

TEACHER OVERVIEW

Human Systems
9th — 12th Grade

Nature Vision Student Packet

The materials contained within have been created by Nature Vision, an environmental education nonprofit organization that brings programming to schools and local greenspaces for over 70,000 PreK-12th grade students each year in King and Snohomish Counties. This work from home curriculum materials packet is designed to foster an understanding of the importance of water and its integral role in supporting life and shaping our planet. Packets can be completed either independently or with the help of an adult caregiver. Each day of the week offers materials building on previous days learning, offering a variety of activities including, art, writing, and field exploration.

These materials are provided to you by City of Auburn Utilities, City of Bothell, City of Lynnwood, and grants from King County Flood Control District, and King County Wastewater Treatment Division. Learn more by visiting:

- City of Auburn Utilities: https://www.auburnwa.gov/city_hall/public_works
- City of Bothell: <http://www.bothellwa.gov/surfacewater>
- City of Lynnwood: <https://www.lynnwoodwa.gov/Home>
- King County Flood Control District: <https://www.kingcounty.gov/services/environment/water-and-land/flooding/flood-control-zone-district.aspx>
- King County Wastewater Treatment Division: <https://www.kingcounty.gov/depts/dnrp/wtd.aspx>

Thanks to Cascade Water Alliance for providing the accompanying series of student packets: Ecosystems, Watersheds, and Humans and Water. To learn more please visit: <https://cascadewater.org/>.

This unit supports NGSS Performance Expectations across various disciplines, as well as supporting K-12 Integrated Environmental and Sustainability Standards. These are listed at the bottom of this page. Teachers will be supplied with PDF formats of materials to be emailed to families, or teachers may print and send to students to complete at home.

Students will begin with an overview of our stormwater system. Then, they will design their own solutions to stormwater problems. Students will learn about the differences in our wastewater system and how access to sanitation varies around the world. Lastly, students will learn the importance of communities working together to care for our water resources.

If you have any further questions or concerns regarding this packet, please email our Office Coordinator at info@naturevision.org.

Grades 9-12

Supports NGSS Performance Expectations: HS-ESS2-5, HS-ESS3-1, HS-ESS3-4, HS-ESS3-6, HS-ETS1-1, HS-ETS1-3.

Grades 9-12
Day 1 - Stormwater Basics
Day 2 - Engineering Stormwater Solutions
Day 3 - Green Stormwater Infrastructure
Day 4 - Wastewater Basics
Day 5 - Stewardship

Stay connected with Nature Vision! Follow us for updates @naturevision.org



PARENT/CAREGIVER OVERVIEW

Human Systems
9th — 12th Grade

Welcome to Nature Vision's student packet for home use. Nature Vision is an environmental education nonprofit organization that brings programming to schools and local greenspaces for over 70,000 PreK-12th grade students each year in King and Snohomish Counties. We are excited to be offering this version of our programming directly to students at home!

This packet is designed to be completed over the course of one week, with each day focusing on a different aspect of environmental science and stewardship. The majority of these materials can be completed independently, but we thought it would be important to provide background information for any adults who may be helping to complete or answer questions. We've included the basic learning objectives for each day along with some vocabulary.

These materials are provided to you by City of Auburn Utilities, City of Bothell, City of Lynnwood, and grants from King County Flood Control District, and King County Wastewater Treatment Division. Learn more about caring for our water by visiting:

- City of Auburn Utilities: https://www.auburnwa.gov/city_hall/public_works
- City of Bothell: <http://www.bothellwa.gov/surfacewater>
- City of Lynnwood: <https://www.lynnwoodwa.gov/Home>
- King County Flood Control District: <https://www.kingcounty.gov/services/environment/water-and-land/flooding/flood-control-zone-district.aspx>
- King County Wastewater Treatment Division: <https://www.kingcounty.gov/depts/dnrp/wtd.aspx>

Challenge yourself to post all the things you are doing with your friends and family to prevent pollution and protect our water!

- City of Auburn Utilities: Tag @auburnwa and include the hashtag #auburnwa
- City of Bothell: Tag @BothellWaUSA and include the hashtag #PugetSoundStartsHere
- City of Lynnwood: Tag @LynnwoodWA and include the hashtag #Lynnwood
- King County Flood Control District: Tag @KingCountyDNRP
- King County Wastewater Treatment Division: Tag @kingcountywtd

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NOTE: Students may require support in reading directions and/or completing some tasks.

Unless otherwise noted, images courtesy of freepik.com

PARENT/CAREGIVER OVERVIEW: DAY 1

Stormwater Basics

Background Information: Storm drains and sewers are both systems that humans have built to manage water; however, they function in very different ways. It is important to know the differences between these two systems in order to be better stewards of our waterways and earth.

Learning Objectives: Students will learn about the differences between water that goes through a storm drain system and water that goes through a sewer system. They will understand the path that water takes through the storm drain system from neighborhoods to local bodies of water. Lastly, they will understand how human behavior can impact the health of water bodies in their region.

Main Activity: Stormwater Investigation

- **Overview:** Students take a walk around their neighborhood or street to collect data and draw conclusions about the effectiveness of stormwater management in their area
- **Parent/Caregiver Tasks:** Provide supervision and accompany the student on their walk

Optional Activity: Puget Soundkeeper Strategies

- **Overview:** Students read about a local organization's strategies for keeping Puget Sound's water healthy and answer questions
- **Parent/Caregiver Tasks:** None

Optional Activity: Stormwater Stewardship Challenge

- **Overview:** Students complete a daily stewardship challenge related to pollution prevention
- **Parent/Caregiver Tasks:** If possible, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: DAY 2

Engineering Stormwater Solutions

Background Information: Our stormwater is not filtered before it is released to the nearest body of water. It is important that we design ways to keep stormwater as clean as possible so it does not impact our environment. People have designed many different solutions to the problem of polluted stormwater.

Learning Objectives: Students will analyze existing ideas for cleaning stormwater in order to design their own system.

Main Activity: Engineering Solutions

- **Overview:** Students learn about various solutions for capturing litter and other contamination, explore how they are similar and different, and design their own stormwater solution
- **Parent/Caregiver Tasks:** None

Optional Activity: Choosing a Solution for Your Community

- **Overview:** Students choose an engineered solution from the previous activity and write a letter advocating for their community solution
- **Parent/Caregiver Tasks:** None

Optional Activity: Stormwater Stewardship Challenge

- **Overview:** Students complete a daily stewardship challenge related to pollution prevention
- **Parent/Caregiver Tasks:** If possible, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: DAY 3

Green Stormwater Infrastructure

Background Information: In order to solve some of the issues we face when managing our stormwater, communities are working to mimic the role that natural pervious surfaces play in absorbing, cleaning, and slowing down stormwater. These include bioswales, green roofs, rain barrels, rain gardens, and permeable pavement. These are collectively known as Green Stormwater Infrastructure, or GSI.

Learning Objectives: Students learn the various types of GSI that are available for communities and how they help us to manage our built environment.

Main Activity: GSI Engineering

- **Overview:** Students engineer a solution to excess rainwater by learning about GSI, how it works, and the role native plants play before designing their own examples
- **Parent/Caregiver Tasks:** None

Optional Activity: GSI Video

- **Overview:** Students see some of the real world examples of GSI in place in our region today and how they compare to their own designs
- **Parent/Caregiver Tasks:** Provide permission and technical support when conducting research

Optional Activity: Stormwater Stewardship Challenge

- **Overview:** Students complete a daily stewardship challenge related to pollution prevention
- **Parent/Caregiver Tasks:** If possible, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: DAY 4

Wastewater Basics

Background Information: Along with stormwater, one of the issues facing our environment is the management of our wastewater. This is all of the water that comes from drains in our homes. Wastewater is cleaned thoroughly before being piped to the Puget Sound.

Learning Objectives: Students learn how our wastewater system works, what can be handled by that system, and what they can do to help support it. In addition, they will learn how our wastewater system differs from other communities that have different systems, or do not have access to wastewater sanitation or running water.

Main Activity: Wastewater Debate

- **Overview:** Students explore both sides of an issue and decide if they believe wastewater infrastructure is needed for the City of Victoria, B.C.
- **Parent/Caregiver Tasks:** None

Optional Activity: Sanitation, Treatment Access, and Design

- **Overview:** Students will design a solution to managing waste for communities with little access to running water
- **Parent/Caregiver Tasks:** None

Optional Activity: Stormwater Stewardship Challenge

- **Overview:** Students complete a daily stewardship challenge related to pollution prevention
- **Parent/Caregiver Tasks:** If possible, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: DAY 5

Stewardship

Background Information: Stewardship is how we care for the world around us. Sometimes this means taking direct action to solve a problem, and sometimes this means that we can help solve a problem by encouraging other people to care about the issue as well. The way that we all treat our stormwater and wastewater has a big impact on the environment and the health of people and animals.

Learning Objectives: Students will understand the importance of caring for the natural world by learning about some of the work that people have done in our region to help make our water bodies cleaner and healthier.

Main Activity: Creative Writing

- **Overview:** Students will create a piece of writing focused on stewardship to encourage others to care of the natural world
- **Parent/Caregiver Tasks:** None

Optional Activity: What's in Your Home

- **Overview:** Students explore the various cleaners and personal hygiene products in their home, researching if they contain potentially dangerous ingredients, and if there are gentler solutions that can be used
- **Parent/Caregiver Tasks:** Provide permission and technical support when conducting research

Optional Activity: Stormwater Stewardship Challenge

- **Overview:** Students complete a daily stewardship challenge related to pollution prevention
- **Parent/Caregiver Tasks:** If possible, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: VOCABULARY

DAY 1

Catch basin: A reservoir for collecting surface drainage or runoff

Pollutant: A substance that makes something (such as air or water) impure and often unsafe

Storm drain: An outside drain that carries water from neighborhoods to water bodies

Water runoff: Excess water draining away from land or buildings, like the overflow of water that drains off of your driveway

DAY 2

Impervious: Does not allow water and particles within to absorb or pass through it

Pervious: Allowing water and particles within to soak in and pass through the surface

Infiltrate: Water on the ground being absorbed by the soil

Innovative: Involving new and original methods

Drain sock: A design that goes directly on the pipe to help clean stormwater by catching trash

Water goat: A design that floats and collects trash to help clean stormwater before it goes to large bodies of water

Ultra-Storm Drain Filter: A stormwater solution installed directly into the storm drain catch basin to filter stormwater runoff

DAY 3

Bioswale: A channel filled with vegetation to both direct and absorb water

Green Stormwater Infrastructure: Solutions to stormwater issues that mimic the natural world

Native plants: Plants that have evolved to grow in a particular climate

Rain garden: A shallow, bowl-shaped garden full of native plants designed to absorb water

Rain barrels: Similar to cisterns, used for collecting water from gutters

Permeable pavement: Pavement that allows for water to pass through it

DAY 4

Biosolids: Fertilizer made from human waste

Digester: Area where biosolids are created

Engineers: People who design water systems

Membrane Filters: Filters that remove bacteria and 99% of water contamination

Microbes: Good bacteria that help to break down parts of our wastewater

Settling tank: Where the light and heavy parts of wastewater are separated

Treatment plant: Where our wastewater is cleaned before being sent back to nature

Wastewater: The water that comes from the drains in our homes

FOG: Fats, oils, and grease from cooking that can clog our pipes and drains

DAY 5

Stewardship: Caring for the world around us; being a protector

DAY 1

Stormwater Basics

Water quality affects the health of local communities, our waterways, and our environment in general. Our communities have systems in place that are designed and developed by engineers to help with water quality management. Stormwater runoff is the leading cause of water pollution in urban and suburban areas due to the high percentage of impervious surfaces such as roadways, parking lots, and rooftops. Pollution enters into the stormwater runoff when it washes over these impervious surfaces, picking up sediment, oil and grease, heavy metals, bacteria, trash, and other pollutants from the urban landscape.

Storm drains and sewers are both systems that humans have built to take care of water; however, they function in very different ways. It is important to know the differences between these two systems in order to be better stewards of our waterways and our planet.



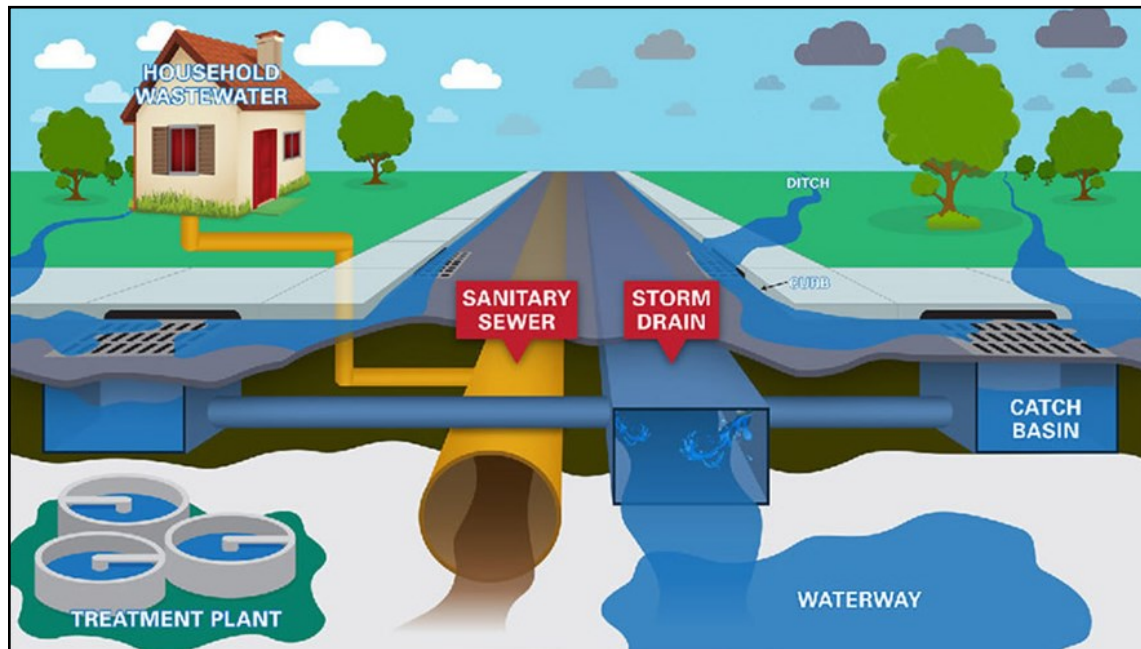
Storm Drain



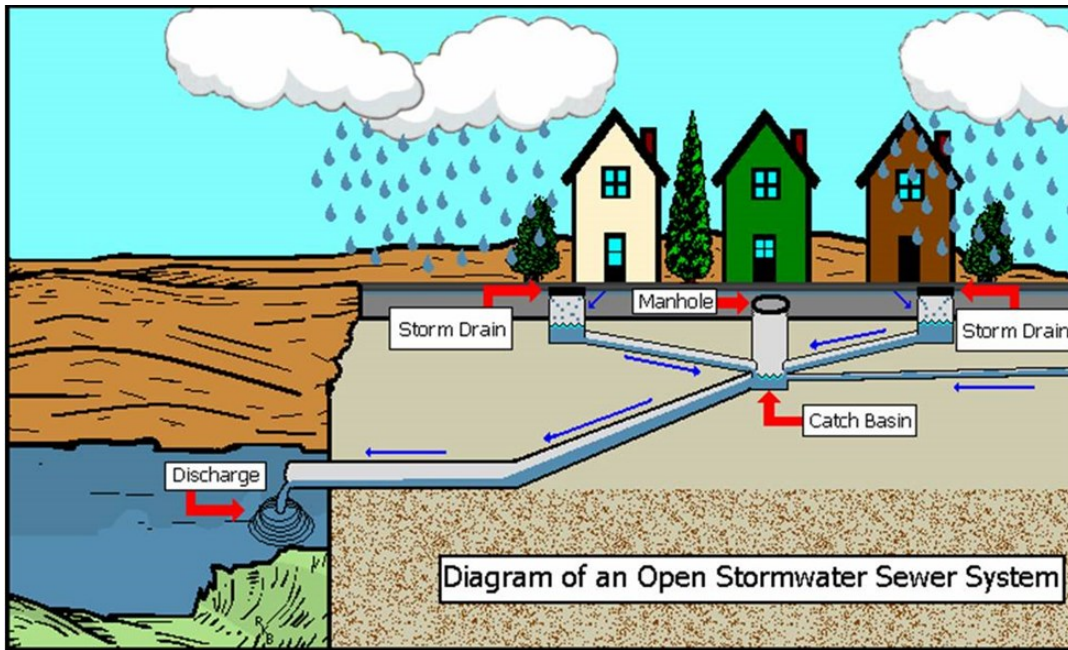
Sewer Cover

What is the difference between a storm drain system and a sewer system (also called sanitary sewers)? Both storm drains and sewer systems involve water moving through pipes, but the similarity ends there. What happens to the water in the two systems is very different.

