Green LEAF & Lessons, Activities Opportunities

Designing a Rain Garden

Erin Conley
Moriarty Environmental Sciences Magnet School in Norwich, CT
and the CT Green LEAF team

Overview: Rain gardens can help filter our water supply and improve our environment. Students will investigate the effects of water runoff on schoolyard surfaces, and understand the importance of water conservation. This activity integrates into ELA, Math, and Science standards.

Target Grade: 4 **Strong Connections: MS and HS**

NGSS Standard(s)	CT Social Studies Standards
4-ESS2-1 Effects of weathering **4-ESS3-2** Human Impact on Earth	**ECO 4.2** Incentives influence on decisions
Common Core Math Standard(s)	**Common Core ELA Standard(s)**
4.OA.A.2 Whole number operations **4.MD.A.1** Measurements **4.G.A.1** Angles and Lines	**W.4.1** Opinion Pieces **W.4.2.A.** Introduce Information **L.6.** Acquire Topic Language

The standards presented here are suggestions only; you may identify others! Please refer to your grade level at Next Generation Science Standards (http://www.nextgenscience.org/search-standards) and Common Core State Standards (http://www.corestandards.org/).

This lesson has been designed to scaffold student learning using the following to connect students' understanding of science:

Scientific and Engineering practices of NGSS	NGSS Crosscutting Concepts
Asking questions and defining problems	Patterns
Constructing Explanations	Cause and effect
Designing solutions	Scale, Proportions and Quantity
Using mathematics and computational thinking	Stability and Change
Obtaining, evaluating and communicating information	Structure and Function

Standards-Based Curricular Connection: Rain Gardens can support your curricular goals in many ways including, but not limited to, the example below.

Earth Systems Connection

- **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation.
    - Students can observe the angles of slope for the downhill movement of water. Students can make observations around the school to note where there are increased amounts of water retention or erosion due to slopes. They can determine if those areas would be suitable for a rain garden.
    - Students can observe effects on vegetation due to weathering related to increased water flow and erosion on slopes.
- **4-ESS3-2.** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
    - Students can learn about water runoff and various ways to reduce it such as community stormwater systems, pervious vs. impervious surfaces, and green roofs. One locally-applied solution could be designing and creating a rain garden to help with polluted water runoff. Students can observe an area around their school in which they notice polluted water runoff. They can then design and create a rain garden mitigation plan.
        - Students can work in small groups to scout out and create proposals for the location of the rain garden.
            - Students should look in areas such as near downspouts, parking lots, slopes, or away from high traffic areas like the playground.
            - Students can then share their proposals and compare plans to select the best location.
    - Students can use the rain garden they develop to observe and collect data on the plants in the garden and the natural Earth processes that affect the plants and structure of the rain garden.

Mathematics Connection

- **4.OA.A.2.** Multiply or divide to solve word problems involving multiplicative comparison.
    - Students can use multiplication and division to determine slope. Students compare different slopes to predict the best location and depth for the rain garden. For more information on determining slope visit http://learningstore.uwex.edu/assets/pdfs/GWQ037.pdf (page 7).
- **4.MD.A.1.** Measurement and data in real-world problems.
    - Students will measure size and depth to determine how large and how deep rain garden should be. Students can record the measurements and note the unit equivalents and make conversions in a table; eg. 12 inches is the same as 1 foot.

- **4.G.A.1.** Draw points, lines, line segments, rays, angles (right acute, obtuse) and perpendicular and parallel lines.
    - Students can check angles when measuring slope. Students can determine types of angles: right, acute or obtuse and make connections with the shape of the slope.
    - Students might make paper models to visualize the different slopes that they have measured.

Other Potential Connections: The following list provides a general overview of other possible uses for **Designing a Rain Garden.** Check you NGSS and CCSS standards documents to explore how these suggestions may assist in achieving your curricular goals.

ELA- Students can write a persuasive letter to a local company to ask for funding for materials needed to build the rain garden with clear reasoning and explanation to why it is important (CCSS ELA W.4.1). Students can gain and use new vocabulary such as berm, stormwater, pervious and impervious surfaces, and runoff (CCSS ELA L4.6.) Students can write and install signage that tells the story of the Rain Garden (CCSS ELA W.4.2.A.)
Social Studies- Students could explore the positive and negative incentives that could be used to form a decision on creating a rain garden. Students could then use this when writing their persuasive letters. (ECO 4.2)
Engagement and Community Involvement- Students can present their rain garden project in a grand opening to which they could invite local town officials, the entire school community, Board of Education members and any local businesses who contributed (SL4.4). Students might enlist the help of local gardeners and landscape designers in their project.

Suggested Implementation

Prior Knowledge & Activities (If applicable)

- Students can measure using standard US Customary Units.
- Students will have an understanding of the water cycle.
- Students will have an understanding of Rain Gardens and how they work.
    - Suggested reading: (use a word wall to aide with new vocabulary presented in the text.) http://nemo.uconn.edu/raingardens/pdf/rain_garden_design_guide.pdf
    - **Check with your school librarian** for age-appropriate books about rain gardens, landscaping, native plants and more on this topic!

