

YOUNG ENVIRONMENTAL LEADERS PROGRAM CURRICULUM

bnwaterkeeper.org/yelp



What is the Young Environmental Leaders Program



About Buffalo Niagara Waterkeeper

Buffalo Niagara Waterkeeper® protects and restores our water and surrounding ecosystems for the benefit of current and future generations. We protect clean water. We restore the health of ecosystems. We connect people to water. We inspire economic growth and community engagement.

For the past 30 years, Buffalo Niagara Waterkeeper has been the guardian of Western New York's fresh water. Our mission is four-fold: we PROTECT the water, we RESTORE both the waterways and the surrounding ecosystems, we CONNECT people to their waterways, and we INSPIRE both economic activity along the waterways and community engagement.

This document was created utilizing funding from a Niagara Falls Community Block Club Grant.

About the Program

The Young Environmental Leaders Program (YELP) is an immersive education and mentoring program. Buffalo Niagara Waterkeeper provides funding for the entire program with no cost to students or parents. The goal is to create leaders for conservation through experiential learning utilizing a curriculum that aligns with the Great Lakes Literacy Principles and focuses locally on Western New York and the Niagara River Watershed.

Young Environmental Leader Program Concepts

- Lake Erie and other Western New York waterways are valuable freshwater resources. They provide economic, recreation, human health and environmental benefits.
- It is important to be connected with our watershed by exploring local ecosystems including waterways, wetlands, and headwater forests.
- The Niagara River Watershed and its functions can be both positively and negatively impacted by humans.
- Being a Young Environmental Leader by taking action to advocate for clean water and healthy ecosystems can have a positive impact on the Niagara River Watershed.



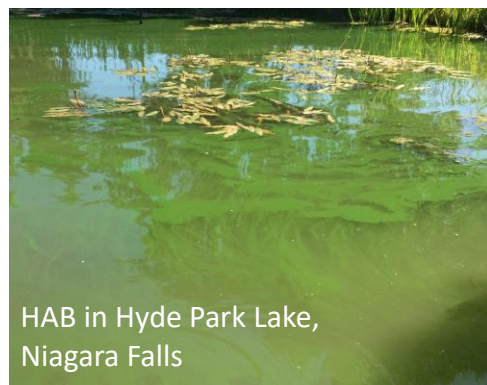


Harmful Algal Blooms are a local water quality issue that can be addressed by restoring shorelines.

Objectives

Participants will be able to:

- Define “Harmful Algal Bloom” (HAB) and explain why it is important to avoid it
- Recognize what a Harmful Algal Bloom looks like
- Describe the factors that increase the chances of an occurrence of a Harmful Algal Bloom



HAB in Hyde Park Lake,
Niagara Falls

Background

Harmful Algal Blooms (HABs) are colonies of algae that have grown excessively, or "bloomed". These colonies can produce toxins that pose a threat to human and aquatic ecosystem health and potentially cause economic damage. An **algae** is a plant-like multicellular organism that contains the pigment **chlorophyll** and produces its own nutrients.

HABs are caused by a unique set of circumstances and have been increasingly common in Western New York, having been observed in both Erie and Niagara County in 2018. They can produce toxins that cause health problems such as abdominal pain and vomiting.

HABs also have a variety of negative impacts on ecosystem health. They use up oxygen in the water, creating an anaerobic conditions that many animals like fish and macroinvertebrates can not survive in. This has a cascading impact on the entire aquatic ecosystem- disrupting interrelationships.

We can improve water quality and reduce the frequency of HABs by restoring shorelines to create **living shorelines**. These incredibly productive shoreline landscapes provide a wide range of benefits including improvements to: runoff filtration, habitat diversity, the visual character of the shoreline, flood mitigation, and erosion resistance along the edge.





HABs can have a variety of causes including:

1. **Excess Nutrients**
 - i. Sources include: Agriculture, Storm Water, Waste Water, and Fossil Fuels
2. **Increased Light and Temperature**
 - i. Ideal temperatures and sunlight needed to thrive
 - ii. Blooms generally occur July-August
3. **Changes in Water Flow**
 - i. Slow water is ideal

Waterways in the **Niagara River Watershed** often contain excess nutrients due in part to agricultural run-off and combined sewer overflows. This makes local waterways susceptible to Harmful Algal Blooms, especially in the warmer summer months.