Today we're going to focus on the storm drain system. Storm drains are part of a system designed to carry extra water off of the streets and into catch basins when it rains. When there is too much water for the soil to soak up, the water needs someplace to go. This is why engineers have installed storm drains! Unfortunately, stormwater carries runoff with pollutants from washing your car, gardening, and more, which means that pollutants can find their way into the storm drains too. This system is not designed to carry sewage or accept hazardous wastes. The runoff is carried through an underground system that ends up in nearby rivers, streams, lakes, wetlands, and ultimately the Puget Sound. It's important to note that the water in a storm drain system is untreated water, so it can carry pollutants with it to our bodies of water.



Source: <http://onetruckeeriver.org/2019/03/rain-rain-go-away-in-the-storm-drain/>



Source: <https://www.bellinghamma.org/departement-public-works/pages/stormwater-information-updated>

What can you do to help the different systems stay clean and working well?

- Let only rainwater go down storm drains
- Avoid littering
- Repair leaks in your vehicle (i.e. oil, antifreeze)
- Recycle motor oil, and properly dispose of hazardous waste
- Pick up after your pet (scoop that poop and throw it in the trash)
- Don't pour paints, cleaners, or household chemicals into any drain
- Use the commercial car wash instead of washing cars on the street or driveway
- Use compost instead of chemical fertilizers
- Never pour anything into a storm drain
- Plant rain gardens and native plants

Vocabulary

Catch basin: A reservoir for collecting surface drainage or runoff

Pollutant: A substance that makes something (such as air or water) impure and often unsafe

Storm drain: An outside drain that carries water from neighborhoods to water bodies

Water runoff: Excess water draining away from land or buildings, like the overflow of water that drains off of your driveway that drains off of your driveway

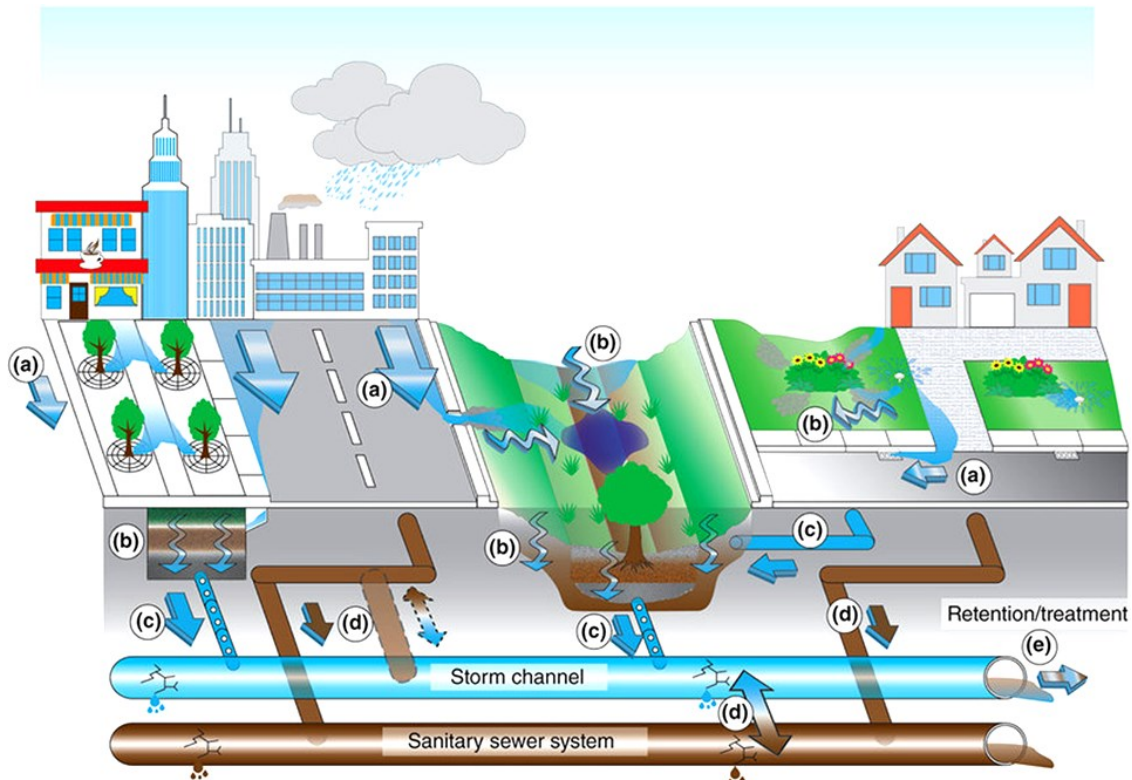
Main Activity

Stormwater Investigation

Storm drain systems serve a very important purpose in our neighborhoods. You have walked past numerous storm drains in your neighborhood probably without even noticing them. The times that we *do* take notice of the storm drain system is when something might not be working like it should. For example, when a catch basin is clogged, it might cause noticeable flooding in the surrounding area. Catch basins use a grate to filter out large debris while collecting and redirecting water. Most of this debris consists of sticks or leaves, though sometimes trash can collect inside a catch basin as well. These concrete catch basins will have an inlet and outlet pipe. When the water in the basin reaches a certain level, it will travel down the outlet pipe to a new location. Using this information, let's investigate the state of the storm drain system in your neighborhood.

Materials: Writing utensil

With an adult, take a walk around your neighborhood, or even just down your street, and collect data about stormwater management in your area. If you cannot go outside, you may look at the diagram provided. While doing so, answer the questions on the next page.



Source: Jiang, Sunny & Lim, Keah Ying & Huang, Eric (Xiao) & McCarthy, David & Hamilton, Andrew. (2015). Human and environmental health risks and benefits associated with use of urban stormwater. *Wiley Interdisciplinary Reviews: Water*. 2. 10.1002/wat2.1107.

Neighborhood Stormwater Data Worksheet

When going outside to complete this activity, ***please ask an adult to accompany you.***

Take a walk around your neighborhood or even just down your street. Using this sheet as a guide, collect data and draw conclusions about stormwater management in your area.

Name of neighborhood/city: _____

Number of storm drains/catch basins on your block: _____

Where do the catch basins appear to be located? Is there a pattern?

Have the roads, curbs, and sidewalks been designed to direct stormwater into the catch basins? How?

How effectively do the storm drains in your neighborhood seem to be working? What evidence leads you to draw this conclusion?

Number of sewer covers (also known as manhole covers) on your block? _____

Have the roads, curbs, and/or other surfaces been designed differently around the sewer covers than the catch basins? How? Why do you think that this is?

Other evidence of stormwater management that I have observed in my neighborhood (check all that apply):

- Wetland
- Water retention pond
- Rain gardens on private land (yard)
- Rain gardens on public/city land

Do you see any problems in your neighborhood that are causing stormwater to not drain properly?

If so, can you think of a solution to the problem? What would you do?

Optional Activity

Puget Soundkeeper Strategies

One organization that is working to keep Puget Sound clean and healthy is the Puget Soundkeeper Alliance. They work with scientists, businesses, and community members to monitor and care for the health of the Puget Sound. Let's see what they're up to!

Materials: Writing utensil

Below are their three main areas of focus: (1) monitoring and enforcement, (2) policy and civic engagement, and (3) education and stewardship. The text below and on the following pages covers their action strategies and the impact they have had on stormwater in the Puget Sound. Read this text, then answer the following questions in the space provided.

- How do you see each of the strategies of Puget Soundkeeper Alliance at work in their work with stormwater runoff?
- In what ways has Puget Soundkeeper Alliance impacted stormwater infrastructure development?
- What actions are Puget Soundkeeper Alliance currently working on to prevent industrial stormwater runoff?
- How is Puget Soundkeeper Alliance encouraging education and stewardship?
- Which of these areas do you think are most effective for Puget Soundkeeper Alliance to pursue? Why?

Strategies

"We accomplish our mission by actively patrolling the waters of Puget Sound, enforcing the Clean Water Act, engaging with businesses, government, agencies and community members, and pursuing strong policy and proactive solutions to the problem of toxic pollution.

Monitoring and Enforcement

Puget Soundkeeper is on the water every week, year round. We patrol Puget Sound and its tributaries looking for illegal pollution and enforce the Clean Water Act, working to bring polluters into compliance with the law and represent the rights of the community.

Policy and Civic Engagement

Soundkeeper is deeply engaged in conversations around policy changes that impact the Sound, and we strive to provide the best and most current information to our members. We tackle complex issues that need thoughtful solutions.

Education and Stewardship

Soundkeeper partners with businesses, government and individuals to stop pollution before it enters Puget Sound. We work to raise awareness and encourage responsible stewardship of the waterways we call home."

Polluted Stormwater Runoff

Polluted stormwater is the number one toxic threat to Puget Sound, and Soundkeeper works to create policy, enforce pollution permits, and educate citizens about best practices to reduce the impact of stormwater pollution.

Polluted stormwater runoff is the number one source of toxic pollution to Puget Sound and surrounding waterways.

Development in urban areas can cover as much as ninety percent of land with pavement. When it rains, the water doesn't soak into the ground but runs over the surface, collecting anything deposited there and dumping it directly into our waterways. Studies have shown that the pollutants in stormwater runoff can kill Coho salmon in as little as three hours, and although many solutions exist, implementation is often a struggle. Soundkeeper works to enforce pollution permits for local businesses and influence the limits imposed by those permits to keep waterways clean and protected, as well as providing resources and support for citizens intent on improving their individual footprint.

Low-Impact Development

It's far more effective to prevent pollution than to deal with the aftermath. Low-impact development has been a focus of Soundkeeper's advocacy efforts for a long time. Low-impact development means using green infrastructure techniques that allow stormwater to filter into the ground, rather than running over impermeable surfaces. This mimics nature's ability to store rainfall where it lands, which slows the rate of runoff and can be hugely effective at removing pollutants. Permeable concrete, rain gardens, and vegetated buffers along waterways and roadways are proven ways of accomplishing this goal.

Over the past ten years Soundkeeper has challenged highway stormwater permits, pushing for retrofits that would reduce polluted runoff from Washington State roads, and fought hard for low-impact development to be required by the Department of Ecology's municipal stormwater permits, which are the main regulatory tool statewide for preventing polluted runoff from damaging water quality and public health.

Current Actions

2019

On July 31, 2019, Puget Soundkeeper appealed the Phase I and Phase II Municipal Stormwater Permits issued by WA Dept of Ecology. These permits regulate stormwater from developed or built-out environments in cities and counties in western Washington. The appeal is to the Pollution Control Hearings Board (PCHB), an administrative board providing judicial oversight of clean water permits issued by Washington State agencies. Our goal is an order from the PCHB requiring Ecology to rewrite the permits to comply with legal requirements and correct the defects which make parts of the permit ineffectual. Puget Soundkeeper is represented by Earthjustice in this appeal. Read more about why we appealed and the specific changes we'd like to see in these permits.

2017

Our legal challenges succeeded, making LID a mandatory part of new development and redevelopment in urban areas around Puget Sound. But this is a huge shift in how we approach development, and it requires that local leaders stand strong and that Ecology enforces violations of the new development codes once they are in place. If the new requirements are taken seriously, Puget Sound health will benefit. In 2017 Soundkeeper helped to develop Nature's Scorecard, a tool for measuring how well municipalities throughout Puget Sound are meeting new LID requirements. You can see the full report online at naturesscorecard.com.

Industrial Stormwater

Because industrial sites often handle materials that pose a toxic threat to waterways, such as petroleum products and harmful chemicals, good industrial stormwater management is critical to protect water quality and human health. Over 1,000 facilities across Washington have industrial stormwater permits that regulate what they can discharge to local waterways. The permits are regulated by the Department of Ecology, but enforcement is spotty, and many sites bypass best practices that could greatly reduce the toxic burden on Puget Sound waters.

Soundkeeper works to keep industrial stormwater pollution out of the Sound by advocating for strong industrial stormwater regulations and pursuing Clean Water Act litigation against facilities that are in violation of their stormwater discharge permit, focusing on the worst offenders. Since 1984, Soundkeeper has taken action against over a hundred facilities and won every case. On average, our settlements control 124 million gallons of stormwater per year.

What most often happens is that facilities reach a cooperative agreement with Soundkeeper and our legal team. They must come into compliance with their permit, monitor their discharge appropriately, and pay a sum determined by the court. That money goes to the Puget Sound Restoration and Mitigation Fund, a grant program administered by the Rose Foundation that fuels restoration projects in the Puget Sound region to repair the damage done by pollution.

We also track the progress of the permits that set pollutant discharge limits for different types of facilities. Permits are reviewed and updated every five years. Soundkeeper reviews and comments on proposed changes to the permits whenever they are renewed, aiming for the strongest possible protections to Puget Sound waterways.

Current Actions

At any given time, Soundkeeper has around ten active Clean Water Act cases to bring industrial polluters into compliance. Our field director and legal team work closely to identify high priority sites and determine where our work could make the most impact. In 2015 we settled cases against SSA Terminals, ABF Freight, and Rainier Petroleum involving violations of their stormwater permits, resulting in a total of \$496,250 paid to the Puget Sound Restoration Fund. We also won a permit appeal that resulted in stronger regulation of polychlorinated biphenyls (PCBs), which are persistent, bioaccumulative and highly toxic.

Optional Activity

Stormwater Stewardship Challenge for Day 1

A stakeholder is a person or group of people that has a stake in an issue or project. Stakeholders can be aware and interested, or they can also be unaware but still impacted. They have the potential to provide important opinions and information that will guide an issue towards a solution or a project to be completed. They could also have the opposite effect as well. A robust list of stakeholders is vital to the success of a project. Your friends, family, neighbors, teacher, classmates, city leaders, other community members, and you can be a stakeholder. Different stakeholders with different thoughts allow you to understand a problem as a whole. They can help determine potential solutions but also limits to what is possible.