Materials needed

- Journals, pencils and clipboards
- "Evidence of" worksheet- the worksheet can be used during the investigation for a location for the rain garden. Students should be given examples of water pollution, runoff, weathering and stormwater systems that they should be looking for. Examples would include motor oil, sediment; paved areas like parking lots, streets, driveways; roof drain spouts, and street drainage systems.
- Garden building materials such as planting tools, indoor area to start seeds, seeds or plants from local nursery.

Activity Suggestions

- Students will review relevant prior lessons and knowledge.
- Students will pick a site for the rain garden using the following guidelines. Below is an example of the "Evidence Of…" worksheet that can be used for picking a site.

Evidence of….

Directions: Find evidence of water pollution, water runoff, erosion, or stormwater systems. Note areas that you think would be a good spot for our class rain garden.

What evidence did you find?	**Where did you find this? (Be specific)**	**Is this a good location for a rain garden? Why or why not?**
Example: Car oil running off from the parking lot	**In the parking lot by the dumpsters**	**Yes because there is an open grassy space behind the dumpsters.**

- Rain Garden Placement Considerations
  - **Avoid poorly drained soils** as this may result in long term ponding.
  - **Stay 10 feet away** from the school's foundation
  - **Septic systems and drinking water wells** are sensitive areas. Avoid installing rain gardens over or near them.
  - **Flat or slightly sloped areas (<15% slope) are ideal for rain gardens**. Steep slopes will make it difficult for construction.

- Soil
    - **Good infiltration is recommended.** Determine if the area has good drainage. Use the soil drainage map at: http://nemo.uconn.edu/raingardens/soilsmap.htm
    - **Conduct a quick infiltration test.** Visit the UCONN site and scroll to "Checking the Soils" section: http://nemo.uconn.edu/raingardens/sizing.htm
- Size
    - **Small rain gardens (100-300 square feet) work great!** To determine the best size of rain garden for your site visit "size map": http://nemo.uconn.edu/raingardens/sizemap.htm
- Aesthetics and function
    - **Questions** educators can ask to help students decide on the aesthetics and function of the rain garden such as:
        - What plants will be planted?
        - What is the best arrangement of the plants?
        - Does it matter which plants are planted where?
        - What will the finished garden look like?
        - How can we manage weeds?
        - How will the rain garden be maintained throughout the school year and summer?
    - Students can use http://nemo.uconn.edu/raingardens/plants.php as a resource for picking plants that do well in Connecticut rain gardens. **Reminder: It is important to pick native plants!**

Additional Connections: Grades and Topics

This investigation was written on a 4th grade level. You could also apply this investigation in other grades, to support your curricular goals. The Disciplinary Core Ideas "ESS2" and ESS3" appear in other grades, allowing similar investigations to be conducted either above, or below, the 4th grade level that is described above. You may also use this concept to connect your lesson with other grade specific standards. Some additional examples to consider are presented here:

5th Grade Connections

- **5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**
    - Students could investigate how different communities have used rain gardens and determine the impact those rain gardens have had. Students

could create their own rain garden and discuss the impact on local oceans and streams.

Middle School Connection

- **MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**
    - Students could design a rain garden and test methods for monitoring how effective it is, noting evidence of pollution and runoff on school grounds over time.

High School Connection

- **HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.**
    - Students could investigate the impacts of nitrogen and phosphorous on bodies of water. They can study how stormwater systems play a role in the distribution of water and how they have an impact on Earth. They can then study how rain gardens could be one solution to the impact of these nutrients.
- **HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.**
    - Students could investigate rain garden designs, model and refine suggested designs to create the best possible method of creating a rain garden. They could answer questions such as: What are the best plants? What soil types work best for rain gardens? What dimensions are best for effective rain gardens?

Additional Rain Garden resources:

UConn Rain garden Website and design guide

http://nemo.uconn.edu/raingardens/index.htm

http://nemo.uconn.edu/raingardens/pdf/rain_garden_design_guide.pdf

University of Rhode Island Rain Garden Manual

http://cels.uri.edu/rinemo/publications/SW.RGEdManual.pdf

Interested in a technology aspect? Use the link below to download this free App about Rain Garden design! http://nemo.uconn.edu/tools/app/raingarden.htm

These suggestions are examples only, and may require adaptation. Check your grade-specific standards to determine whether or not the suggestions provided meet your individual curricular needs.

This practice was seen in action at: Moriarty Environmental Sciences Magnet School 2015.

For more information, contact ctgreenleaf@ctgreenschools.org

This document was developed as a collaborative effort of many teachers, through their participation in the Connecticut Green LEAF Professional Learning Communities Project. Funding was provided through a US Department of Education Teacher Quality Partnership (TQP) grant.