

Engineering GSI Lesson

GREEN STORMWATER INFRASTRUCTURE



LESSON 1

JIGSAW - Why is Stormwater a Problem and What Can We Do to Solve It?

Problem Statement: How can I apply the practices of engineering design to recommend the best green stormwater infrastructure (GSI) applications for a high priority site in my neighborhood? Use these handy sub-questions in [Breaking Down the Problem Statement](#).

Subject: Human Geography, Science, Engineering, Math, Civics, Common Core

Grade Level: Middle School or High School

BACKGROUND

Actually, stormwater is **not a problem for Nature**. Our Pacific Northwest forests thrive because of how they have evolved and adapted to the amount of rain we get.

The “**natural**” **engineering design** of leaves, needles, twigs, limbs and tree bark intercepts the rain, slows it down, and takes it in. Sometimes the rain, absorbed by leaves and needles, never even reaches the ground. Centuries of fallen and slowly decaying organic material builds a spongy forest floor with an incredibly intricate soil food web teaming with microbial life, nutrients, and water. The forest floor can absorb a lot of water.

Percolating through layers of humus, soil, sand, clay, and gravel, stormwater becomes groundwater. As it infiltrates, the water is filtered and cleaned. Tree roots stabilize the soil preventing erosion while pulling water back up into the biomass of the trunk, limbs, and leaves. The leaves use water molecules in their chemical equation for photosynthesis.

Nature has engineered what we might call “**green infrastructure**” to take full advantage of whatever amount of precipitation falls on its land area.

In our cities we have developed a lot of “**gray infrastructure**” made from cement, steel, aluminum, and asphalt, to capture and remove stormwater so that our roads and parking lots are not flooded. We have pavement, sidewalks, curbs, gutters, storm drains and underground pipes to redirect the stormwater that falls on our **impervious** surfaces somewhere else. Sometimes this goes straight into the nearest stream or lake carrying pollution along with it.

ACTIVITY 1

Analyzing Infographics

See if you can develop a well-rounded answer to the question “***Why is stormwater a problem?***” by analyzing how different graphic artists have designed the infographics shared below to help people understand the problem and take action.

Here are some suggested prompts...

- What grabs your **attention** first on this infographic? Why? How would you describe the design layout or “visual hierarchy” of this graphic?
- What do you infer about the purpose of this infographic?
- How would you describe the **color scheme** for this infographic? Does it help unify, group, or compare main ideas?
- How are **shapes** used to help organize and feature critical information? Does the size, color, and placement of shapes guide your eye around the infographic?
- How does the size, font, and placement of **text** support the main ideas without being “too much reading?”
- How is **data** displayed? How does the color, size, and placement of numbers help you understand what's quantifiable and measurable?
- Are **icons** used to help symbolize key concepts? What about photos?
- Okay, so what is the point of this infographic? And who is the intended audience? What's the format? Is it a fact sheet, poster, flier, social media post, webpage, report?

Which infographics do you think are the most successful?

Defend your answer and then pair and share to practice your full response to the question, “Why is stormwater a problem and what can we do to solve it?”

1. [INFOGRAPHIC - Orcas Love Rain Gardens](#)
2. [INFOGRAPHIC - Bioaccumulation of Toxins in Puget Sound](#)
3. [INFOGRAPHIC - Runoff Before and After Urban Development](#)
4. [INFOGRAPHIC - Landcover - Forested vs Urban Development](#)
5. [INFOGRAPHIC - Preventing Pollution, Protecting our Waters \(11x17\)](#)
6. [INFOGRAPHIC - Stormwater Pollution, the Big Picture](#)

7. [INFOGRAPHIC - CSO - Sewage and Stormwater Treatment](#)
8. [INFOGRAPHIC POSTER - Stormwater Runoff, Toxic Threat to Puget Sound](#)
9. [INFOGRAPHIC POSTER - Solving Stormwater, The Nature Conservancy](#)

ACTIVITY 2

Analyzing Videos

View and analyze these different videos to **unpack the basic storyboard** that you think was used to produce the story. Explore this fun collection of [Video Notetaking Graphic Organizers](#).

- What are the main ideas and how are they sequenced?
- How does the storyteller hook you at the beginning, take you on a learning journey, and then leave you with a strong message at the end?
- What shot angles, editing tricks, and use of graphics were integrated to keep you engaged as well as make the scientific concepts clear?
- How do these videos deepen your understanding of the question, **“Why is stormwater a problem and what can we do to solve it?”**

VIDEO: Stormwater 101 (Youth-Voiced) [Watch VIDEO](#) [11:36] This is a recorded slideshow voiced by 10th grader Anshika Rath with great images and clear descriptions of why stormwater is a problem in our bioregion.

