SIEMENS STEM DAY | Science Technology Engineering Math

SIEMENS STEM DAY ACTIVITY

# RUN OFF SOLUTIONS

## OBJECTIVES

Students will be able to:

- Apply the processes of absorption and evaporation as they design a rain garden
- Create a model of their low impact development design using a diagram software program

## STEM LESSON FOCUS

**Engineering Design Cycle**

- Creating or Prototyping

**21st Century Skills**

- Critical Thinking

## STEM CATEGORY

Engineering

## CAREER PATH

Manufacturing

## TOPIC

Develop Solutions

## OVERVIEW

Students will learn about the concept of low impact development: practices that use or copy natural processes such as absorption or evaporation to protect water quality. Students will be tasked with creating a rain garden designed to absorb rainfall so it doesn't run off and pollute nearby waterways. In order to do this, students will conduct research on effective gardening techniques. They will then design a virtual rain garden that protects the environment!

## MATERIALS

- Computer or tablet, with the ability to project
- Laptop or tablet, one per every two students
- Scrap paper

## HAVE YOU EVER WONDERED...

**Where water goes when it rains?**

If planting a garden could do more than just beautify an area?

## MAKE CONNECTIONS!

**How does this connect to students?**

While we may not think of it often, storm water has the potential to have a huge effect on our lives! When you drive, walk your dog, go for a jog, or mow the lawn, you are covering the ground with traces of materials—some may be harmful; others not. Eventually, these particles are relocated by storm water and washed into a watershed. These watersheds are used by plants, animals and maybe even humans…so just think about the possible effects that pollutants may have!

**How does this connect to careers?**

**Water Conservationists** are scientists who work on issues related to fresh water, including improving water quality, preventing groundwater contamination, and conserving water.

**Environmental Engineers** work to develop solutions to environmental problems. Using their knowledge of science and the environment, they help others manage pollution and protect the Earth from waste byproducts.

**Landscape Architects** plan and design outdoor areas in parks, homes, campuses and other spaces. Some architecture firms even specialize in rain gardens and integrate them into their overall design.

**How does this connect to our world?**

Though it may seem like water is limitless, in reality only about 3% of Earth's water is fresh water.[1] When storm water runs through areas, it can pick up pollution like fertilizers, trash, animal manure and pesticides.

Eventually this water flows into streams, rivers and lakes. As you can imagine, this pollution has the ability to cause a variety of negative effects such as damage to fish habitats, drinking water contamination, swimming area contamination, and more. It is therefore important, all over the world, to be aware of the effects of storm water runoff and to take steps to protect the environment.

**Sources**

[1]"How Much Water is There In, On, and Above the Earth? U.S. Department of the Interior. https://water.usgs.gov/edu/earthhowmuch.html

## BLUEPRINT FOR DISCOVERY

1. Begin class with a question on the board: Where does storm water go after it rains? Instruct student to brainstorm with a partner, recording their answers in words or sketches on a piece of scrap paper.
2. Encourage students to share their ideas. Explain that while some rain water does soak into the ground, as students are likely to suggest, water that hits impervious surfaces (surfaces that don't allow liquid to soak through like roads, sidewalks, patios, etc.) becomes run-off. In other words, water that hits impervious surfaces travels…and travels…and travels.
3. Instruct student pairs to imagine a situation like this where storm water hits an impervious surface and

continues to run, rather than being absorbed into the ground. Ask them to sketch what this would look like. What would happen to the water? What would it take to stop the water from running?

4. Show this video from the Environmental Protection Agency, instructing students to listen especially carefully to the consequences of runoff storm water, as well as potential solutions to the problem.
5. Introduce the term low impact development: human development that uses or copies natural processes such as absorption or evaporation to protect water quality.

   Ask:

   - Which of the solutions in the video could be connected to low impact development?
     - Lead students to: vegetate bare ground and plant grass.
   - How are these connected to low impact development?
     - Lead students to: A plant-covered ground is able to absorb much more water than a hard, bare surface because it is softer and more porous. This protects water quality because it is able to absorb the storm water, which prevents it from becoming runoff and carrying pollutants into our waterways.
6. Introduce students to the concept of rain gardens and tell them that today they will be in charge of designing a rain garden that protects their local waterways. *Explain that a rain garden is a type of low impact development. Rain gardens can be big or small, but they are all placed downhill from drainage areas and are designed in a way so that they are able to capture storm water. Some of the rain water will be absorbed into the garden's soil and used by the plants, and some of the rain water will eventually evaporate. No matter what, the rain garden stops it from continuing to run downslope.
   *(Note: Designating a specific area in your community where the rain garden could exist will help your students further connect to this assignment!)
7. Separate students into pairs and give them a few minutes to brainstorm how a rain garden could be designed so that it allows for as much absorption and evaporation as possible. Students can explore https://www.epa.gov/soakuptherain/soak-rain-rain-gardens for ideas on rain garden design.
8. Introduce students to Smartdraw.com where they can set up a trial account.
9. Once students have created an account, have them click on "Blank Residential Landscape." From there, they can use the left toolbar to add landscape features, landscape greenery, and more.
10. Instruct them to work with their partner for the rest of the class period to create a model rain garden. The only two criteria for their digital design are that it must include:

    1. Labels where evaporation will occur.
    2. Labels where absorption will occur.
11. When students are complete, they may save their design to their device or print it.
12. If time allows, encourage students to pair with another group to share their gardens, explain the rationale behind their designs, and ask each other questions.

Students can spend additional time researching specific plants, shrubs, and other greenery that would flourish in their community's climate, as well as plants that would thrive in damp or wet soil. The National Wildlife Federation's Native Plant Finder website or the EPA's What to Plant Guide are good places to start. They can then redesign their gardens to incorporate these specific plants!

Once students have researched plants that would thrive in their rain garden, brainstorm an area in your community that could benefit from this garden. Do your best to garner support from your community (gather plant donations and garden tool loans, for example) and then work together with these community stakeholders to make this garden a reality.

## NATIONAL STANDARDS

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| Science | Next Generation Science Standards<br>HS-ETS1-2. Design a solution to a complex real- world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| Technology Education | **Standards for Technological Literacy** Design Standard 8: Students will develop an understanding of the attributes of design.<br><br>Abilities for a Technological World Standard 12: Students will develop the abilities to use and maintain technological products and systems. |