden? What design characteristics and features of a rain garden are necessary to consider prior to building one?

An exercise to identify characteristics and features necessary to build a rain garden, including:

- Determining the source and direction of water flows
- Routing water to the garden
- Site characteristics
- Sunny versus shaded areas
- Soil drainage properties

Objective

To educate students on the factors that determine the location of a rain garden. Students will investigate their current campus to determine feasibility for a rain garden or evaluate an existing onsite rain garden.

Science State Standards

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ES.1

Education Module #2
Activity Instructions:
This module includes a three-step process in order to help students consider a feasible location for a future rain garden. For schools that currently have an onsite rain garden, the activities are meant to engage students in an evaluation of the factors considered when it was originally designed. If a school already has an onsite rain garden, teachers may also challenge students to come up with an additional or alternate rain garden location.

These activities are meant to be performed in order, as they build on one another. Due to the complexity of the concepts, the activities “Campus Walk” and “Site Evaluation” are suitable for 3rd-12th grade. The “Soil Test” activity is suitable for K-12th grade, with modifications for various learning levels.

Instructions for each module are contained in the following pages. Teachers are encouraged to view the “Prep” and “Tools Needed” sections in advance, as these activities are dependent on weather conditions and require preparation before class.

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Prep: This exercise requires an out-of-the classroom walk around the school campus. This activity is suitable for 3rd–12th grades. An aerial picture, map, or diagram of the campus is needed. Divide the students into groups of three. Each group should designate a recorder to note their observations. Each group should have a copy of the aerial image that allows them to mark features they observe.

Tools Needed:
- Students should have a notebook or other portable hard surface to write on, a pencil or pen, and appropriate walking shoes.
- Standard measuring tape of at least 10 feet – one for each group
- Copies of an aerial picture, map, or diagram of campus – one for each group
- Copies of “Campus Walk” worksheet for each student

Steps:
1. Begin the exercise by discussing the instructions with all students.

Instructions (also found on worksheet): “Walk around the school campus with your group. On the map that you have been given and using the symbols shown below, mark the places where you see slopes or low spots, downspouts, and any areas where you think water flows on the property. Mark the direction that you think the water flows. When you observe an area that you think would be a good location for a rain garden, draw a shape for the garden and label it with the letter A. If you find additional areas that you think would be good rain garden locations, draw a shape for a garden in each area and label each with a letter (B, C, D and so on). If there is a rain garden on your campus already, draw the shape of it and label it with the letters RG.

Once you have identified possible rain garden sites, measure the distance from the edge of the garden site to any structure, such as a building, patio, porch or other immovable object. Show the distance from the garden edge to the structure on your map. If the distance is more than 10 feet, simply put “10+ feet.”

2. Once all groups have completed their observations, return to the classroom and have students complete the activity worksheet questions.
**Activity 2: Site Evaluation**

**Prep:** This exercise requires an out-of-the-classroom walk around the school campus. This activity is suitable for 3rd – 12th grades. The “Advanced” portion is suitable for 5th – 12th grades and may be added as an additional worksheet. This activity is intended to build upon the “Campus Walk” activity or be used at an existing school rain garden.

**Schools without a rain garden or proposing a new location:**
From the observation maps submitted by the students from the “Campus Walk” activity, choose the rain garden location that was most recommended by the class. Prior to administering the activity, the instructor should choose the shape and size of the rain garden for the activity. It is recommended that you choose a shape that is easy to draw and measure, such as a square, rectangle, circle, or triangle. To make the exercise more difficult for upper grade levels, the shape and size might be modified.

**Tools needed:**
- Measuring tape
- Popsicle sticks, stakes, or other items to mark off the garden shape
- String, rope, twine, or other material long enough to wrap around stakes for border
- Students should have a notebook or other portable hard surface to write on, a pencil or pen, and appropriate walking shoes.

**Steps:**
1. Begin in the classroom by showing the class, either digitally or via a copied image, which site was chosen from their “campus walk” recommendations. The illustration provided to the class should include a sketch of the shape and size of the proposed garden.

2. Take the class out to the proposed site. Ask for 7 volunteers: 4 to place stakes, 2 to measure, and 1 to wrap string. With direction and input from the class, and following the image and dimensions previously chosen, place stakes on corners or around the border to lay out the shape of the garden. Dimensions should be measured prior to stake placement for accuracy. Once all stakes are placed, wrap twine, rope, or other material around the stakes to make an easily recognizable border.