Hyde Park, Niagara Falls

Hyde Park in Niagara Falls has seen several Harmful Algal Blooms. Hyde Park Lake has historically had poor water quality, and HABs thrive in areas with excess nutrients. The living shoreline project explained on the discussion page helps to address HABs as well as other water quality issues!



Ellicott Creek Park, Tonawanda

Ellicott Creek Park has had several instances of potential Harmful Algal Blooms in both Ellicott Creek and Tonawanda Creek. Buffalo Niagara Waterkeeper is in the process of a reforestation project at this site. Planting trees will provide shade and keep the water cool. Trees will also filter nutrients, sediment, and pollutants before they enter the water. Over time, the Ellicott Creek reforestation project can help to prevent the occurrence of algal blooms.



HARMFUL ALGAL BLOOMS (HABs)

What is a Harmful Algal Bloom?

A Harmful Algal Bloom (HAB) contains organisms that can produce toxins. Most algae are harmless and are components of a healthy aquatic ecosystem. The most accurate name for these blooms in Western New York are **Cyanobacteria Blooms**. Cyanobacteria are a phylum of bacteria and are aquatic and photosynthetic. The most widespread cyanobacterial toxin is **microcystin**.

What Causes Harmful Algal Blooms?

HABs are likely to occur in slow moving water with excess nutrients like nitrogen and phosphorus.

Warm temperatures and abundant sunlight also create ideal conditions for blooms. HABs are more likely to occur with our changing global climate.

What is the Health Risk?

HABs are harmful to people and animals. Symptoms coinciding with contact of HABs include stomach, skin, eye, and throat irritation, allergic reactions or breathing difficulties. If you think you're experiencing health risks associated with a HAB, consider visiting a healthcare professional. Pets should not enter water with a suspected HAB. Dogs and livestock that swim or drink water that contains microcystin and other cyanotoxins can become severely ill or die. Even after visible blooms subside, the toxins may still be present in the water.

Blooms in Lake Erie and Western New York Waterways

HABs have become prevalent in the western basin of Lake Erie in recent years. During the summer of 2019 there were several HABs reported at Presque Isle State Park, located along the Lake Erie coast in Pennsylvania. For additional information including forecast models visit:

www.glerl.noaa.gov/res/HABs_and_Hypoxia/

The NYSDEC HABs Program documents blooms into 3 categories:

Suspicious

DEC staff determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs.

Confirmed

Water sampling results have confirmed the presence of a cyanobacteria HAB which may produce toxins or other harmful compounds.

Confirmed with High Toxins

Water sampling results confirmed that there were toxins present in quantities to potentially cause health effects if people or animals came in contact with the water.

Buffalo Niagara Waterkeeper staff respond to HAB reports made by Riverwatch Volunteers throughout the year. A water sample may be collected by trained staff if deemed necessary. Sample results are then forwarded to the NYSDEC for confirmation. The following waterbodies in the Niagara River Watershed were documented with blooms in 2019.

Hyde Park Lake, Niagara Falls

In June of 2018 there was a 'Confirmed' HAB in Hyde Park Lake in Niagara Falls, NY. Waterkeeper staff and Riverwatch volunteers kept a close eye on this waterway in 2019 and observed another HAB in October, showing that these blooms can occur in the fall season. This 2019 bloom was deemed 'Suspicious' by the NYSDEC.

Beth Pond, Tifft Nature Preserve

In October, Waterkeeper staff observed a HAB at Tifft Nature Preserve. This bloom was deemed 'Suspicious' by the NYSDEC.

Ellicott Creek, Tonawanda

A suspected bloom was reported to Waterkeeper along Ellicott Creek near Ellicott Creek Park in Tonawanda. After further investigation this bloom was identified as a *Euglena* Bloom. This type of bloom is not considered a HAB by the NYSDEC.