Materials: Writing utensil, computer/phone/tablet, internet connection

The storm drain system contributes to the decline of water quality throughout our waterways. Raising awareness on this issue can be an effective pollution prevention solution. To start sharing your knowledge, you need to determine a list of stakeholders. These are people who may be interested in this issue, eager to learn more, or are experts on this issue and can become a resource for your list. The list can also include stakeholders that disagree with your own opinion. For example, you neighbor could possibly not understand how storm drains function and not share your passion to fix this problem. They are still an important stakeholder because they are impacted regardless. This stakeholder has given you something that requires your focus: ensure your solution idea includes a persuasive argument that is backed with scientific evidence!

Create a list of stakeholders in the table on the next page. With an adult, determine best method of communication with these individuals. Record your reason for listing this individual as a stakeholder. *How are they impacted by stormwater pollution or why might they be interested?*

Stakeholders!	Name	<i>Best method of communication?</i>	<i>Why do you consider this person a stakeholder?</i>
Stakeholder #1:			
Stakeholder #2:			
Stakeholder #3:			
Stakeholder #4:			
Stakeholder #5:			
Stakeholder #6:			

To share your work, post your challenge to Facebook and/or Instagram (**with an adult**) so other people in your community can learn, too! Don't forget to tag @naturevisionorg in your post! Do you live in Auburn, Bothell, Lynnwood, or King County? Use the hashtags and tag the city or county group below. They want to see all the work you are doing to keep our water clean!

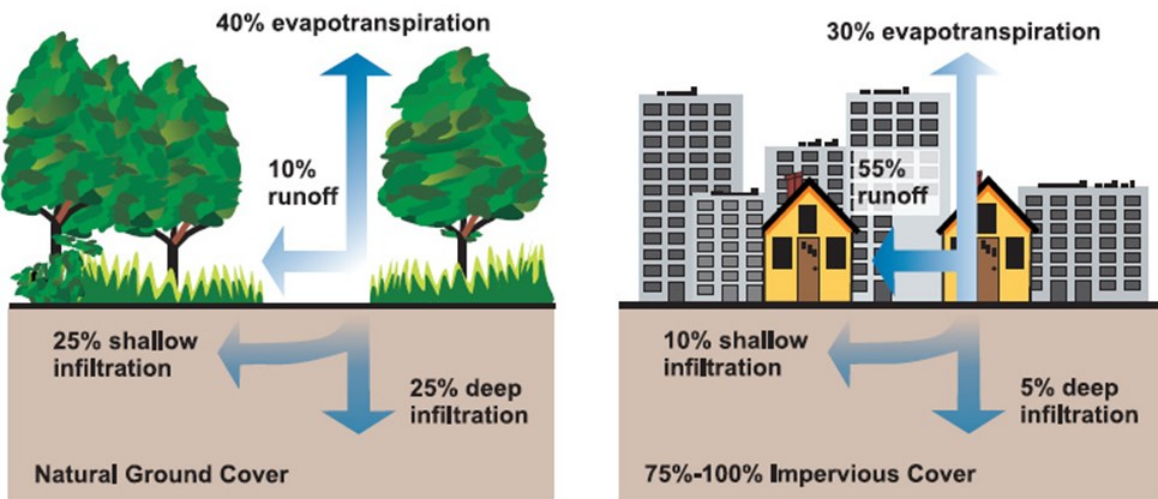
- If you live in City of Auburn: Tag @auburnwa and include the hashtag #auburnwa
- If you live in City of Bothell: Tag @BothellWaUSA and include the hashtag #PugetSoundStartsHere
- If you live in City of Lynnwood: Tag @LynnwoodWA and include the hashtag #Lynnwood
- If you live in King County: Tag @KingCountyDNRP and @kingcountywtd

DAY 2

Engineering Stormwater Solutions

Our cities and towns usually contain many areas with pavement, roads, and sidewalks. These materials are **impervious** and do not absorb water. Everything that is not absorbed by the environment or that falls on an impervious surface is carried by rainwater to a storm drain. This includes pollution, litter, animal waste, chemicals, oils, sediment, etc. which find their way into the storm drain, travelling directly to a local stream or water body. Impervious surfaces also channel water very quickly, which increases the flow of streams. The high rate of flow can lead to the rapid transport of pollutants and also contributes to erosion, landslides, and flooding.

Pervious surfaces, or areas with grass and soil that allow water to soak into the ground, generally help control water and help filter out pollutants. Whether or not an area has pervious or impervious surfaces has a big impact on the way the water moves through the environment and whether it picks up and carries any pollutants with it.



Storm drains are important to prevent flooding on impervious surfaces, where the water cannot **infiltrate** into the ground.

Now that we know why storm drains are important, let's think about a few problems that storm drains could cause. Our stormwater does not get filtered or treated, so it carries pollution into the nearest body of water. Any litter, oil, or chemicals that are on our roads and driveways can end up in a storm drain during a rain event. Large pieces of trash, dead leaves, and soil can also block storm drains, stopping water from flowing through, which leads to flooding on streets.

Today, we will be looking at three different **innovative** solutions to these stormwater pollution problems. Each of these solutions has benefits and drawbacks. Determining which system is the correct choice for a community involves analyzing factors such as cost, ease of installation and maintenance, and the specific needs of that community.

One solution is called the **water goat**. The water goat is a floating system placed in the water to collect litter before it continues into our larger waterways. It can catch and hold the items that are floating on the top of the water.



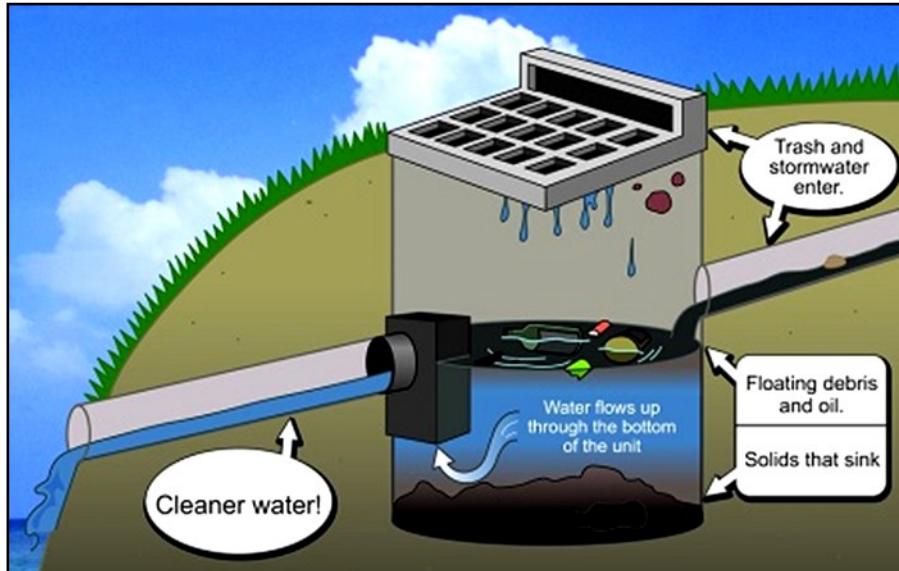
Source: <http://www.planhillsborough.org/have-you-seen-a-water-goat/>

Another solution that people have made is called a **drain sock**. A drain sock is a net that has been fitted to the mouth of a storm drain outlet to trap litter and debris that washed into the system after a rainstorm. This design catches trash that is later emptied. These materials are then thrown away, recycled, or composted.



Source: <https://www.abc.net.au/news/2019-06-09/drain-sock-kwinana-pollution-solution-takes-world-by-storm/11190266?nw=0>

Another solution involves installing a filter inside of the storm drain, like **Ultra-Storm Drain Filters** from the company GEI Works. This system works to hold debris and sediment and filters out oil and other contaminants.



Source: <https://www.silt-barriers.com/stormdrainfilters.html>

Vocabulary

- Impervious:** Does not allow water and particles within to absorb or pass through it
- Pervious:** Allowing water and particles within to soak in and pass through the surface
- Infiltrate:** Water on the ground being absorbed by the soil
- Innovative:** Involving new and original methods
- Drain sock:** A design that goes directly on the pipe to help clean stormwater by catching trash
- Water goat:** A design that floats and collects trash to help clean stormwater before it goes to large bodies of water
- Ultra-Storm Drain Filter:** A stormwater solution installed directly into the storm drain catch basin to filter stormwater runoff

Main Activity

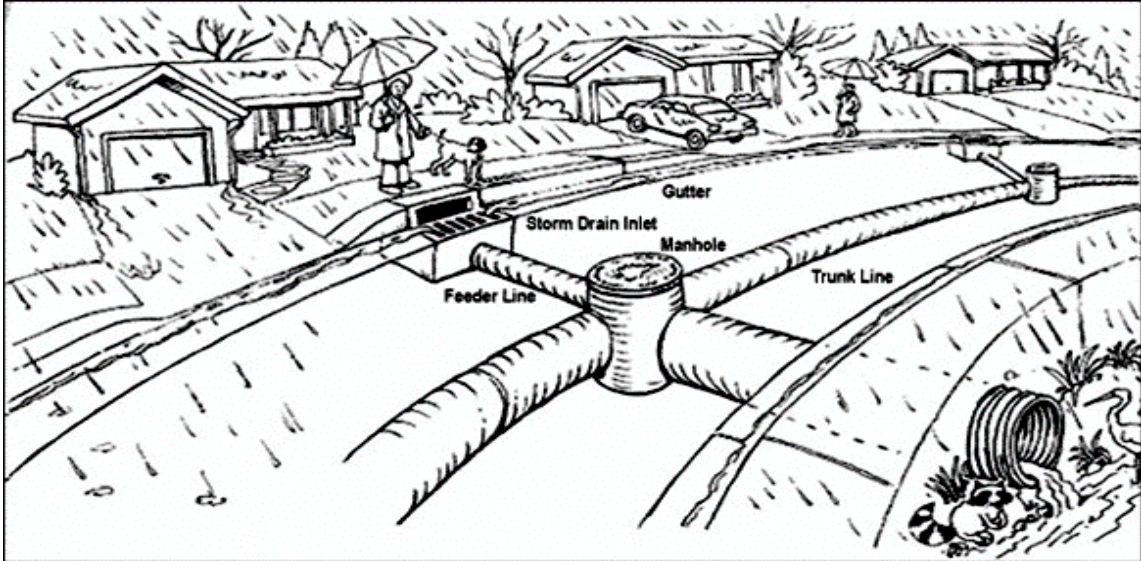
Engineering Solutions

When engineers are designing solutions to problems, they research existing tools and resources to help them discover what is working, what they need to avoid, and what is missing. This analysis leads them to discovering new ideas! With this in mind, compare and contrast these existing solutions below, then design your own solution.

Materials: Writing utensil, paper

	Water Goat	Drain Sock	Ultra-Storm Drain Filter
<i>How does this storm drain solution improve stormwater runoff?</i>			
<i>What are the potential problems or shortcomings?</i>			
<i>Why might a community choose this solution instead of another?</i>			
<i>How are these systems similar?</i>			
<i>How are they different?</i>			

Now that you've learned about existing designs to solve stormwater issues, you can design your own. How could you integrate a stormwater design solution with the neighborhood below? How will your design help to ensure that our waterways remain free of chemicals, debris, and litter? Use the space below to brainstorm, then draw your design on a separate piece of paper.



Source: <http://www.stancounty.com/publicworks/images/storm-drain-system.gif>



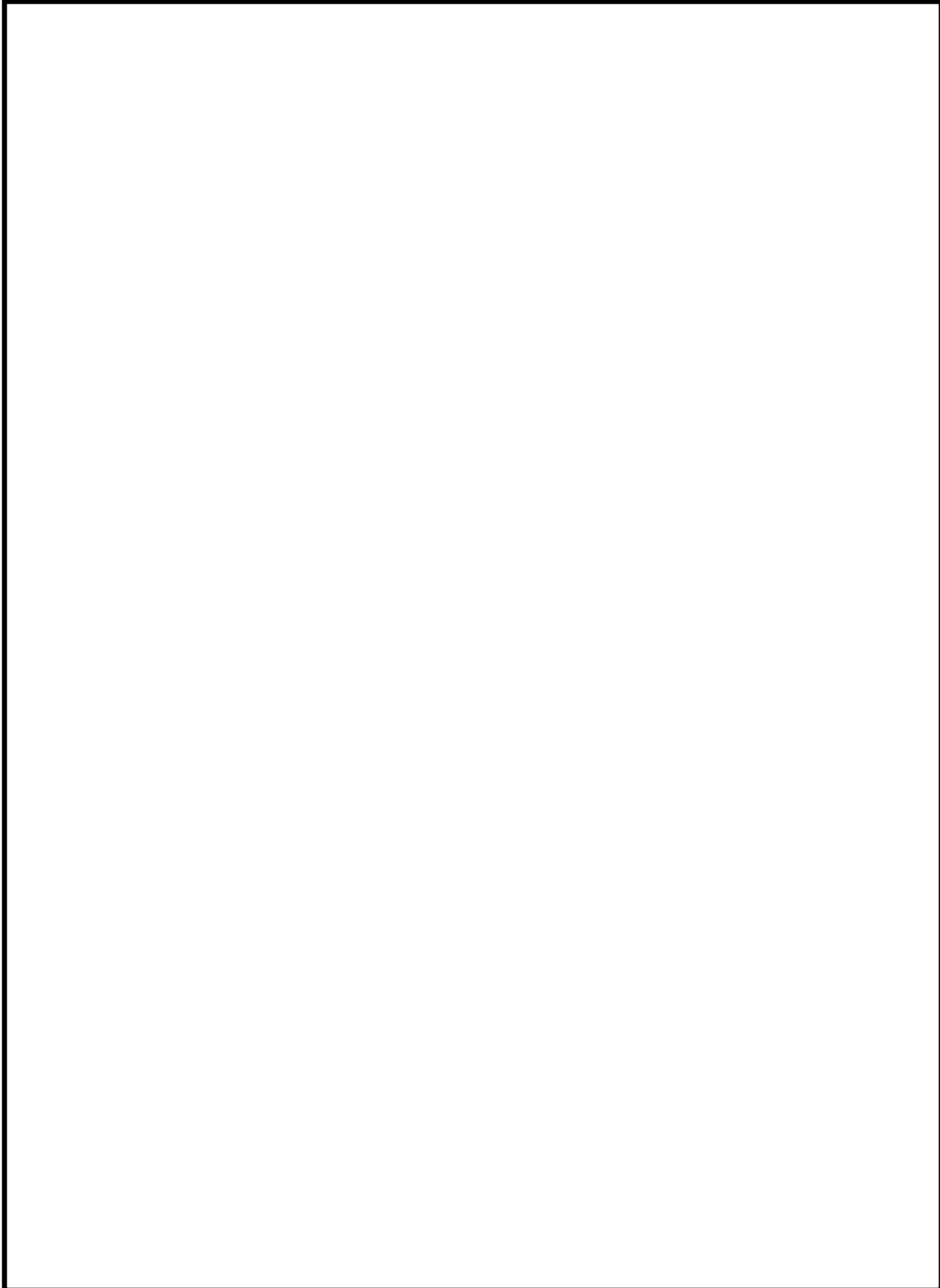
Optional Activity

Choosing a Solution for Your Community

After completing the analytical work in the previous activity, it's now time to put it into action. Which one of these solutions seems best for your community? Would you prefer to see water cleaned before it enters the drain? Once it's inside the pipes? Or when it gets to the larger body of water? Can the design that you choose remove litter and chemicals? What would be difficult about implementing this choice? What are the physical or cost limitations?