3. Students should answer the questions on the sheet provided by observing the proposed garden and its location.

**Schools with a rain garden:**

**Tools needed:**
- Measuring tape
- Popsicle sticks, stakes, or other items to mark off the garden shape
- String, rope, twine, or other material long enough to wrap around stakes for border
- Students should have a notebook or other portable hard surface to write on, a pencil or pen, and appropriate walking shoes.

**Steps:**
1. Take the class out to the rain garden. Ask for 7 volunteers: 4 to place stakes, 2 to measure, and 1 to wrap string. Ask students to sketch the basic shape of the garden. Have volunteers place stakes on corners or around the border to mark the shape of the garden. Sections between stakes should be measured, and dimensions should be recorded in appropriate units by each student. Once all stakes are placed, wrap twine, rope, or other material around the stakes to make the border easier to view.

2. Students should answer the questions on the sheet provided by observing the garden, its location and surroundings.
**Activity 3: Soil Test**

**Prep:** This activity is suitable for grades K-12. The questions or complexity of observations will vary greatly depending on grade level. The activity worksheet is intended for use by 2nd-12th grades. The observation worksheet is intended for use by 4th-12 grades. This activity may be completed **outside or in the classroom**.

**Tools needed:**
- A metal open-ended cylinder, such as a coffee or large soup can with both ends removed. If multiple groups are conducting the test, make sure cans are all the same diameter.
- One gallon of water or enough to provide 4 cups for each experiment group
- Measuring cup (size: one cup)
- Stopwatch or clock
- Paper towels
- Students should have a notebook or other portable hard surface to write on, pencil or pen, and appropriate walking shoes.
- (In the classroom) 5 gallon bucket filled at least halfway with compacted soil. The soil should be from a projected rain garden location or nearby when possible. If it is not possible to obtain soil from the rain garden location, any soil mixture may be used except potting soil.

**Outside the Classroom**

**Steps:**
1. Take the class out to the proposed site or existing rain garden. Divide the class into groups, depending on the amount of supplies available. One can, four cups of water, a stopwatch or clock, and a measuring cup are needed for each group.

2. Find a location that is free from heavy grass or gravel—this makes it easier to insert the cylinder into the ground. Clear the location of all surface debris but avoid disturbing the soil. It is important to avoid disturbing the soil as much as possible, in order to get accurate test results. For accurate results, the soil should be left in its original compacted state.

3. Each student should pick up a handful of dry soil, rub it between their fingers, and record observations of texture/content of the soil. If loosened soil is not available at the site, a prepared sample may be passed around.

4. Insert the can approximately two inches into the ground. Due to the compacted soil, some students might require assistance in order to reach the desired depth and avoid any injuries.

5. With the stopwatch ready, pour two cups of water into the can. Start the stopwatch as soon as the two cups of water are in the cylinder. Stop the stopwatch when the standing water is no longer visible and only the soil surface can be seen. Record the time under “Dry Soil Test Results.”

6. Now that the ground is saturated, repeat the test a second time, following the instructions in step #5. Record the time it takes for the water to soak in under “Wet Soil Test Results.”

7. Each student should take a handful of wet soil, or pass around a sample, rub it between their fingers, and record observations of texture/content.

**Inside the Classroom**

In order to conduct this activity within the classroom, the only modification required is the pre-gathered soil sample. Fill a bucket with soil. The soil should be moderately packed. One bucket for each group demonstration is required. Students will insert cans into the soil in the bucket and proceed with the test as described above.
Rain Garden Location
Designing a rain garden on the school ground with native plants is an exciting process that can improve the quality of water; provide habitat for wildlife; and offer opportunities to observe nature. A rain garden should be placed where there is rain water runoff coming from roofs, downspouts, driveways, sidewalks, parking lots, or other hard surfaces. The goal of a rain garden is to keep rainwater close to where it falls, rather than allowing it to collect pollutants and wash away soil as it travels to the nearest waterway.