Report a HAB

To report the bloom to NYSDEC fill out and submit a Suspicious Algal Bloom Report Form. Visit their webpage:

www.dec.ny.gov/chemical/77118.html

For additional information visit:

bnwaterkeeper.org/harmful-algal-bloom/



Background (continued)

Meadows, and the **edge of woodlands** contain grasses and shrubs that act as coarse filters that strain stormwater runoff, removing sediments and contaminants as water drains downhill towards the waterbody. Deep root zones add stability to the shoreline and soak up excessive nutrients carried in stormwater runoff before it enters a waterbody.



Woodlands contain large trees such as cottonwoods and willows that have deeper root systems compared to the shallow, spreading roots of upland tree species. These deep roots hold soil together, improving shoreline resistance to erosion. The large canopies of these trees provide habitat for birds and the shade they cast onto the water is ideal for fish and amphibians which eat mosquito larva.



Wetland ecologies absorb flood waters and regulate stream function, further improving shoreline stability. Aquatic vegetation grows here which provides food for fish, and the fallen woody debris that collects along the edge offers juvenile fish protection from predators and dissipates wave energy, protecting the fragile ecosystems located closer to shore.



A **gradual transition** between habitats is a defining feature of living shorelines. Each habitat, when connected with the others and the waterway, provides ecosystem services that benefit wildlife and water quality.



ACTIVITY 1: Erosion Model

This activity is adapted from: <https://www.soils4teachers.org/home>

This experiment is meant as a hands on exploration of how plants keep our soil intact and help to purify water! The experiment can be carried out over several lessons, or a single lesson. If possible, visit a local waterway or living shoreline habitat restoration project with your students.

Time

1.5 – 2 hours

Grade Level

9 -12

Materials

- 3 large plastic water jugs
- Potting soil
- Grass
- 3 plastic water bottles
- Yarn

1. Collect three large plastic water jugs. Have students carefully cut the top portion of each jug, leaving a large open space
2. In the first water jug, plant seeds.
3. In the second water jug, place dried leaves and other “detritus” collected from outside.
4. In the third and final water jug, place only soil.
5. Carefully remove the bottom half of each of the three plastic water bottles. Using hole puncher or scissors, attach yarn the sides and hang from the larger water jugs. Ensure that the cap of each plastic water bottle is tightly closed.
6. Add an ample amount of water to each large water jug, containing the plants, dried leaves, and soil. The water should slowly percolate through and collect in the plastic water bottles.
7. Allow students to make observations.
8. The roots of plants hold soil in place. When water runs through the jug with plants it comes out clearer than the jug with leaves and the jug with only soil.



This experiment shows the importance of plants as a part of our shoreline habitats. Water running into a waterbody that passes through soil with vegetation will be clearer and cleaner. Plants help to stabilize shorelines, prevent erosion and sedimentation, and keep water clean.

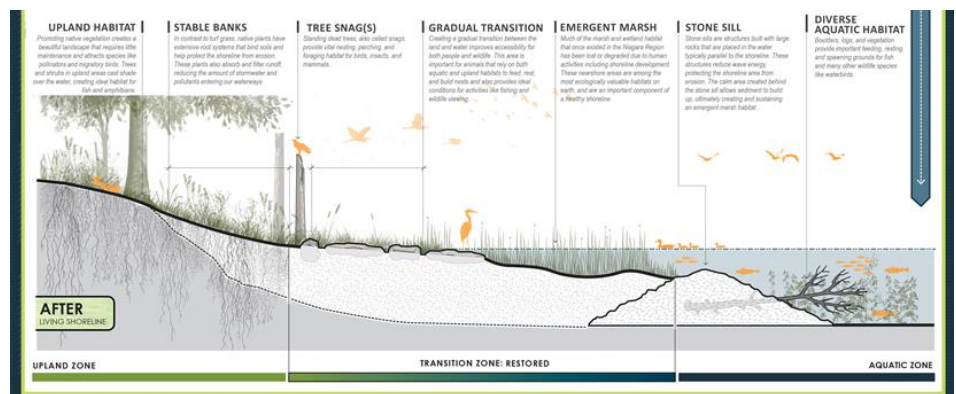


ACTIVITY 2: Riparian Zone Restoration Tour




The best way to make a connection with the natural environment is to see it in person! If you have the opportunity, take your students to visit a local shoreline and see these concepts in action. For a list of shoreline restoration sites, visit <https://bnwaterkeeper.org/projects/livingshorelines>

1. Head to the waters edge and walk along it. While walking, ask the students for observations about the shoreline or to describe the shoreline habitat.
2. Use a riparian buffer diagram to help explain this habitat type.