VIDEO: Isolating Chemicals in Stormwater (Youth-Voiced) [Watch Video](#) [6:56]. Learn how polluted stormwater runoff from roadways carries many chemicals that are harmful to our local aquatic ecosystem. Scientists have been able to isolate some of these chemicals and analyze how they affect the health of salmon. These chemicals are known as PAH's or polycyclic aromatic hydrocarbons. Helpful [Viewing Guide](#).

VIDEO: Copper Brake Pad Pollution (Youth-Voiced) [Watch Video](#) [5:25]. Detailed breakdown of how car brakes work, why copper flakes are used in brake pads, and how copper dust on roadways runs off into local streams and is extremely toxic to salmon. Helpful [Viewing Guide](#).

VIDEO: Toxic Tire Dust (Youth-Voiced) [Watch Video](#) [6:28]. Introduction to 6PPD, a chemical in car tires that keeps tires protected from the heat and friction from driving. But, 6PPD creates a byproduct called, 6PPD-Quinone, which is toxic to many aquatic creatures, including salmon. Helpful [Viewing Guide](#).

VIDEO: 6-PPD Quinone and Salmon (Youth-Voiced) [Watch Video](#) [8:20]. A detailed story of the scientific method being applied to isolate 6-PPD Quinone as a deadly toxin for salmon. Helpful [Viewing Guide](#).

VIDEO: Drained - Urban Stormwater Pollution [Watch VIDEO](#) [8:30] EarthFix Producer Katie Campbell teams up with local underwater filmmaker Laura James to swim up close to a stormwater outfall spewing sludge from our streets and parking lots into Puget Sound.

VIDEO: Why are Salmon Dying Before They Can Spawn? [Watch VIDEO](#) [7:41] When it comes time to spawn, salmon swim upstream back to where it all began to lay their eggs and die. Many salmon are dying before they can complete this spawning phase of their lifecycle. Kathryn Davis, Stewardship Manager for Puget Soundkeeper walks us through how human development and infrastructure is driving salmon pre-spawn mortality.

VIDEO: Toxics in Stormwater Pollution [Watch VIDEO](#) [11:00] Jenifer McIntyre, Research Scientist with the WSU Stormwater Center, describes the current science on the toxic chemicals entering Puget Sound from polluted storm water runoff with a focus on how it impacts salmon. Current research on rain garden soil filtration points to solutions for reducing these toxics, leaving cleaner water with less impact on fish.

VIDEO: Stormwater Impact on Pacific Herring [Watch VIDEO](#) [9:50] Louisa Harding, Research Scientist with WSU describes the impacts of stormwater runoff on developing herring from Puget Sound. Due to the presence of petroleum hydrocarbons in stormwater, she compares her results to experiments with crude oil exposure conducted by collaborators from the Northwest Fisheries Science Center (NOAA) following the Exxon Valdez oil spill.

VIDEO: Green Solutions to Stormwater Runoff [Watch VIDEO](#) [4:07] Easy to follow video that provides a clear overview of the problem with polluted stormwater runoff and then showcases a number of local solutions.

ACTIVITY 3

Analyzing Maps

View and analyze these different maps to see how they depict the geographical aspects of the stormwater problem.

- What is the scale of each map?
- Why was the map created?
- Who manages the data for the map?
- Does the map legend help you to understand the story of the data on the map?
- Who are the stakeholders who might be interested in the story this map is telling?
- How do these maps deepen your understanding of the question, “**Why is stormwater a problem and what can we do to solve it?**”

MAP: City Maps of Stormwater Pipes

It's pretty fascinating to get a hold of a map that your city maintains to see the actual system of stormwater pipes in the ground and where they flow, sometimes into detention ponds, something right into a stream, river or lake. Check out a few of these examples to practice reading the icons and flow direction, and then ask your city for a digital copy to use in your classroom. You may be able to find it on your own just by searching for "surface water drainage map", or "stormwater infrastructure map." When you do access this important map, zoom in on your school or home neighborhood to see what you can learn.

- [Seattle Drainage Map](#) (interactive webpage)
- [Kent Drainage Map](#) (high res document)
- [Sammamish Drainage Map](#) (interactive webpage)
- [Bellevue Drainage Map](#)

MAP: Combined Sewer Overflow Status [See the CSO Map](#)

This map is active! Check the map at this link to see if a combined sewer overflow, or CSO, is occurring before going swimming, wading, fishing, or boating near a CSO warning sign. These overflows take place within the City of Seattle.