A rain garden is a lower area in the ground that allows water to collect and soak into the ground. When looking for a good rain garden location, observe the drainage areas and where stormwater naturally runs over the school grounds. Low areas with bare or eroded soil are ideal for rain gardens because the plants in the garden will help cover the soil and keep it in place. Locating a rain garden in an area with a downward slope will help to naturally route water to the garden. Typically, rain gardens are located near downspouts where water drains from a roof. Downspouts can be modified to re-route water towards the rain garden. To avoid problems with buildings, rain gardens should be located at least 10 feet away from buildings or structures.

When determining the size and shape of a rain garden, consider how the garden will fit in with the surrounding landscape. Also, it is important to make sure that the garden location does not block any entrances or walkways. Choosing a low traffic area will help the garden avoid being damaged. Rain gardens should not be installed near large trees. Trees have large root systems that could be damaged when digging a rain garden. The size of a rain garden depends a lot on the type of soil it has and how fast it can drain.

Down to the Dirt
The type of soil has the greatest influence on the size the garden will be. A sandy soil or soil high in organic matter (already decomposed material or a material in the process of decomposition, that acts like a sponge absorbing lots of water) is best suited for a rain garden. Sandy soils that drain quickly are suitable for smaller and deeper rain gardens. However, much of Northeastern Indiana has clay soil, soil that has very tiny particles and is easily compacted. Clay soils that drain slowly require larger and shallower gardens. In some cases, a clay soil is not suitable for a rain garden without improvements being made or making the garden larger so there is more area where water can soak in.

There are several methods to identify the type of soil in your proposed rain garden. It is not necessary to use expensive equipment to analyze your soil; simply feeling the soil with your hands can be good enough! Soil is made up of three particle sizes – sand, silt, and clay. Soils have different textures, depending on the proportions of sand, silt, or clay particles. Sand feels gritty and, when it is wet, the grains do not stick together when squeezed. Silt feels velvety or flour-like when dry, and sticks together slightly when it is wet and is squeezed. Dry, smashed clay feels smooth but can be hard to crush by hand if it has dried in clumps. Wet clay feels sticky or very smooth and satin-like when rubbed, and it sticks together well when squeezed.
Walk around the school campus with your group. On the map that you have been given and using the symbols shown below, mark the places where you see slopes or low spots, downspouts, and any areas where you think water flows on the property. Mark the direction that you think the water flows. When you observe an area that you think would be a good location for a rain garden, draw a shape for the garden and label it with the letter A. If you find additional areas that you think would be good rain garden locations, draw a shape for a garden in each area and label each with a letter (B, C, D and so on). If there is a rain garden on your campus already, draw the shape of it and label it with the letters RG.

Once you have identified possible rain garden sites, measure the distance from the edge of the garden site to any structure, such as a building, patio, porch, or other immovable object. Show the distance from the garden edge to the structure on your map. If the distance is more than 10 feet, simply put “10+ feet.”

During your campus walk, draw the following on your map:

- **Sloping Area or Low Spot:** draw lines with arrows that indicate which direction the area observed is sloping down

- **Downspout:** place letters on map where a building downspout is located

- **Water Flow:** draw dashed lines with arrows that indicate which direction water is flowing, or is expected to flow, away from downspouts, off of sidewalks, or across other paved areas

- **Border of Garden:** draw the border of the proposed garden locations where space is available. Label each location with a letter if there is more than one. Example: B

  If there is an existing rain garden mark it as: RG

- **Distance from Structure:** record the distance measured, in feet and inches, from the garden border to any permanent object. If more than 10 feet, show “10+ feet.”
Discuss and review the group observations drawn on the campus map during your Campus Walk. Answer the following questions:

1. How many downspouts are there on campus? _____________________________

2. Do you think there is more than one potential location for a rain garden? Explain your answer.___________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

3. If there is more than one potential location, which letter location would be the most visible to the students at your school? ______ To the public? ______

4. Are all the potential locations more than 10 feet away from any structure?___
   If no, which letter locations are more than 10 feet away? ________________

5. In 3-5 sentences, explain how water currently flows from or leaves your school site.
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

6. At which letter location would you like to see a rain garden constructed? Why do you feel it is the best choice?
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

7. If your school currently has a rain garden, do you think it is in the right place? Explain why or why not. _________________________________
   ___________________________________________________________________
   ___________________________________________________________________
1. In the box below or on graph paper, draw a simple sketch of the proposed rain garden. Label the measurements of each section of the border. Indicate with marks where a **berm** (dam or ridge on the edge of a rain garden that helps keep water in the rain garden, allowing it to soak in) should be built. Use this symbol: 