After taking into account all of these considerations, write a letter to your local city council, neighborhood association, or water district advocating for one of the above solutions, a combination, or your own design. Feel free to use the space below or your own paper.

Materials: Writing utensil



Optional Activity

Stormwater Stewardship Challenge for Day 2

Some of the most well-known environmental heroes were storytellers, artists and poets. People like Aldo Leopold, Jane Goodall and John Muir all used art as a way of inspiring the people around them to care more about nature.

Materials: Writing utensil, computer/phone/tablet, internet connection

Poetry is a form of written art that uses devices like rhyming, rhythm, symbolism and the sounds of words to create emotions and mental images. Poems can be short and very literal or long and abstract. Like all art, there is no right or wrong way to write a poem, it is up to you as the writer!

*The Grand Show is Eternal
It is always sunrise somewhere,
The dew is never dried all at once,
A shower is forever falling,
Vapor is ever rising,
Eternal sunshine, eternal sunset,
Eternal dawn and gloaming,
On sea and continent,
And islands, each in its turn,
As the round earth rolls.*
-John Muir

*When the night wind makes the pine trees creak,
And the pale clouds glide across the dark sky,
Go out, my child, go out and seek
Your soul: the eternal I. For all the grasses rustling
at your feet,
And every flaming star that glitters high,
Above you, close up and meet,
In you: the eternal I.*

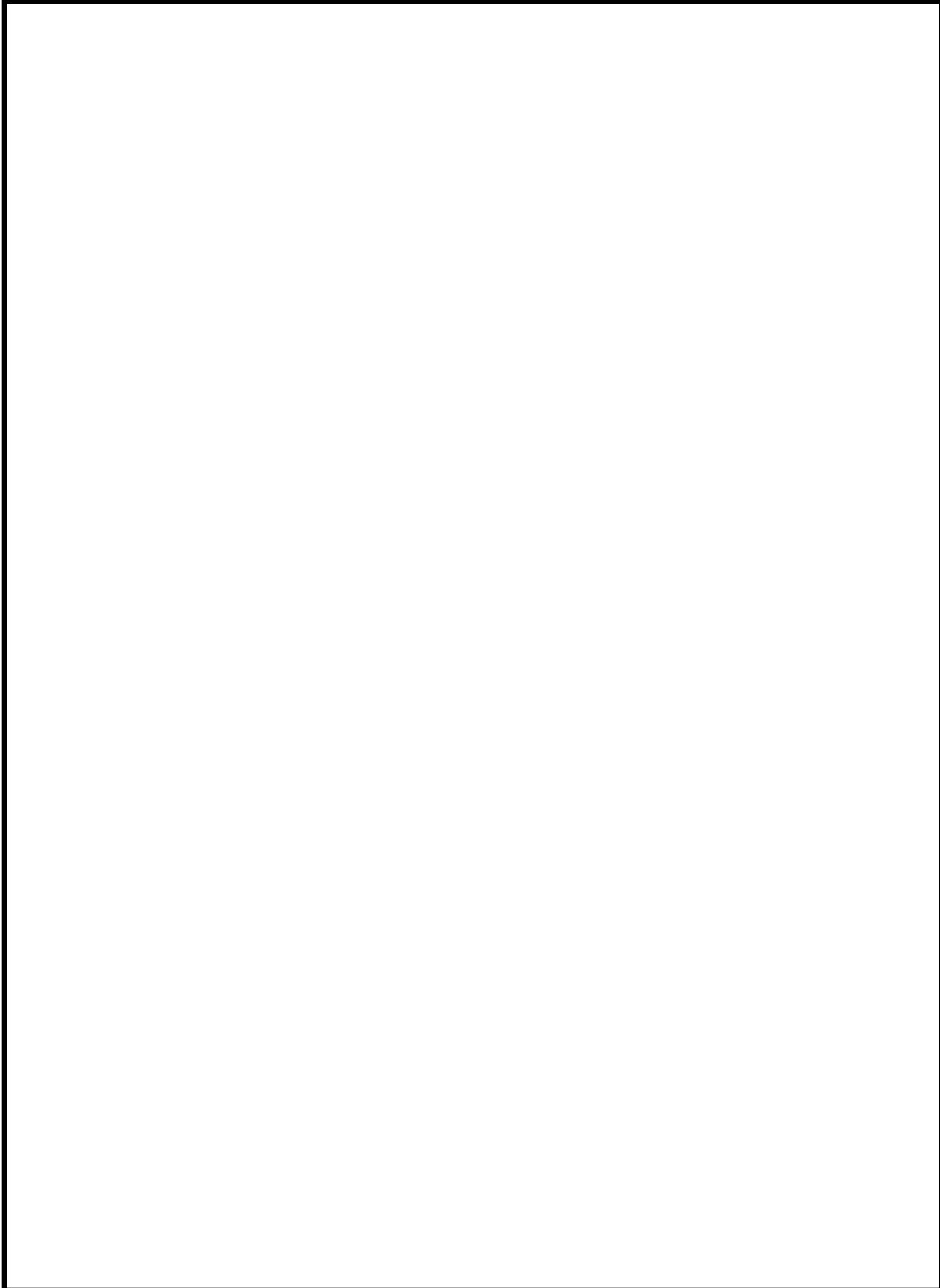
*Yes, my child, go out into the world; walk slow,
And silent, comprehending all, and by and by,
Your soul, the Universe, will know,
Itself: the eternal I.*
-Jane Goodall

*Then on a still night,
When the campfire is low and the Pleiades have climbed over rimrocks,
Sit quietly and listen for a wolf to howl,
And think hard of everything you have seen and tried to understand.
Then you may hear it — a vast pulsing harmony — its score inscribed on a thousand hills,
Its notes the lives and deaths of plants and animals,
Its rhythms spanning the seconds and the centuries.*
-Aldo Leopold

Following their example, write a short poem on the next page to help inspire the people you share it with to care more about stormwater and its effect on pollution and our environment.

To share your work, post your challenge to Facebook and/or Instagram (**with an adult**) so other people in your community can learn, too! Don't forget to tag @naturevisionorg in your post! Do you live in Auburn, Bothell, Lynnwood, or King County? Use the hashtags and tag the city or county group below. They want to see all the work you are doing to keep our water clean!

- If you live in City of Auburn: Tag @auburnwa and include the hashtag #auburnwa
- If you live in City of Bothell: Tag @BothellWaUSA and include the hashtag #PugetSoundStartsHere
- If you live in City of Lynnwood: Tag @LynnwoodWA and include the hashtag #Lynnwood
- If you live in King County: Tag @KingCountyDNRP and @kingcountywtd



DAY 3

Green Stormwater Infrastructure

It is estimated that 118 billion gallons of polluted stormwater washes directly into our waterways each year in King County and threatens water quality. The stormwater carries motor oil, pesticides, pet waste, and more. This pollution is causing a decline of native salmon and threatening the survival of resident Orca whales.

Human beings can impact the environment in positive ways as well as negative ways. We can change the environment to fit our needs and to divert rainwater, while also helping to provide healthy, native habitats for the other animals that share our ecosystems. The ways that our communities handle stormwater have changed over the years. As we've learned, many problems can arise from overwhelming our storm drain systems. Engineers have designed solutions to this problem that mimic the natural world. These include bioswales, green roofs, rain gardens, and rain barrels. These are all types of **Green Stormwater Infrastructure (GSI)**.

Bioswales help to combine the actions of a storm drain and a pervious surface. They are essentially ditches that are filled with native plants that work to absorb excess stormwater. They are built alongside roads to help direct and slow down the flow of stormwater. Rather than allowing high amounts of stormwater runoff to enter our storm drain system, bioswales help the stormwater be absorbed and cleaned in a city just like it would in a natural wetland area.



Green roofs are designed to provide stormwater with the opportunity to soak into areas that would otherwise lead to our gutters and storm drains. They also support the growth of plants to provide oxygen and remove carbon dioxide from the air.



Source: <https://www.greenroofs.com/projects/seattle-city-hall/>

Rain gardens are shallow, bowl-shaped gardens that have native trees, shrubs, and grasses that provide a habitat for animals, and help us to control water.



Below is a detailed explanation of the features of a rain garden.

Beautiful, Hard Working Rain Gardens

Rain gardens prevent flooding, increase home value and create habitat for birds and butterflies.

A RAIN GARDEN is a beautiful landscape feature in your yard that captures and filters runoff from your roof, driveway or other hard surface.

 **x 600**

The average home rain garden naturally filters 30,000 gallons of water per year, enough to fill a bathtub 600 times!

Calculation based on a typical 10' x 12' residential rain garden capturing average rainfall for the Puget Sound region from 1,200 square feet and a bathtub volume of 50 gallons.



12,000
RAIN GARDENS
in Puget Sound

For more information go to: www.12000raingardens.org

Rain barrels are exactly what they sound like: barrels that contain rainwater! These are typically attached to gutters that carry water off of a roof, pouring all of that rainwater directly into the barrel instead of letting it flow across the land. However, not every roof or building can accommodate a rain barrel. It is important to research the rules for rainwater collection in your own area before attempting to install a rain barrel.



Another innovative solution to the issue of impervious surfaces is the construction of **permeable pavement**. This is a product that is designed to be hard and solid like regular pavement, but still has small spaces throughout that let water pass straight through it! When you have a road or parking lot made out of permeable pavement, you do not have to worry about floods or puddles because water and any pollution it may be carrying are able to pass through the pavement and down into the earth below.



Vocabulary

Bioswale: A channel filled with vegetation to both direct and absorb water

Green Stormwater Infrastructure: Solutions to stormwater issues that mimic the natural world

Native plants: Plants that have evolved to grow in a particular climate

Rain garden: A shallow, bowl-shaped garden full of native plants designed to absorb water

Rain barrels: Similar to cisterns, used for collecting water from gutters

Permeable pavement: Pavement that allows for water to pass through it

Main Activity

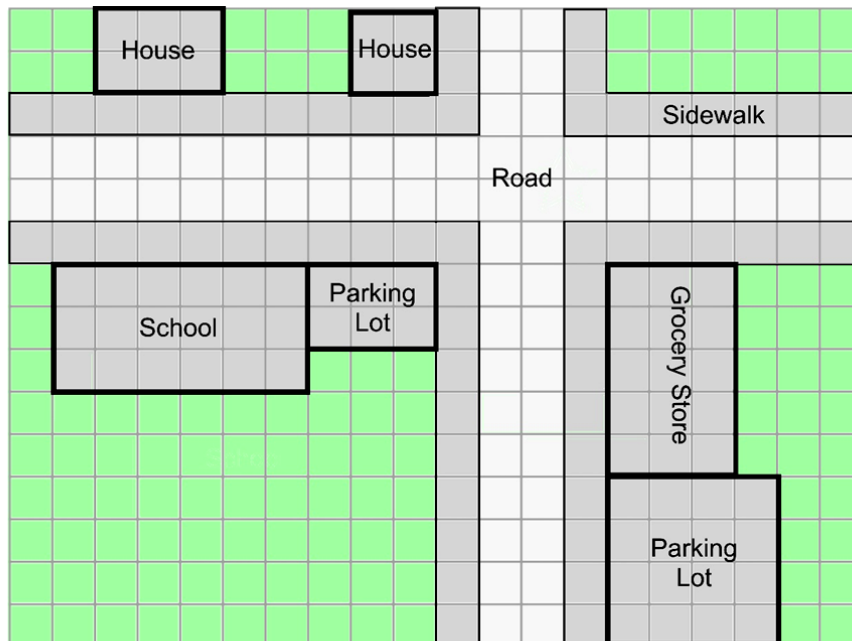
GSI Engineering

Using what you've learned during your neighborhood investigation on Day 1, what do you think some of the best Green Stormwater Infrastructure would be for your neighborhood? Let's figure it out!

Materials: Planning sheet on next page, computer/phone/tablet and internet connection if desired for extra research (not necessary to complete activity)

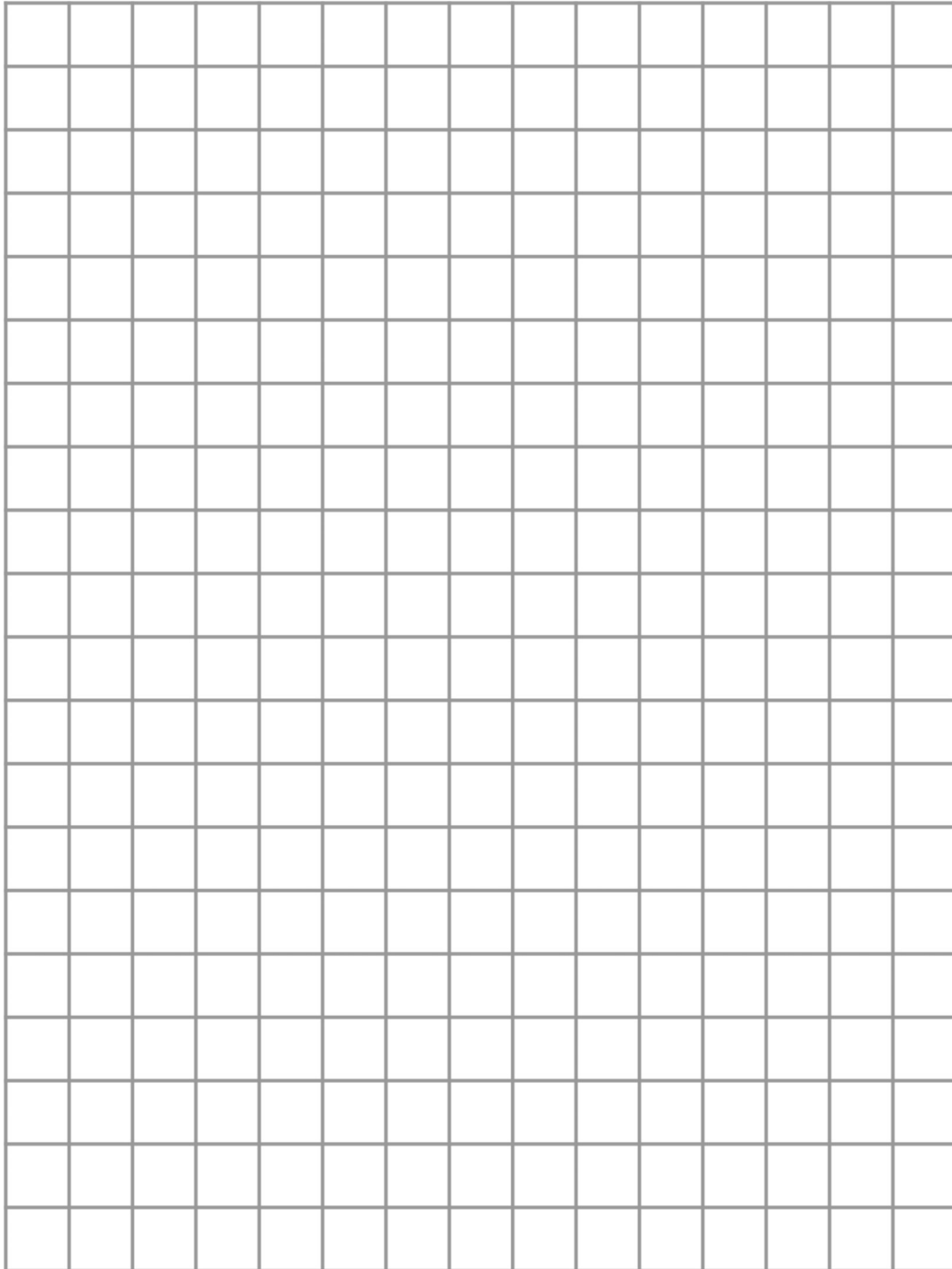
Think about how rain gardens, bioswales, or green roofs would work for drainage, filtering water, and absorbing water in a neighborhood. When deciding on your preferred infrastructure, consider which plants you might include in that area and where your green stormwater infrastructure could go.