MAP: Puget Sound Stormwater Heat Map [Intro Video](#) [2:20] | [Website](#)

The stormwater community welcomes a new mapping tool, the Puget Sound Stormwater Heatmap, which can help users identify hotspots where stormwater pollution is generated. This will help stormwater managers decide where pollution interventions should be made to address the most contaminated parts of our landscape.

MAP: My Watershed Address [Go to Website](#)

Sustainability Ambassadors has developed a cool community impact mapping tool to help people understand all the various geographic conditions and impacts that shape our neighborhoods. Everyone knows their street address. But do you know your watershed address? Click on a bunch of the map layers to see what's here. And then click on the map layer called **Impervious Surface Area**. Zoom into your school or home neighborhood. What do you notice?

MAP: Washington Environmental Health Disparities Map [See the Map](#)

This is an interactive mapping tool that compares communities across our state for environmental health disparities. The map shows pollution measures such as diesel emissions and ozone, as well as proximity to hazardous waste sites. How does this map overlap with the stormwater pollution maps above?

ACTIVITY 4

Analyzing Text

Read and analyze some or all of these excellent resources and work with your team to develop your response to, “**Why is stormwater a problem and what can we do to solve it?**”

TEXT: Traditional Infrastructure Investments to Protect Our Waters: Integrates a series of excellent diagrams that help you learn about storage tanks, pipes, and wet weather treatment stations. [Visit King County Website](#)

TEXT: Natural Drainage Solutions to Protect Our Waters: Integrates a series of excellent diagrams that help you learn about green stormwater infrastructure (GSI) solutions that help our urban environment function more like a forest, capturing, filtering, and infiltrating stormwater right where it falls. [Visit King County Website](#)

TEXT: Stormwater Pollution - The Big Picture. This beautifully organized King County document mixes text and graphics to tell an excellent story. [Get Document](#)

TEXT: Why Is Green Infrastructure Important? Well-written, short, but detailed reasons for why stormwater is a problem and why green infrastructure is needed. From the Natural Resource Defence Council. [Visit Website](#)

TEXT: 700 Million Gallons: The City of Seattle has a goal to manage 700 Million Gallons of stormwater a year. This easy to read, well-designed website features a handy list of solutions. [Visit Website](#)

TEXT: The Science of Stormwater: This useful resource, excerpted from King County, discusses the following key ideas. [Get Document](#)

- What stormwater is, where it comes from, and why it is important
- How it is polluted, including details on specific pollutants and their sources
- How stormwater pollution is controlled
- What are Stormwater Facilities, and how do they work?
- What businesses need to do to protect stormwater
- What homeowners can do to protect stormwater

TEXT: Puget Sound Vital Signs: This is the dashboard where scientists share information on 23 indicators of ecosystem health. See [Toxins in Aquatic Life](#)

TEXT: Natures' Scorecard: Stormwater Problems and Impacts in Puget Sound: This easy to read webpage describes how stormwater is the biggest source of toxic pollution impacting Puget Sound. [Visit Website](#)

TEXT: Recent research from the UW and WSU: Tire-related chemicals are largely responsible for adult coho salmon deaths in urban streams: [UW News](#)

TEXT: All you need to know about Stormwater Runoff: This is an example of excellent journalism, using news to make stories to make people wake up and take action. [See Article](#). This article is part of a series called [Curbing Toxic Runoff](#) by Sightline investigative reporter, Lisa Stiffler.

TEXT: Stormwater Facts - Encyclopedia of Puget Sound: This is where scientists go to share information for decision makers, the media, and the general public. [Visit Website](#)

WHAT CAN WE DO?

1. Impact Project Template: [I Heart Storm Drains](#)
2. Impact Project Template: [Use a Commercial Carwash](#)
3. Impact Project Template: [Install a Neighborhood Doggie Bag Station](#)
4. Impact Project Template: [Don't Drip and Drive](#)
5. Impact Project Template: [Disconnect Your Downspout](#)
6. Help plant [3 Million Trees](#)
7. Switch to these strategies for [Natural Yard Care](#) (in 15 different languages!)
8. Take personal action at [Puget Sound Starts Here](#)
9. Build a Rain Garden at [12,000 Rain Gardens](#)

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Learn More about Sustainability Ambassadors
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