

Lesson 6: Outdoor Research to Investigate Patterns of Stormwater Runoff

Overview

If your class has chosen to focus on the GLRI focus area of reducing nutrient runoff, this lesson would be a good option for getting outdoors and making observations to gather data about your study site. Students will explore the concepts of nonpoint source pollution and stormwater runoff as they note the features of their study site on a map.

Curriculum Connections

Michigan K-12 Science Standards

- Earth's Systems
 - 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
 - MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- Earth and Human Activity
 - MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
 - MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Michigan K-12 Social Studies Standards

- 6 - G5 .1 .1 Describe examples of how humans have impacted and are continuing to impact the environment in different places as a consequence of population size, level of consumption, and technology.
- 6 - G5 .1 .3 Identify ways in which human-induced changes in the physical environment in one place can cause changes in other places.

Great Lakes Literacy Principle(s)

#6 - *The Great Lakes and humans in their watersheds are inextricably interconnected.*

Focus Areas of GLRI Action Plan

- Reducing nutrient runoff that contributes to harmful/nuisance algal blooms

Key Questions

- How is stormwater moving on our school grounds?
- What might be the implications of nonpoint source pollution for our watershed?

Student Objectives

- A student will be able to describe the problem of stormwater runoff and how nonpoint source pollutants can be harmful to the watershed as a whole.
- Students will analyze patterns of stormwater flow on their study site and note their observations on a map, following a legend.

Vocabulary

Algae Bloom
Eutrophication
Nonpoint Source Pollution
Nutrient Runoff
Runoff

Sedimentation
Stormwater Runoff

Materials List and Setup

- Video Fifteen to the River: Explaining Stormwater Runoff by West Michigan Environmental Action Council <https://www.youtube.com/watch?v=GrBEEjijxaY>
- Investigating Patterns of Stormwater Runoff worksheet (1 per person)
- Clipboards (1 per person)
- Whiteboard and dry erase markers
- Document Camera/projector
- Student-created maps of study site or printouts of satellite Google maps image of site/copies of a map of the site (one per pair) of students

Notes:

- Before doing this lesson, it's recommended that you spend some time developing expectations for outside learning with your students.
- This lesson will be best if your students have some background knowledge of runoff and nonpoint source pollution. The stormwater runoff video does a good job of briefly explaining this concept in the context of Grand Rapids. Other informational videos and websites can be found in the References section of this lesson.
- It would be a good pairing to do this lesson after you have done a general assessment of your study site and even had students create maps of the study site. Student-created maps would work best for this lesson as they would be easiest for students to annotate with the pollutant and stormwater infrastructure legends on their worksheet.

Program Activities

1. Engage:
 - a. Materials
 - i. Video *Fifteen to the River: Explaining Stormwater Runoff* by West Michigan Environmental Action Council <https://www.youtube.com/watch?v=GrBEEjijxaY>
 - ii. Investigating Patterns of Stormwater Runoff worksheet (1 per person)
 - iii. Whiteboard and dry erase markers
 - b. Procedure
 - i. Start by showing the 2-minute video about stormwater runoff. Tell students to pay specific attention to the types of pollutants that are commonly carried by stormwater. Make sure to emphasize that in Grand Rapids, it takes only 15 to 30 minutes for stormwater to reach the Grand River.
 - ii. Distribute the Investigating Patterns of Stormwater Runoff worksheet to each student. Explain that today we will look at the study site and make observations on a map of how stormwater is moving through the site and what potential pollutants it may pick up on its journey through the watershed. If necessary, explain which stream or body of water stormwater enters before it makes its way to the Grand River.
 - iii. Explain the Study Site Legend of Surface Features to students; give them time to look at each icon and allow them to ask for clarification if they are unsure what they mean. Let them know they will be locating these items on their site assessment map.
 1. *Note: These icons represent predominantly urban infrastructure features. Use the space in the worksheet below the legend to*

brainstorm what other icons need to be added, such as agricultural fields.

- iv. Then, create a class list of pollution sources that could be on our school grounds. Work together as a group to come up with icons for these sources; the instructor can note the icons on a whiteboard. Students will record notes on the blank space on the front side of their worksheet labeled Pollution Sources Legend.
 - 1. Examples of pollutants: oil, excess sediment/soil, animal waste, trash, fertilizer, pesticides, salt.

2. Explore

a. Materials

- i. Investigating Patterns of Stormwater Runoff worksheet (1 per person)
- ii. Clipboards (1 per person)
- iii. Student-created maps of study site or printouts of satellite Google maps image of site/Copies of a map of the site (one per pair) of students

b. Procedure

- i. Explain that students will use the legend they just made, as well as the urban infrastructure legend that was given to them, to analyze how stormwater runoff travels on their section of the school grounds.
- ii. Go over the directions on the worksheet with students.
- iii. Give students a guideline of how long they will have outside and where to meet at the end of that time.
- iv. Let students know that each group will present their map and explain it to the class when we come back in, being prepared to answer any questions.