Example Starting Grid (before GSI):



Source: <https://eriefresh.files.wordpress.com/2009/12/rain-garden-design-templates.pdf>

Now, it's your turn to create a similar grid for your neighborhood map. What percentage of the area that you looked at is currently covered in impermeable surfaces? How could you improve the flow of stormwater and impact the amount of pollution that makes its way to storm drains? Draw your plan and label what you are "planting." Ideas for native trees, shrubs, and ferns are included on the following pages.



Native Plant Ideas:

Native plants are beneficial to our environment. They require much less watering, fertilizer, and little to no pesticides to grow. Adding native plants can help reduce pollution because they can easily thrive without chemicals. They also can help with water absorption thus reducing the amount of water runoff. Below are examples of native plants that you could choose to add to a rain garden, bioswale, or green roof:

Vine Maple



Oso Berry



Oregon Grape



Salal



Snowberry



Sword Fern



Cattails



 Nature
VISION

You may find additional information on native plants here: <https://green2.kingcounty.gov/gonative/Plant.aspx?Act=list> or <https://www.wnps.org/native-plant-directory>. Also, you can conduct an internet search for “King County Native Plant List.”

Optional Activity

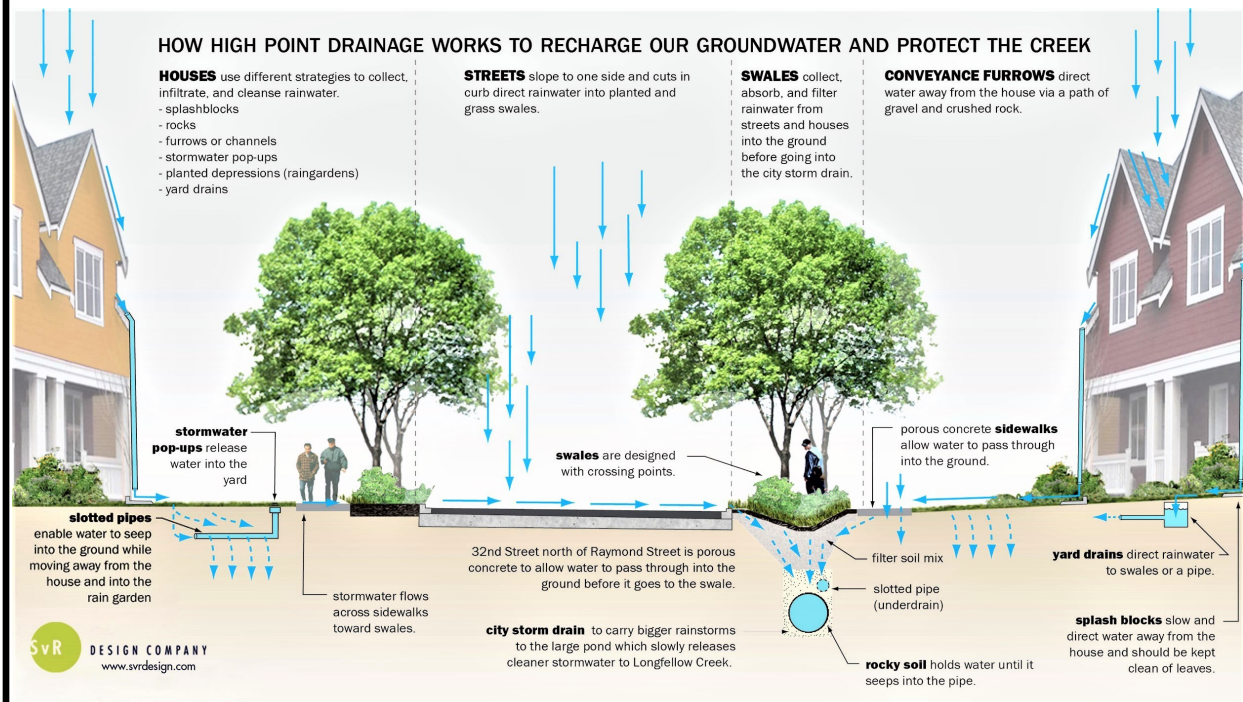
GSI Video

Green Solutions to Stormwater Runoff: This short video from Sightline Institute shows the Green Stormwater Infrastructure (GSI) currently being installed in our local community. **With adult permission**, watch the video. When watching, think about the similarities and differences between this video's solution examples and what you accomplished in the previous design engineering activity.

This video can be found by doing a YouTube search for "Sightline Institute Green Solutions to Stormwater Runoff" or by clicking the following link:
<https://www.youtube.com/watch?v=bsNjk0gpir4>.

Materials: Computer/phone/tablet, internet connection

If you're unable to access the video, another example of Green Stormwater Infrastructure at work is the High Point Neighborhood of West Seattle. They have combined a number of Green Stormwater Infrastructure solutions.



Source: <https://highpointseattle.com/about-high-point/natural-drainage-system/>

Optional Activity

Stormwater Stewardship Challenge for Day 3

One of the best ways to share ideas is through local news companies. Most newspapers have a “Letter to the Editor” section where readers submit their thoughts to be shared with the community. The Editor supervises the content that goes out every day in various news outlets and part of their job is publishing feedback and information from the community.

Materials: Writing utensil, paper, computer/phone/tablet, internet connection

Using what you have learned, write a letter to the editor of a local paper and share some ways that we can protect our environment and why it matters to you. After you’re finished writing, feel free to send the letter via email or by mail.

To share your work, post your challenge to Facebook and/or Instagram (*with an adult*) so other people in your community can learn, too! Don’t forget to tag @naturevisionorg in your post! Do you live in Auburn, Bothell, Lynnwood, or King County? Use the hashtags and tag the city or county group below. They want to see all the work you are doing to keep our water clean!

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DAY 4

Wastewater Basics

Information and images adapted from curriculum by King County Wastewater Treatment Division

We've learned about where our stormwater goes and how water is moved from our streets. We've also thought about ways that we can clean and improve that water. Next we'll think about where water travels when it leaves our homes as wastewater. We'll also learn how we can keep that water as clean as possible.

Think about all the drains inside of your home, including your sink, toilet, shower, and washing machine. All of the water that goes down those drains is called **wastewater**. Unlike our stormwater, this wastewater is sent from our homes to a **treatment plant** to be cleaned before it is released back into our water sources.

Below is a picture of one of King County's five wastewater treatment plants, Brightwater Treatment Plant.



In order to understand how the wastewater is cleaned and filtered, let's go through each step of the process, starting with the water before it arrives at the treatment plant.

First, let's think about what is in our wastewater when it leaves our homes. Besides the water, plenty of other things also go down our drains. Litter, pieces of food, chemicals, soap, toothpaste, mouthwash, and even things like toys. Below is a table of the different drains that might be in your home. Your job is to think about all of the things that could end up going down them. Write down your ideas in the table!

Drain Location	What Goes Down the Drain
Shower	Water and...
Kitchen Sink	Water and...
Toilet	Water and...
Dishwasher	Water and...
Washing Machine	Water and...
Bathroom Sink	Water and...

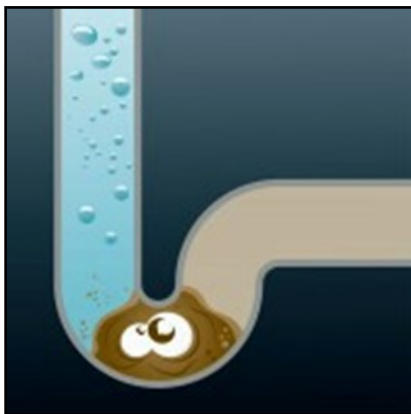
Now that you've thought about what might go down the drain, we can think about what we can remove from the water, what we can't, and how you can help keep this water as clean as possible for its journey back to nature.

One of the easiest things that we can do to make sure that our water is clean is to ensure only the materials that our wastewater systems are prepared to clean make it down the drain. The materials we are prepared to remove are those that come from our bodies, like poop, pee, and puke. Additionally, toilet paper can easily be removed because of how it's made. We call these things the 4 P's. Everything else falls into one of these other categories:

- **Chemicals:** Anything coming from your shampoos, cleaning products, personal care products, makeup, medications, hair gel, etc. These are almost impossible to remove from the water once at the wastewater treatment plant. The best choice we can make is to use gentle soaps and environmentally-friendly cleaning products.



- **Organics:** This includes food and other materials that can break down. Organics are materials that come from living things. They include our poop and pee as well as once-living organisms like bugs or goldfish. However, there is one type of organics that can cause a problem. This is called **FOG** which is the fats, oils, and grease used in cooking. These organics can clog our pipes very easily once cooled and solidified. Therefore, cooking oils should be cooled and composted or thrown in the trash to avoid drain problems.



- **Trash:** This includes items unnecessarily found in wastewater like wipes, paper towels, toys, Q-Tips, cotton balls, and feminine hygiene products. All of these things need to be removed from the water and placed in the trash if they make it to the wastewater treatment plant. These can also cause clogs in the pumps and pipes that can cause plenty of problems at treatment plants, despite being an avoidable issue.

Engineers need to design and build a way to remove all of these things from our wastewater. They must figure out how to clean as much of the water as they can, and they need to figure out how to process a lot of water. Our water treatment plants need to handle as much as 200 million gallons of water every day!

Once the wastewater arrives at the treatment plant, the cleaning and filtering occurs to remove the materials we just discussed and to make sure the water is clean before being released back to the Puget Sound. The process is described on the following pages.

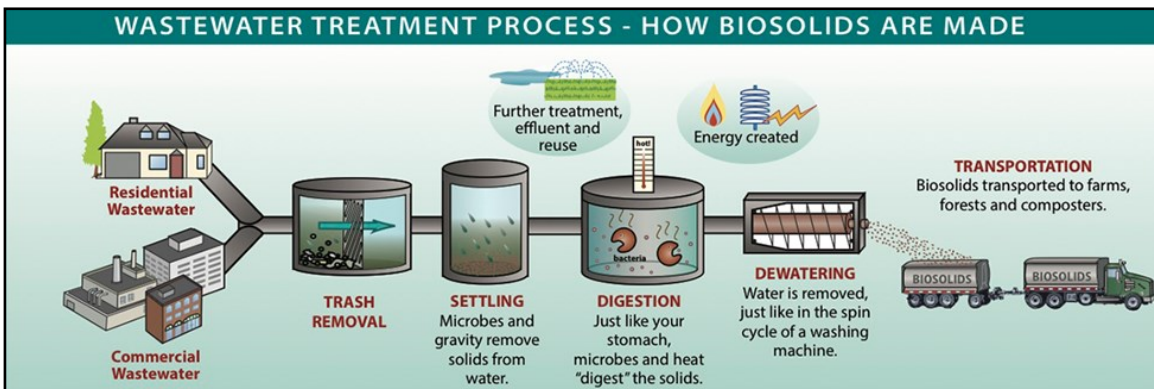
First, wastewater is screened to remove any of the trash/debris. Anything that is not one of the “4 P’s” is removed by a strainer, ground into small pieces, and sent to a landfill to be thrown away.



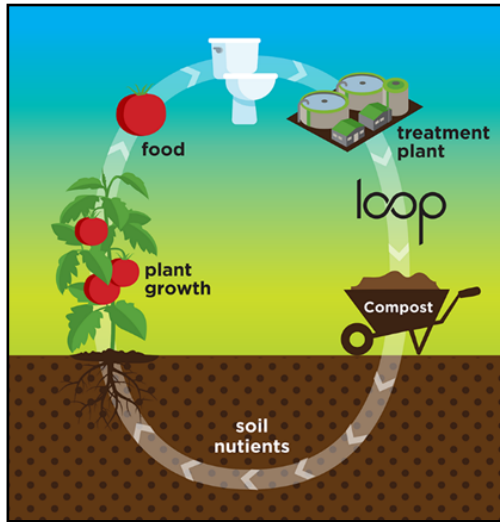
Next, the wastewater is sent to a **settling tank** where large pieces of waste and food sink to the bottom, while lighter items like fats, oils, and grease (FOG) float to the top.



With gravity helping to separate these materials from the water, larger items are pushed along the bottom of the tank to be sent to a **digester**, while lighter items are scraped from the top. The digester breaks down the food and waste material into **biosolids**. These are later used as part of a fertilizer called Loop. Loop makes soil healthy and helps farms grow more food. So we eat food, and use our wastewater treatment to make healthy soil for *more* food!



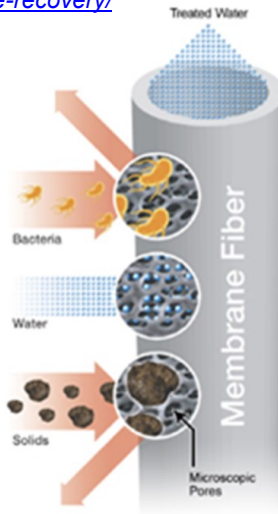
Source: <https://nwbiosolids.org/what-are-biosolids-overview>



Source: <https://www.kingcounty.gov/services/environment/wastewater/resource-recovery/loop-biosolids/about.aspx>

The wastewater still has smaller pieces of waste and food in it. The wastewater is treated further by adding hot air and **microbes** to the water. We can think of microbes as good bacteria that help to break down our waste materials much like they would in nature. The warm air helps to make this process go much faster than it normally would. After the microbes break down the bacteria, all that is left in this water are any chemicals. These include what we use for cleaning, like bleach, as well as anything that passes through our bodies. We cannot easily take these out of the water, so our best way to manage this is by not using harsh chemicals so that they do not enter our water.

Some of our treatment plants, like Brightwater in Woodinville, have a last step to filter out 99% of all the contaminants in this water. Called **membrane filters**, they are like a collection of straws with tiny holes that block everything but water molecules.



Lastly, all of the water that has been cleaned is sent to the Puget Sound (Salish Sea) where it can be used by plants and animals and returned to the hydrologic cycle. The really important part to remember about our water systems is that we take our water from nature, and we return it to nature. So it's our job to make sure that it is as clean as possible when we are done using it.