3. Describe a storm event and why stormwater runoff is an ongoing source of pollution. Have students list pollutants that could be carried into waterways via stormwater.
4. Ask the students “why would plants (a buffer zone of thick vegetation) reduce the threat of stormwater runoff?” – make sure to emphasize absorption of stormwater and reduced erosion.

The Gill Creek Watershed is great watershed to use to learn about the importance of healthy shoreline habitat. Check out the website below for handouts and more information: <https://bnwaterkeeper.org/gillcreek/>

 **BENEFITS OF RIPARIAN BUFFERS**

Plants growing beside Gill Creek make up the riparian buffer. A riparian buffer is a wide strip of native trees, shrubs, and grasses, that helps in the following ways:

- ▶ Improves and protects water quality.
- ▶ Creates shade keeping water cooler.
- ▶ Links valuable wildlife corridors.
- ▶ Reduces bank erosion and sedimentation.
- ▶ Captures nutrients and pollutants.
- ▶ Supports plant and animal diversity.

 **PROJECT OVERVIEW**

In partnership with the City of Niagara Falls, N.Y. and with funding from the U.S. Forest Service Great Lakes Restoration Initiative, Buffalo Niagara Waterkeeper mobilized volunteers to plant over 1,000 trees and shrubs during a three year period along the Gill Creek corridor. This project offered volunteers a direct way to help improve the well-being of their communities and local watershed. Plantings implemented during this project are one step towards restoring the water quality and aesthetic beauty of Gill Creek while also enhancing recreational opportunities.

- ▶ NINE RIPARIAN PLANTING LOCATIONS
- ▶ OVER 600 VOLUNTEERS ENGAGED
- ▶ 1,125 NATIVE TREES AND SHRUBS PLANTED
- ▶ 26,810 GALLONS OF STORMWATER CAPTURED ANNUALLY



ACTIVITY 3: Invasive plants Vs. Native Plants

Find handouts for native and invasive species online. This is a good resource
<https://plants.usda.gov/java/factSheet>

1. Some vegetation has greater ecological value and impacts than others.
2. Find a specimen of the native plants which match the handouts you will be providing, such as a native tree (sugar maple, tulip tree)
 1. Identify the plant and list some describing features
 2. Explain how it supports local wildlife
3. Move onto a second specimen and ask the students to describe it and see if they can guess how it supports wildlife. Fill in any important facts they did not guess or point out.
4. Now find an invasive plant species that matches one of your info sheets such as purple loosestrife or common buckthorn.
 1. Identify the plant and list some describing features
 2. State its native habitat range and how it arrived here
 3. Provide a definition of an invasive species.
 4. Explain how it causes harm (ecological, economic, and human health)
 5. Explain how to control and remove the invasive specie.
5. Find a second invasive species and have the students describe this specimen. Have them guess its impacts and control and removal method. Fill in any information they missed.
6. The students should now be able to answer questions 4-6 on the worksheet.
7. Give students time to finish the worksheet and then collect them. Encourage students to take pictures of the habitat while they wait for other students to finish.

Example Handouts:


USDA NRCS
 United States Department of Agriculture
 Natural Resources Conservation Service

Plant Fact Sheet

TULIP POPLAR

Liriodendron tulipifera L.
 Plant Symbol = LITU

Contributed by: USDA NRCS New York State Office



Alternate Names
 yellow-poplar, tulip magnolia, tulip tree, whitewood

Uses
 The wood of tulip poplar is moderately light, soft, brittle, moderately weak, and is very easily worked. It is used for furniture stock, veneer and pulpwood.