3. Explain

a. Materials

- i. Document Camera/projector

b. Procedure

- i. Students will select one map from their group to present.
- ii. Call student groups up to present under the document camera, and challenge each group with a question to answer about what they observed about patterns of stormwater runoff or clarifications of features of their maps.

4. Extend/Elaborate

a. Materials

- i. Investigating Patterns of Stormwater Runoff worksheet

b. Procedure

- i. Student will complete the “Digging Deeper” questions on the back of the worksheet.
- ii. Collect the worksheets as their exit ticket and review their responses to the digging deeper section to gauge their attainment of the learning objectives.
- iii. Many of the websites and videos linked below can provide further information on the consequences of nonpoint source pollution entering waterways through stormwater runoff, such as nutrient loading and algal blooms.

References

Lesson adapted from:

Nature Works Everywhere. (2016). *Urban Runoff: Design a School Stormwater Management Plan.*

Retrieved from <https://www.natureworkseverywhere.org/resources/urban-runoff/>
Groundswell Michigan. (2017, Jan 26). *Communities for Clean Water: Managing Excess Nutrients* [Video File]. Retrieved from https://www.youtube.com/watch?time_continue=1&v=Q9iwqF4_-4Y

Groundswell Michigan. (2017, Jan 26). *Communities for Clean Water: Managing Excess Sediment* [Video File]. Retrieved from <https://www.youtube.com/watch?v=HQ6NTWxSmb4>

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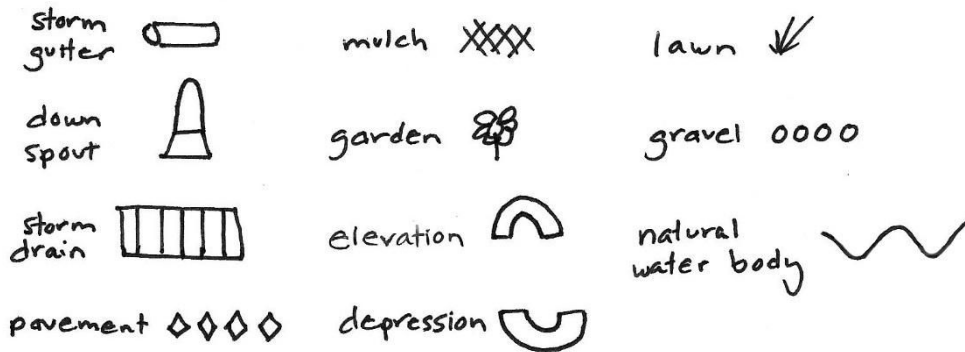
Groundswell Michigan. (2017, Jan 26). *Communities for Clean Water: Watersheds and NonPoint Source Pollution* [Video File]. Retrieved from <https://www.youtube.com/watch?v=j6AeuKl4Fwg>

USGS. *Nitrogen and Water*. Retrieved from https://www.usgs.gov/special-topic/water-science-school/science/nitrogen-and-water?qt-science_center_objects=0#qt-science_center_objects

USGS. *Runoff: Surface and Overland Water Runoff*. Retrieved from https://www.usgs.gov/special-topic/water-science-school/science/runoff-surface-and-overland-water-runoff?qt-science_center_objects=0#qt-science_center_objects

Investigating Patterns of Stormwater Runoff

Study Site Legend of Surface Features:



(Legend from Nature Works Everywhere. (2016). *Urban Runoff: Design a School Stormwater Management Plan*. Retrieved from <https://www.natureworkseverywhere.org/resources/urban-runoff/>)

Pollution Sources Legend:

1. Mark the high points on the site with the elevation icon from the legend.
2. Where are the low points where water would collect on your site? Indicate where they are located using the depression icon from the legend.
3. Use arrows, like the one below, to mark the paths rainwater would travel on your site.



4. Identify any storm drains on your site. Indicate where they are located using the storm drain symbol from the legend.
5. Identify any sources of nonpoint source pollution you find on your site. Indicate where they are located using the appropriate symbols from the legend.
6. Label the surface types on your site using symbols from the legend (e.g. lawn, gravel, pavement, dirt, mulch).
7. Mark any other special features of your site: storm gutters, bodies of water, etc.

Digging Deeper

1. Look again at the stormwater map you have created of your site. Circle the location where you think stormwater runoff is the most polluted. **Explain why you chose this area.**
2. Describe where these pollutants will travel beyond your site and the impact of how they may cause damage.
3. What do you think could be done to decrease stormwater runoff on your study site?