Vocabulary

Biosolids: Fertilizer made from human waste

Digester: Area where biosolids are created

Engineers: People who design water systems

Membrane Filters: Filters that remove bacteria and 99% of water contamination

Microbes: Good bacteria that help to break down parts of our wastewater

Settling tank: Where the light and heavy parts of wastewater are separated

Treatment plant: Where our wastewater is cleaned before being sent back to nature

Wastewater: The water that comes from the drains in our homes

FOG: Fats, oils, and grease from cooking that can clog our pipes and drains

Main Activity

Wastewater Debate

Since its creation in the 1800's, the City of Victoria B.C. has not had a way to treat their wastewater. Until recently, this Canadian city has only used a screen to prevent large pieces of debris from entering the ocean. After many years of debate and input from scientists, environmentalists, and members of the community both in Canada and in Washington State, a treatment plant is now set to be completed at the end of 2020 at a cost of nearly \$800 billion. This debate was especially difficult in regards to managing the concerns of many different people. The article on the following pages explains the arguments both for and against the construction of the wastewater treatment plant. While this construction is now nearing completion, the ability to look at two sides of a debate and make informed choices is an important skill, especially when it comes to issues concerning our environment.

Materials: Writing utensil

After reading both sets of information starting on the next page, decide which side you agree with more. Answer the questions below to determine whether you believe the construction of this treatment plant was needed or not.

Questions:

What arguments are being made for the treatment plant?

What are the arguments being made against it?

Do you think that the environmental benefits or prevention outweigh the costs?

Why or why not?

'Ick factor,' not science is driving Victoria's \$765M wastewater treatment project, say critics · Treatment facility has to be up and running by 2020 in order to comply with federal regulations

Briar Stewart · CBC News · Posted: May 06, 2019 · <https://www.cbc.ca/news/canada/british-columbia/victoria-sewage-treatment-plant-construction-regulations-1.5123974>

Two years into the construction of Victoria's first wastewater treatment facility and a year and a half out from completion, the \$765 million project is still being debated — heralded as long overdue by some and dismissed as unnecessary by others.

Wastewater facilities don't typically stoke civic pride, but the project and its decades-long history are unique because most of the Victoria area has never treated its sewage. "I think it is huge," said Elizabeth Scott, deputy project director of the wastewater treatment facility, located at Victoria's McLoughlin Point on the rocky south coast of Vancouver Island. "There [are] a lot of residents that understand the importance of the project ... and will feel a great deal of pride in the project for generations to come."

Currently, wastewater is screened and anything larger than 6mm is blocked. The rest flows into two separate outfall pipes and is then discharged into the Strait of Juan de Fuca. The region is the last major coastal community in North America to dispose of untreated sewage into the marine environment, according to the local government.

Several scientists have repeatedly argued that the area's cold water and fast flowing currents mean the wastewater is quickly diluted and produces no harmful effects.

Federal laws changed in 2012

However, federal regulations introduced in 2012 mean that the Capital Regional District, which includes Victoria, Saanich, and Esquimalt, B.C., have to have a treatment plant up and running by the end of 2020.

Construction of the facility began in 2017. When it's finished, it will include three levels of treatment. Officials say it will be able to remove contaminants that are particularly concerning like pharmaceuticals.

It will also quell the criticism and protest that has been levelled against the region for decades.



Deputy project director Elizabeth Scott says the most challenging part of the wastewater treatment project is that it requires laying as much as 30 kilometres of pipe, which will run through urban areas. (Briar Stewart/ CBC News)

"We have had a false image of a garden city and underneath, we had all the sewage going into the ocean," said James Skwarok, a Victoria teacher who strolled the coasts and streets dressed as a human turd called Mr. Floatie beginning in 2004.

He got the inspiration for his environmental protest about sewage dumping from a character on the cartoon show South Park.

As the mascot for the group P.O.O.P. (People Opposed to Outfall Pollution), Mr. Floatie raised a stink, becoming a walking, visual representation of a message environmental groups had been delivering for years.

"Our beautiful ocean is not a big magical toilet where everything disappears," Skwarok said. "It was an embarrassment for the tourism industry and for local politicians to have this tall turd walking around."



Mr. Floatie and other environmentalists ran a public campaign to try and pressure officials to build a wastewater treatment plant. The mascot frequently spoke to tourists visiting Victoria about where the city's sewage was ending up. (Chat Hipolito/The Canadian Press)

Over the years officials from Washington State have threatened a tourism boycott of the Victoria area because of the sewage issue.

Once construction began two years ago, Mr. Floatie and local politicians headed to Seattle to make amends. As for the mascot costume, it is now retired and sitting in the Royal BC Museum.

'Ick factor'

While the impact of Mr. Floatie and the protests were successful in helping to get the plant built, scientist Tom Pedersen argues the whole campaign obscured the situation.

"I think the whole issue has been driven by misperception of the public and that's what some of us euphemistically called the ick factor," he said.



James Skwarok, aka Mr. Floatie, was invited to community events, and the mascot briefly ran for mayor of Victoria in 2005. (Briar Stewart/CBC)

Pedersen, who recently retired from the University of Victoria, has held several positions over the years, including Dean of Science, and he served on a marine science panel made up of experts from B.C. and Washington State who studied the sewage issue.

He contends there is no scientific rationale for building the plant because the ocean's strong tidal currents are naturally decomposing what is in the wastewater. He adds it is one of the very few spots in the world where it is safe to dispose of sewage this way.

With construction well underway, Pedersen says he understands that the treatment facility is a done deal, but he suggests that when it comes to marine protection, the \$765 million spent on the plant could have been better used elsewhere.



Tom Pedersen recently retired from the University of Victoria but has been studying the sewage issue for years. He says the wastewater treatment facility is unnecessary. (Briar Stewart/CBC News)

When the plant is up and running, it will provide sewage treatment for an area with a population of about 320,000. The facility will treat more than 100 million litres of wastewater each day, and the sewage sludge that is left over will be pumped to a separate facility where it will be turned into biosolids.

Officials say the hope is to be able to use those to fuel cement kilns.

"The regulations that the federal government put into place gave us a firm deadline," said Colin Plant, board chair for the Capital Regional District.

He said debates over the science became moot once those regulations were put into place. He believes many Canadians may be surprised when they learn that the Victoria area hasn't been treating its sewage, considering Vancouver Island has a reputation for being green and environmentally progressive.

"The general public is of the mind now that, thank goodness, we're finally doing the right thing."

The Victoria Sewage Alliance held the view that this wastewater was a danger to the environment and used the following information to make their case for a treatment plant http://www.victoriasewagealliance.org/index_files/FactsVictoriaSewageAlliance.htm

Victoria pumps an average of 82 million litres of raw sewage daily into waters just off Victoria's harbour. It is pumped into our pristine ocean through two one-meter wide pipes 60 and 65 meters under the surface by twin 1000 horsepower motors.

DON'T CURRENTS IN THE STRAIT DILUTE THE SEWAGE RAPIDLY?

Contrary to what we've been told, the currents near the outfalls do not carry the sewage out into the Pacific; the net current at the outfall depths is east into Georgia Strait. Further, because currents change direction with the ebb and flow of the tide, a lot of the sewage either stays nearby or flows back into Georgia Strait. Also, dilution does not get rid of what's in sewage (organics, pathogens like hepatitis, heavy metals or chemicals) and therefore it doesn't prevent the long-term damage to the environment, or the waste of the energy and mineral resources carried by sewage.

VICTORIA HAS CONCENTRATED ON SOURCE CONTROL - ISN'T THIS ENOUGH?

Source control is an important part of keeping our environment healthy, and responsible municipalities both manage source control and treat their sewage. However, many sources acknowledge the limits of source control, here is one comment from the BC Ministry of Environment, "source control has limited capacity to reduce contaminants ... Treatment is not only more effective in reducing contaminants, it is effective immediately upon implementation and will remove a wide array of contaminants not targeted under source control."

ISN'T VICTORIA'S SEWAGE NON-INDUSTRIAL SO WE DON'T NEED TREATMENT?

Most industrialized cities have a sewer use bylaw similar to Victoria's sewer use bylaw, which ensures all industrial waste is pre-treated before entering the sewers. These bylaws will put industrial city wastewater on a level similar to Victoria's, however all of these more industrialized cities will then have sewage treatment before discharging into surface water.

SCIENCE HAS NOT PROVEN THAT RAW SEWAGE HARMS THE ENVIRONMENT, HAS IT?

Yes it has. In fish toxicity tests on Victoria's sewage, the fish died within 20 minutes. In identical tests on pulp mill effluent, fish routinely survive for more than 96 hours. These are just a few examples of the growing amount of independent scientific data (i.e. not conducted by a government agency biased against sewage treatment) that supports the need for treatment.

VICTORIA HAS DISCHARGED RAW SEWAGE SINCE 1894; WHY CHANGE NOW?

In 1894, those responsible for Victoria's sewage did what they were first asked to do - get rid of it. In that era industry also discharged its effluent untreated, but as our understanding of industrial effluent changed, so did society's tolerance for pollution. We now understand that raw sewage includes many harmful and toxic chemicals, therefore, environmental laws no longer tolerate raw sewage discharges from municipalities.

- *Environment Canada has closed 60 square kilometers around the outfalls to all shellfish harvest; The plume from the outfalls hits the water surface under various conditions, which raises concerns for humans who are engaging in primary contact recreation in these areas (wind and kite surfers)*
- *Toxicity tests show that Victoria's sewage is toxic to rainbow trout fry, water fleas, blue mussel larvae, and oyster larvae;*
- *Nineteen chemicals found in the sewage are found on the seafloor and exceed the Contaminated Sites Regulation. For any one exceedances a site is considered to be sufficiently contaminated to be designated as a contaminated site;*
- *Twenty-eight chemicals found in Victoria's sewage are in concentrations that exceed water quality guidelines for the protection of fish and aquatic life, some exceed the guidelines by nearly 85 times;*
- *Toxicity tests at Macaulay Point outfall indicated exposure to sediments from this location resulted in significantly reduced survival or growth of polychaete worms and survival and normal development of blue mussel larvae; and*
- *No studies have been conducted in the vicinity of the two outfalls to evaluate the effects of pharmaceuticals and personal care products on aquatic organisms or aquatic-dependent wildlife*

Optional Activity

Sanitation, Treatment Access, and Design

Not everyone has access to running water or wastewater treatment. You might have used an outhouse if you have gone camping or visited a place with only a few residents. These toilets collect waste and break it down below ground. Many places in Asia have squat toilets. These are very similar to the toilets we are used to, but many are not connected to running water, and need to be “flushed” by rinsing them separately after use. Even though these may be less comfortable to use for some people, they are still a healthy and safe way for us to be able to use the bathroom.

Materials: Writing utensil

People sometimes do not have access to a toilet and must go to the bathroom directly in bodies of water or sometimes out in the open. There are reasons that people in our communities might not have access to clean, healthy bathroom facilities. Can you think of any?

Looking at the pictures on the following page, which of these toilet options are you most familiar with?

Which would you rather use?

What problems do you think these toilet options solve?

What problems do you think these toilet options might create?

Designing sanitation solutions for communities with little or no access to running water facilities is a difficult task. It's also extremely important for the people in those communities to be able to safely use the bathroom.

What solutions can you imagine for people to be able to use the toilet in their communities that do not have easy access to running water? Consider the following constraints that the design must include:

- Efficiently and safely remove, store, or use waste.
- Be able to be maintained by the community.
- Provide users with safety and privacy.

Use the following page to design a solution.



Outhouse



Squat toilet with water for flushing

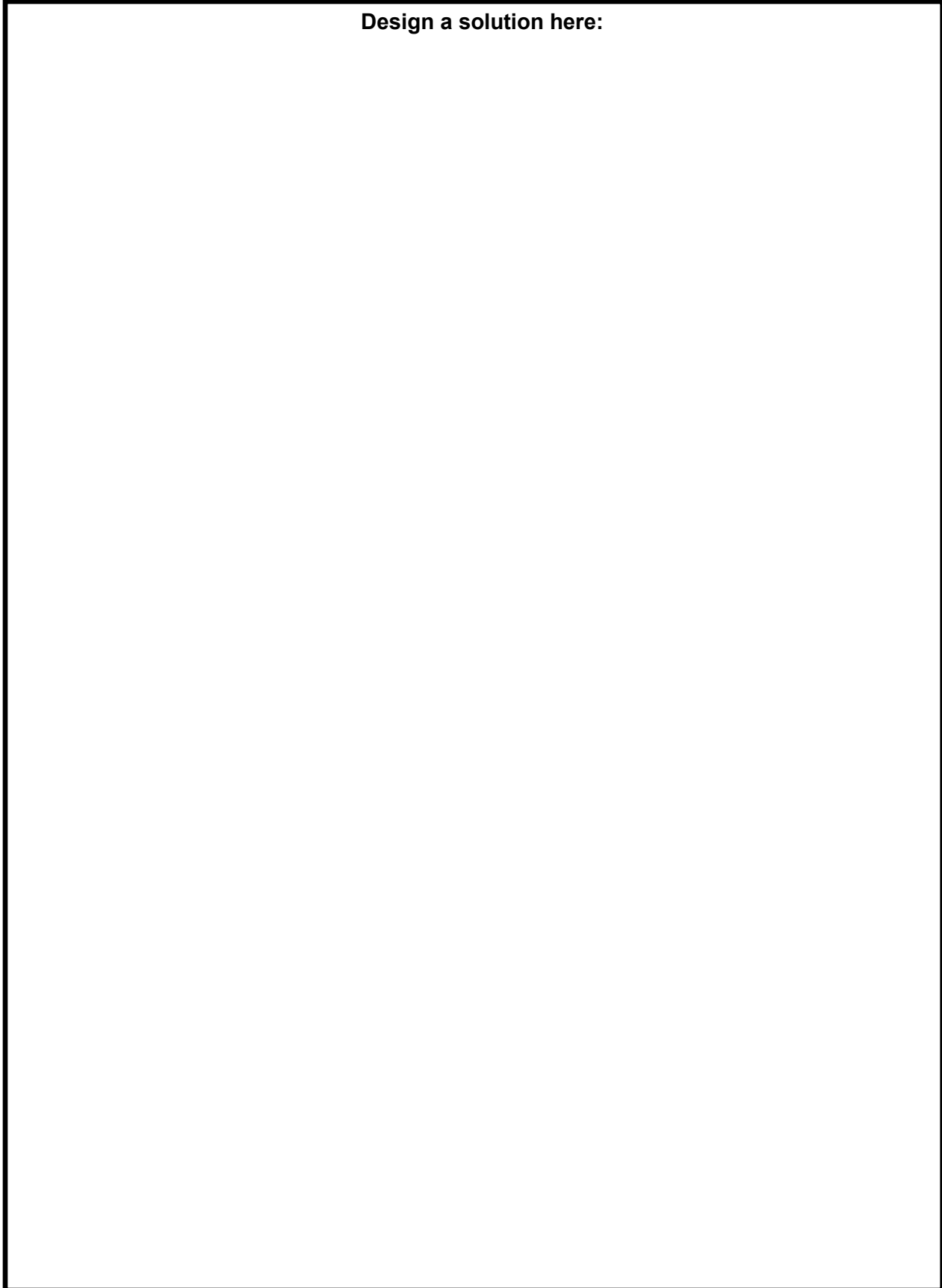


Toilet over fish pond



Open toilet near water

Design a solution here:



Optional Activity

Stormwater Stewardship Challenge for Day 4

The wastewater treatment plant actively treats and disinfects the wastewater that is sent down our home drains and toilet. Human fluids, human waste, and toilet paper are acceptable items to flush down the toilet. Anything else should not be flushed as it will not break down in the water and could clog the pipes. Other items that need to be disposed should be either put into the trash or properly recycled. Many household items are labeled as “flushable.” Items such as flushable wipes are misleading as they remain intact once flushed and can damage the wastewater treatment system. The treatment plant spends a lot of time removing flushed wipes, paper towels, tissue paper, and other pieces of trash from the wastewater before sending the trash to the landfill.