![berm symbol]

2. What is the approximate percentage of sunlight on the garden?

   Full Sun _________%  Spotted Sun _________%  Full Shade___________%

3. Which surrounding items affect the amount of sunlight reaching the proposed garden? Check all that apply:

   - Tree(s) ______
   - Shrub(s) ______
   - Building ______
   - Pavilion ______
   - Other ______ write in item ________________________________

4. How many downspouts might drain to the garden? ____________________________

5. How many downspouts are close enough to be routed to the rain garden? _____

6. Are there any sidewalks, driveways, or paved areas from which water would flow towards the rain garden? (circle) YES / NO  Do you think the same amount of water will come from each area? Explain your answer._________________________

   _______________________________________________________________________

   _______________________________________________________________________

7. List two possible negatives to this rain garden location. Consider accessibility, amount of sun, visual appeal, foot traffic, etc._________________________________

   _______________________________________________________________________

   _______________________________________________________________________
1. In the box below or on graph paper, draw a simple sketch of the rain garden border. Label the measurements of each section of the border. Indicate with marks where a berm (dam or ridge on the edge of a rain garden that helps keep water in the rain garden, allowing it to soak in) is built within the garden.

Use this symbol:

2. What is the approximate percentage of sunlight on the garden?

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<tr>
<td>Full Sun</td>
<td>Spotted Sun</td>
<td>Full Shade</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
</tbody>
</table>

3. Which surrounding items affect sunlight reaching the garden? Check all that apply:

- Tree(s) [ ]
- Shrub(s) [ ]
- Building [ ]
- Pavilion [ ]
- Other [ ] write in item ________________________

4. How many downspouts are in line to drain to the garden? ________

5. How many downspouts are close enough to be or are routed to the rain garden? ________

6. Are there any sidewalks, driveways, or paved areas from which water flows towards the rain garden? (circle) YES / NO  If yes, describe each.

___________________________________________________________________________

___________________________________________________________________________

7. List two things you might change about the garden if you could. Consider accessibility, amount of sun, visual appeal, foot traffic, and size.

___________________________________________________________________________

___________________________________________________________________________
8. What is the area of your garden, or the proposed garden in square feet?

______________________________

9. Using the formulae given in the image below, calculate the Drainage Area from which water flows into the garden in the following scenario:

A building is 40 feet wide by 40 feet long. The building has 5 downspouts total, but not all of them will drain to the rain garden (see the placement on the picture below). Assuming the garden is 6 inches deep and it is designed to collect one inch of water, is the garden that you drew in question #1 large enough?
Dry Soil Test:

1. Pick up a sample of dry soil. Rub it around between your fingers. Check the words that describe the soil:
   
   Gritty__________ Smooth__________ Other words:

   Sticky__________ Chalky__________ ________________

   Rough__________ Lumpy__________ ________________

2. Dry Soil Test Results: ____________ Minutes _____________ Seconds

3. After the test, pick up a handful of the damp soil. Check which applies:

   ______ Wet (water dripped when soil is squeezed)
   ______ Damp (soil held its shape when squeezed)
   ______ Dry (soil will not hold shape when squeezed)

Wet Soil Test:

1. Pick up a sample of wet soil. Rub it around between your fingers. Check the words that describe the soil:

   Gritty__________ Smooth__________ Other words:

   Sticky__________ Chalky__________ ________________

   Rough__________ Lumpy__________ ________________

2. Wet Soil Test Results: ____________ Minutes _____________ Seconds

3. After the test, pick up a handful of the wet soil. Check which applies:

   ______ Wet (water dripped when soil is squeezed)
   ______ Damp (soil held its shape when squeezed)
   ______ Dry (soil will not hold shape when squeezed)
Observations:
1. Outside the classroom: Write a couple of sentences describing the area around where the soil test was performed. Was it in the shade or sun? Were there lots of sticks, litter, or rocks? Did the soil have an unusual smell or color?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

2. Inside or outside the classroom: Consider your soil test time results. What conclusions can you draw from results about whether the soil tested is suitable for a rain garden?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

3. If placed in a rain garden, how do you think the soil tested affects the plants, structure, and overall performance of the rain garden? On what do you base your opinion?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
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___________________________________________________________________________