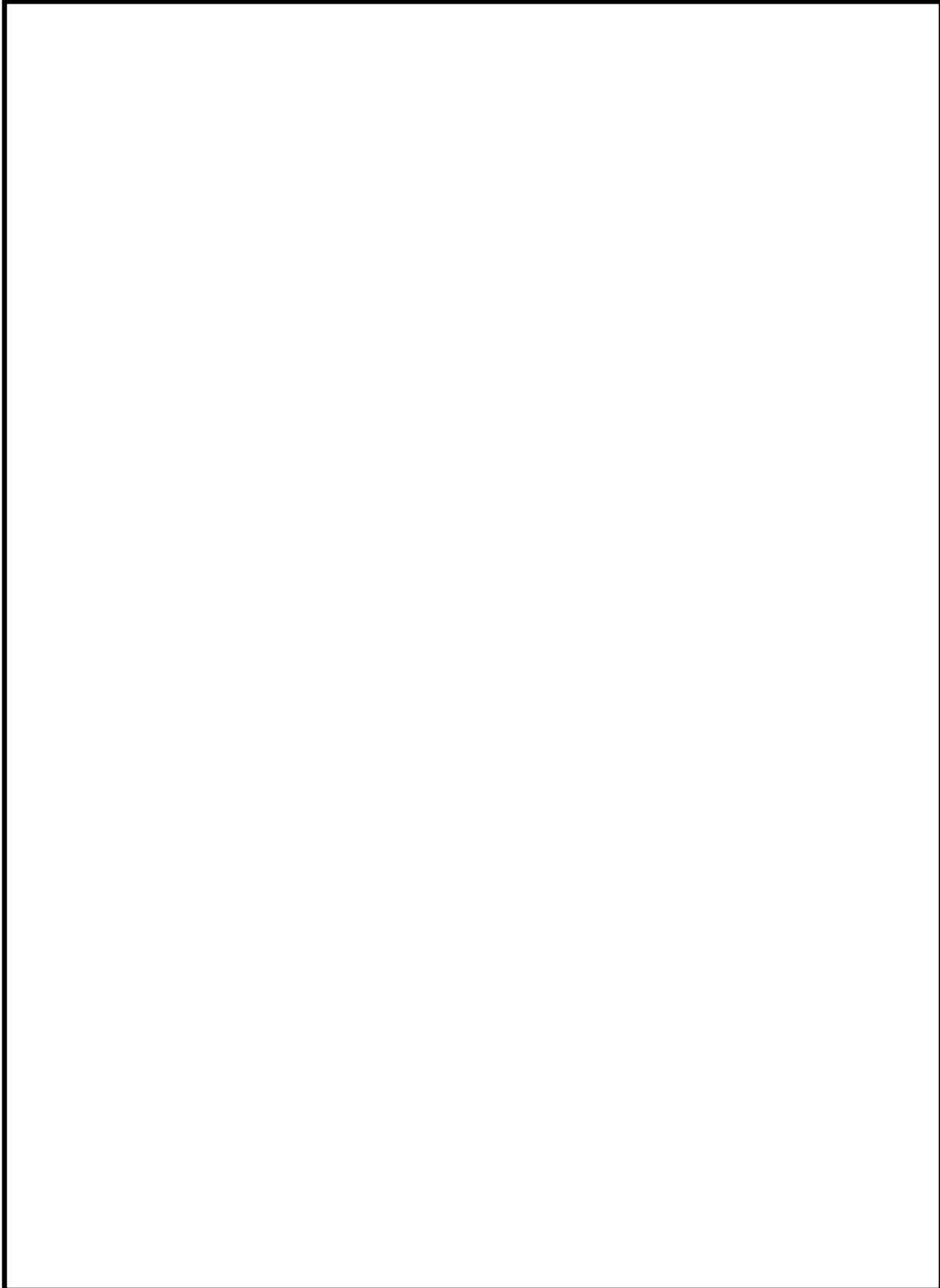
Materials: Writing utensil, paper, markers, tape, computer/phone/tablet, internet connection

Design a sign to remind people in your home of what not to flush. You can create a sign of your own design or brainstorm with other members of your home to decide what is most appropriate to display. Use the following page or your own materials. When your sign is complete, ask an adult if you are allowed to tape the sign on the toilet or on the bathroom mirror.

Additional activity: with an adult, research companies that create “flushable wipes.” Write a letter, email, or social media message to this company that the term “flushable” is misleading and is not only damaging to the wastewater treatment system, but creates additional litter. Encourage them to remove the label of “flushable” or to properly include text on their packaging that explains how the wipes will not break down in wastewater. Send your letter, email, or social media message with the help of an adult.

To share your work, post your challenge to Facebook and/or Instagram (**with an adult**) so other people in your community can learn, too! Don't forget to tag @naturevisionorg in your post! Do you live in Auburn, Bothell, Lynnwood, or King County? Use the hashtags and tag the city or county group below. They want to see all the work you are doing to keep our water clean!

- If you live in City of Auburn: Tag @auburnwa and include the hashtag #auburnwa
- If you live in City of Bothell: Tag @BothellWaUSA and include the hashtag #PugetSoundStartsHere
- If you live in City of Lynnwood: Tag @LynnwoodWA and include the hashtag #Lynnwood
- If you live in King County: Tag @KingCountyDNRP and @kingcountywtd



DAY 5

Stewardship

Stewardship is how we care for the natural world. It includes conservation of the natural resources like water that all living things need to survive, thinking and acting carefully about how we interact with the world around us, and doing our best to make sure that we have a positive impact on the environment. Specifically, these activities are focused on what students and families can do to keep water free from pollution and clean for the rest of the environment.

As we've learned this week, there are many different factors that affect the quality of our water in our community. Stormwater runoff from our neighborhoods and storm drains carries harmful debris and pollution like chemicals into our freshwater sources. The wastewater from our homes undergoes an intense level of cleaning before it is sent back to the environment, but continues to carry various chemicals into our water. Along with the issue that even our best efforts may not fully clean this water, not every community has access to stormwater or wastewater solutions.

As the human population continues to grow and we better understand our impact on the natural world, it is extremely important for us to consider ways that we can engage in stewardship efforts.

Vocabulary

Stewardship: Caring for the world around us; being a protector

Main Activity

Creative Writing

One way that people engage in stewardship is by convincing others about the importance of caring for the environment and the dangers that we may face if we ignore our role as stewards of our natural resources.

Materials: Writing utensil

Create a piece of writing — either fiction or non-fiction — to convince someone close to you of the importance of monitoring and cleaning both our stormwater and our wastewater. Your piece of writing should include an overview of why water pollution is a problem, the impacts on the environment if we choose to do nothing, and the impact of possible solutions. Use the following pages or your own paper. Examples of creative writing are listed below as an excerpt from NetWorlding Blog:

Source: <https://networlding.com/types-creative-writing/>

#1. Essays

Writing an essay requires creative thinking. This is especially true for personal or descriptive essays. If you're trying to create a persuasive argument for the reader, then you'll need to engage the creative centers of your mind to make that happen.

#2. Journals

A journal is not quite the same as a diary. Diaries help you keep track of the events that happen to you during the day. A journal takes on more of a memoir role. You can choose the types of memories that you write down by keeping everything within a specific topic or heading. Dreams are a common journal, but you could also focus on relationships, contentment, gratitude, or virtually any other emotion.

#3. Poetry

Poetry might not be a form of creative writing that hits bestseller lists often, but it shouldn't be ignored by any writer. Poems can be written in any format. You can also write them with specific form and prose if you prefer. If you really want to stretch your creative energies, try to come up with a rhyming story – kids love stories that rhyme.

#4. Vignettes

These are short stories that can take on virtually any format that is offered here. Pretty much anything goes from a creative standpoint if you're writing a vignette – except for length. This type of creative writing is extremely short. It can even just be a couple of sentences long if you wish, as long as the descriptions used are evocative.

#5. Short Stories

A short story has natural ABC progression which allows you to tell a full tale that is meaningful to the reader. These stories don't have to be lengthy either. You can write a solid short story in 1,000-2,000 words and still include character development and plot details.

#6. Letters

Our ability to communicate with one another is relying more and more on the written word these days, so writing letters to someone is a great creative writing skill to develop. You can even have your characters write letters to each other within the context of a story you're creating.

#7. Songs

Some might say that song lyrics are really just a poem set to music, but there is a certain rhythm to song lyrics that is unique to the writing world. If you can play an instrument or like to sing, then consider stretching your creative writing skills into this type of writing to see what happens. If you don't play an instrument, maybe someone you know does and would be interested in coming up with a collaboration.

#8. Blogging

Think of blogging as a published form of journaling, but without the limitation of purpose. A blog can be a personal diary, a reflection of a spiritual journey, or even be educational in nature.

#9. Free Writing

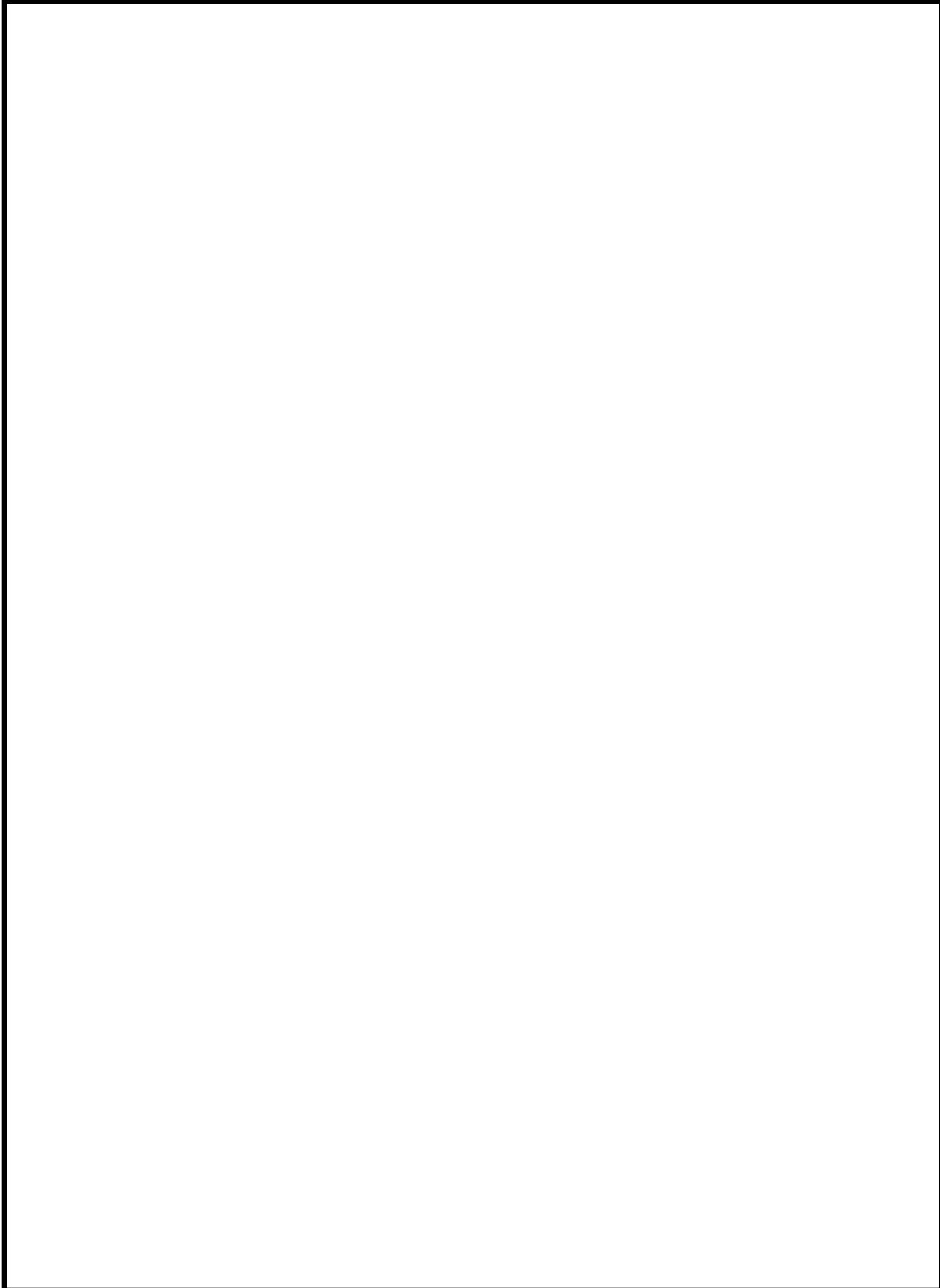
This might be the most creative type of writing. Just turn on your computer or open up a notebook and start to write. Don't let anything stop you. Whatever comes to mind gets put onto your screen or that page. Nothing is off-limits. Set a time limit for yourself – say 15 minutes. When you've finished, you may have several great ideas that can be turned into larger stories later on.

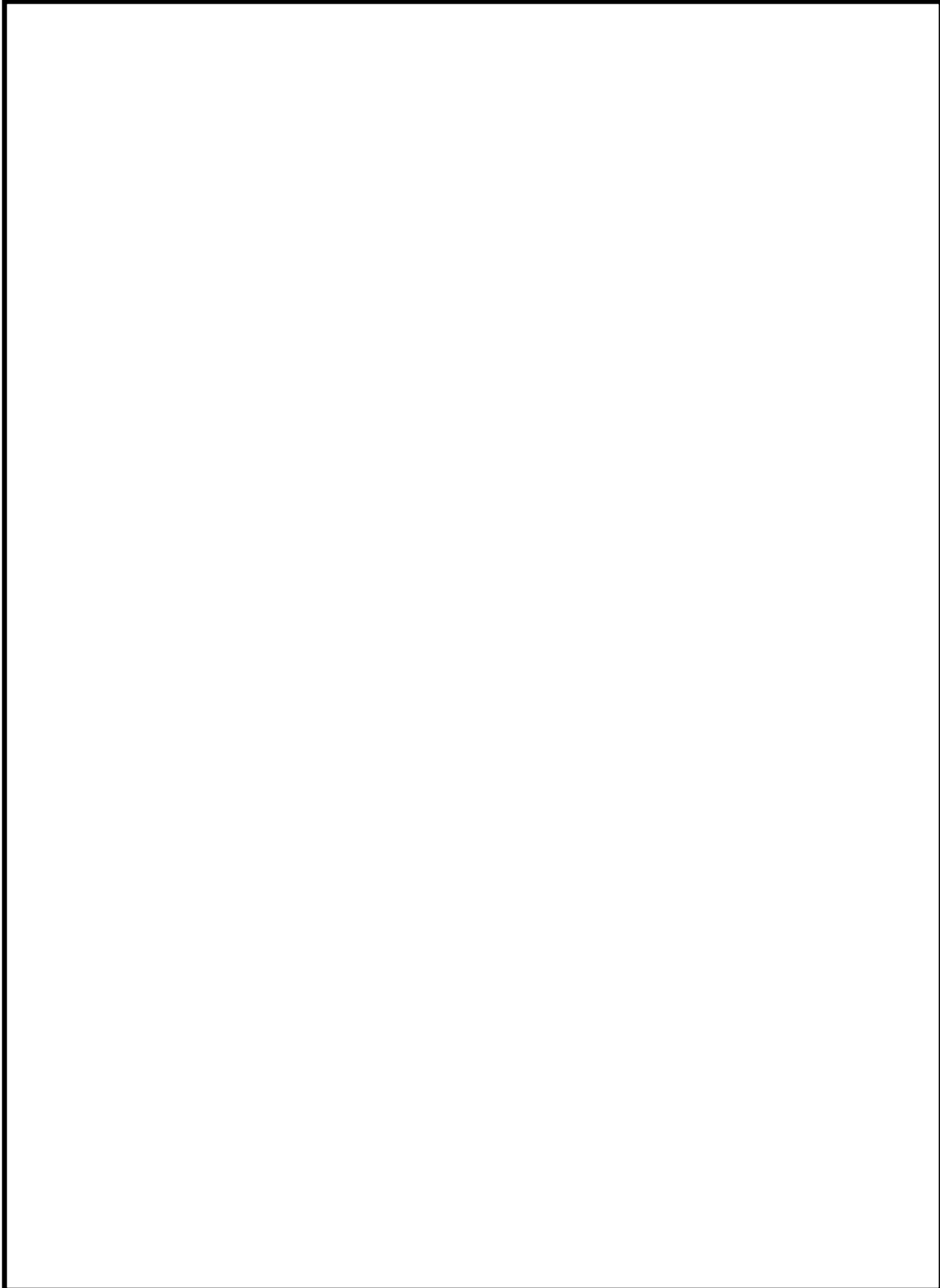
#10. Reporting

Journalists tends to follow this type of creative writing most often, especially when writing a column or opinion piece. Some journalistic writing only reports facts, events, and actions, but even then there is a certain creative element to the writing that makes it compelling. If you've ever read a local article about a city council meeting, then you've seen a reporter being creative with some very dry content so it could be interesting.

#11. Speeches

Speeches are a lot like essays, but the goal of a speech tends to be more persuasive or inspirational. The good news about this creative writing type is that virtually any subject matter can be discussed. You do have limits on length in this format – about 100 words can be spoken clearly per minute, so be precise with your key points so a rambling speech isn't the end result.





Optional Activity

What's in Your Home

Two Minutes on Oceans with Jim Toomey: Wastewater: This short video shows us how untreated water can be a problem for people and animals and what we can do to help solve this problem. Watch this video *with adult permission*. It can be found by doing a search for “Two Minutes on Oceans with Jim Toomey: Wastewater” or by following this link:

<https://www.youtube.com/watch?v=itCOY7VviRU>

After watching the video, read through the article below before conducting an audit of the chemicals in your home that would be harmful if they found their way into wastewater.

Materials: Computer/phone/tablet, internet connection

Stewardship means not only fixing or solving problems, but preventing them as well. One of the ways that we can prevent potentially toxic materials from entering our water is to be aware of, and reduce the amount of these chemicals that we use. The following article details the common sources of potentially toxic materials in our homes, as well as alternatives.

Take a moment to look through the materials in your home, especially cleaning and personal hygiene products. Did you find any of these potentially toxic materials present? Can you make a switch to a gentler alternative?

Below is an excerpt from an Experience Life article, titled “8 Hidden Toxins: What’s Lurking in Your Cleaning Products?”

By: Jessie Sholl | October 2011

1. Phthalates

Found in: Many fragranced household products, such as air fresheners, dish soap, even toilet paper. Because of proprietary laws, companies don’t have to disclose what’s in their scents, so you won’t find phthalates on a label. If you see the word “fragrance” on a label, there’s a good chance phthalates are present.

Health Risks: Phthalates are known endocrine disruptors. Men with higher phthalate compounds in their blood had correspondingly reduced sperm counts, according to a 2003 study conducted by researchers from the Centers for Disease Control and Prevention and the Harvard School of Public Health. Although exposure to phthalates mainly occurs through inhalation, it can also happen through skin contact with scented soaps, which is a significant problem, warns Alicia Stanton, MD, coauthor of *Hormone Harmony*. Unlike the digestive system, the skin has no safeguards against toxins. Absorbed chemicals go straight to organs.

Healthier Choice: When possible choose fragrance-free or all-natural organic products. Greer recommends bypassing aerosol or plug-in air fresheners and instead using essential oils or simply opening windows to freshen the air. Besides causing more serious effects like endocrine disruption, “Aerosol sprays and air fresheners can be migraine and asthma triggers,” she says. Also consider adding more plants to your home: They’re natural air detoxifiers.

2. Perchloroethylene or “PERC”

Found in: Dry-cleaning solutions, spot removers, and carpet and upholstery cleaners.

Health Risks: Perc is a neurotoxin, according to the chief scientist of environmental protection for the New York Attorney General’s office. And the EPA classifies perc as a “possible carcinogen” as well. People who live in residential buildings where dry cleaners are located have reported dizziness, loss of coordination and other symptoms. While the EPA has ordered a phase-out of perc machines in residential buildings by 2020, California is going even further and plans to eliminate all use of perc by 2023 because of its suspected health risks. The route of exposure is most often inhalation: that telltale smell on clothes when they return from the dry cleaner, or the fumes that linger after cleaning carpets.

Healthier Choice: Curtains, drapes and clothes that are labeled “dry clean only” can be taken instead to a “wet cleaner,” which uses water-based technology rather than chemical solvents. The EPA recently recognized liquid carbon dioxide (CO2) as an environmentally preferable alternative to more toxic dry-cleaning solvents. Ask your dry cleaner which method they use. For a safer spot remover, look for a nontoxic brand like Ecover at a natural market, or rub undiluted castile soap directly on stains before washing.

3. Triclosan

Found in: Most liquid dishwashing detergents and hand soaps labeled “antibacterial.”

Health Risks: Triclosan is an aggressive antibacterial agent that can promote the growth of drug-resistant bacteria. Explains Sutton: “The American Medical Association has found no evidence that these antimicrobials make us healthier or safer, and they’re particularly concerned because they don’t want us overusing antibacterial chemicals — that’s how microbes develop resistance, and not just to these [household antibacterials], but also to real antibiotics that we need.” Other studies have now found dangerous concentrations of triclosan in rivers and streams, where it is toxic to algae. The EPA is currently investigating whether triclosan may also disrupt endocrine (hormonal) function. It is a probable carcinogen. At press time, the agency was reviewing the safety of triclosan in consumer products.

Healthier Choice: Use simple detergents and soaps with short ingredient lists, and avoid antibacterial products with triclosan for home use. If you’re hooked on hand sanitizer, choose one that is alcohol-based and without triclosan.

4. Quarternary Ammonium Compounds, or “QUATS”

Found in: Fabric softener liquids and sheets, most household cleaners labeled “antibacterial.”

Health Risks: Quats are another type of antimicrobial, and thus pose the same problem as triclosan by helping breed antibiotic-resistant bacteria. They’re also a skin irritant; one 10-year study of contact dermatitis found quats to be one of the leading causes. According to Sutton, they’re also suspected as a culprit for respiratory disorders: “There’s evidence that even healthy people who are [exposed to quats] on a regular basis develop asthma as a result.”

Healthier Choice: You don’t really need fabric softener or dryer sheets to soften clothes or get rid of static: Simple vinegar works just as well. “Vinegar is the natural fabric softener of choice for many reasons,” explains Karyn Siegel-Maier in her book *The Naturally Clean Home*. “Not only is it nontoxic, it also removes soap residue in the rinse cycle and helps to prevent static cling in the dryer.” White vinegar is your best choice for general cleaning; other types can stain.

Alternatives to chemical disinfectants abound, including antibacterial, antifungal tea-tree oil. Mix a few drops of tea-tree oil and a tablespoon of vinegar with water in a spray bottle for a safe, germ killing, all-purpose cleaner. Add a couple of drops of lavender essential oil for scent.

5. 2-Butoxyethanol

Found in: Window, kitchen and multipurpose cleaners.

Health Risks: 2-butoxyethanol is the key ingredient in many window cleaners and gives them their characteristic sweet smell. It belongs in the category of “glycol ethers,” a set of powerful solvents that don’t mess around. Law does not require 2-butoxyethanol to be listed on a product’s label. According to the EPA’s Web site, in addition to causing sore throats when inhaled, at high levels glycol ethers can also contribute to narcosis, pulmonary edema, and severe liver and kidney damage. Although the EPA sets a standard on 2-butoxyethanol for workplace safety, Sutton warns, “If you’re cleaning at home in a confined area, like an unventilated bathroom, you can actually end up getting 2-butoxyethanol in the air at levels that are higher than workplace safety standards.”

Healthier Choice: Clean mirrors and windows with newspaper and diluted vinegar. For other kitchen tasks, stick to simple cleaning compounds like Bon Ami powder; it’s made from natural ingredients like ground feldspar and baking soda without the added bleach or fragrances found in most commercial cleansers. You can also make your own formulas with baking soda, vinegar and essential oils. See the “DIY Cleaners” sidebar for a list of clean concoctions.

6. Ammonia

Found in: Polishing agents for bathroom fixtures, sinks and jewelry; also in glass cleaner.

Health Risks: Because ammonia evaporates and doesn't leave streaks, it's another common ingredient in commercial window cleaners. That sparkle has a price. "Ammonia is a powerful irritant," says Donna Kasuska, chemical engineer and president of ChemConscious, Inc., a risk-management consulting company. "It's going to affect you right away. The people who will be really affected are those who have asthma, and elderly people with lung issues and breathing problems. It's almost always inhaled. People who get a lot of ammonia exposure, like housekeepers, will often develop chronic bronchitis and asthma." Ammonia can also create a poisonous gas if it's mixed with bleach.

Healthier Choice: Vodka (**adult use only**). "It will produce a reflective shine on any metal or mirrored surface," explains Lori Dennis, author of *Green Interior Design*. And toothpaste makes an outstanding silver polish.

7. Chlorine

Found in: Scouring powders, toilet bowl cleaners, mildew removers, laundry whiteners, household tap water.

Health Risks: "With chlorine we have so many avenues of exposure," says Kasuska. "You're getting exposed through fumes and possibly through skin when you clean with it, but because it's also in city water to get rid of bacteria, you're also getting exposed when you take a shower or bath. The health risks from chlorine can be acute, and they can be chronic; it's a respiratory irritant at an acute level. But the chronic effects are what people don't realize: It may be a serious thyroid disrupter."

Healthier Choice: For scrubbing, stick to Bon Ami or baking soda. Toilet bowls can be cleaned with vinegar, and vinegar or borax powder both work well for whitening clothes. So does the chlorine-free oxygen bleach powder made by Biokleen. To reduce your exposure to chlorine through tap water, install filters on your kitchen sink and in the shower.

8. Sodium Hydroxide

Found in: Oven cleaners and drain openers.

Health Risks: Otherwise known as lye, sodium hydroxide is extremely corrosive: If it touches your skin or gets in your eyes, it can cause severe burns. Routes of exposure are skin contact and inhalation. Inhaling sodium hydroxide can cause a sore throat that lasts for days.

Healthier Choice: You can clean the grimeiest oven with baking-soda paste — it just takes a little more time and elbow grease (see recipes in "DIY Cleaners" sidebar). Unclog drains with a mechanical "snake" tool, or try this approach from the Green Living Ideas Web site: Pour a cup of baking soda and a cup of vinegar down the drain and plug it for 30 minutes. After the bubbles die down, run hot water down the drain to clear the debris.

Beware of Greenwashing

If a cleaning product at your supermarket proclaims itself “green,” “natural,” or “biodegradable,” that doesn’t necessarily mean it’s nontoxic. In 2010 the environmental consulting firm TerraChoice Group produced a report called “The Sins of Greenwashing.” In it the group found more than 95 percent of so-called green consumer products had committed at least one “greenwashing sin,” like making an environmental claim that may be truthful but unimportant. “CFC-free,” for example, is a common one, since CFCs are banned by law. Donna Kasuska of ChemConscious offers this advice: “When gauging ecological claims, look for specifics. ‘Biodegradable in three to five days’ holds more meaning than ‘biodegradable,’ as most substances will eventually break down with enough time.”

DIY Cleaners

Clean your home safely — and cheaply — with the following recipes:

- **Basic sink cleanser** — Combine $\frac{1}{2}$ cup baking soda with six drops essential oil (such as lavender, rosemary, lemon, lime or orange). Rinse sink well with hot water. Sprinkle combination into sink and pour $\frac{1}{4}$ cup vinegar over top. After the fizz settles, scrub with a damp sponge or cloth. Rinse again with hot water. (From *The Naturally Clean Home*, by Karyn Siegel-Maier.)
- **Oven cleanser** — Put a heatproof dish filled with water in the oven. Turn on the heat to let the steam soften any baked-on grease. Once the oven is cool, apply a paste of equal parts salt, baking soda, and vinegar, and scrub. (From *Super Natural Home*, by Beth Greer.)
- **Bathroom mildew remover** — Good ventilation helps prevent mildew and mold. When they do occur, make a spray with 2 cups of water and $\frac{1}{4}$ teaspoon each of tea-tree and lavender oil. Shake first and spray on trouble spots. The oils break down the mildew so there’s no need to wipe it down. (From *Green Interior Design*, by Lori Dennis.)
- **Carpet shampoo** — Mix 3 cups water, $\frac{3}{4}$ cup vegetable-based liquid soap, and 10 drops peppermint essential oil. Rub the foam into soiled areas with a damp sponge. Let dry thoroughly and then vacuum. (From *The Naturally Clean Home*.)
- **Laundry soap** — Try “soap nuts” made from the dried fruit of the Chinese soapberry tree. Available in natural groceries and online, the reusable soap nuts come in a cotton sack that goes into the washing machine with clothes.
- **Dusting** — Skip the furniture polishes. Instead, use a microfiber cloth. Made from synthetic fibers that are then split into hundreds of smaller microfibers, they capture dust more efficiently than regular rags. If necessary, a little olive oil makes a fine polishing agent.

Optional Activity

Stormwater Stewardship Challenge for Day 5

There are so many ways to protect and care for our water. At the end of every daily lesson, we will be giving a stormwater challenge to help you show off what you've learned.

Materials: (Optional) writing utensil, colored pencils/markers, computer/phone/tablet, internet connection

Using what you've learned this week regarding stormwater pollution, it's time to be creative! Create a challenge you can pose to those in your household, to your friends, to your community, or to a broader audience on the internet through social media. Think about each topic the packet covered this week and list one aspect you can take from each lesson to incorporate into a new stormwater challenge for today:

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To share your work, post your challenge to Facebook and/or Instagram (**with an adult**) so other people in your community can learn, too! Don't forget to tag @naturevisionorg in your post! Do you live in Auburn, Bothell, Lynnwood, or King County? Use the hashtags and tag the city or county group below. They want to see all the work you are doing to keep our water clean!

- If you live in City of Auburn: Tag @auburnwa and include the hashtag #auburnwa
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