Tulip poplar makes a desirable street, shade, or ornamental tree but the large size it attains makes it unsuited for many sites. Its good points for aesthetic use are: (1) rapid growth (2) pyramidal form (3) resistance to insect and disease damage (4) unusual leaves and attractive flowers, and (5) yellow autumnal color.

This species has some wildlife value. The fruits provide food for squirrels in the late fall and winter months, and the white-tailed deer often browse on the twigs.

Tulip poplar is planted for reforestation purposes because of its rapid growth and the commercial importance of its wood, and is often planted as an ornamental. Tulip poplar and white pine were the largest trees in the eastern forest.

Status
 Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
 Tulip poplar actually is not a poplar, but a member of the magnolia family. The leaves are tulip-shaped, alternate, and simple. The leaf is smooth on both surfaces, dark green and lustrous above, pale and often with a slight whitish bloom beneath.

Twigs are moderately stout, olive-brown, to reddish brown, very smooth and usually hairless; the large terminal bud has two large dark-bell-shaped scales.

Tulip poplar produces tulip-shaped, light greenish-yellow flowers from April to June. It is a prolific seed bearer but has a low percent germination. The cone shaped fruit clusters usually persist on branches. There are about 12,000 seeds per pound.

The bark on younger trunks and branches is quite smooth, light silty-gray with very shallow, longitudinal, whitish furrows. With age the bark becomes very thick, having deep undulating furrows and rather narrow rounded ridges.

This tree is rapid growing, attaining heights of 80-120 feet and a trunk diameter of 2 to 5 feet. Young trees have a pyramidal form.




Adaptation and Distribution
 Tulip poplar is exacting in soil and moisture requirements. It does best on moderately moist, deep, well drained, loose textured soils; it rarely grows well in very dry or very wet situations. It will tolerate a pH of 4.5 to 7.5.

Tulip poplar is distributed throughout the east and southeast portions of the United States. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Web site.

Establishment
 Natural regeneration of tulip poplar is usually by stump sprouts and seed. Regeneration from seed requires a seedbed of mineral soil, adequate soil moisture, sufficient direct sunlight for early growth; seedlings are intolerant of shade.

Plant Materials <<http://plant-materials.nrcs.usda.gov/>>
 Plant Fact Sheet Outline Coordination Page <<http://plant-materials.nrcs.usda.gov/outline/pfs.htm>>
 National Plant Data Center <<http://npdc.usda.gov/>>

COMMON BUCKTHORN (*Rhamnus cathartica*)

This species of small trees was introduced from Europe as an ornamental hedge plant

Identification:

- Perennial woody shrub that can grow up to 20 feet tall
- Leaves are elliptic in shape with toothed edges
- Has a thorn located at the tip of most branches
- Dark bark has lenticels or small horizontal markings that allow for gas exchange
- Flowers are small and appear in clusters, bloom in late spring or early summer
- Small pea-sized fruit turn from green to red and then finally black when ripe
- Fruit often remains on plant through winter

Impact:

- Seeds easily propagate, especially in disturbed sites
- Grows rapidly, forming dense thickets that crowd out other plants
- Decomposing leaves can alter soil pH

Control/Removal:

- Hand pull small young plants
- Larger plants may require digging and larger equipment
- Frequently check disturbed soil areas for new growth
- Chemical herbicides can aid in control when applied to plants



Discussion Questions

1. What does algae need to survive?

Algae, which are plant-like, need water, sunlight, and nutrients. They grow quicker in warmer conditions.

Like other green plants, algae create and metabolize food through the processes of photosynthesis and respiration.

PHOTOSYNTHESIS

carbon dioxide + water + light energy → food (carbohydrates) + oxygen
 (CO_2) (H_2O) $(\text{C}_6\text{H}_{12}\text{O}_6)$ (O_2)

RESPIRATION

food (carbohydrates) + oxygen → chemical energy + water + carbon dioxide
 $(\text{C}_6\text{H}_{12}\text{O}_6)$ (O_2) (H_2O) (CO_2)

2. What is a Harmful Algal Bloom? What are two characteristics to look for when identifying a HAB?

HABs can be difficult to identify! **Harmful Algal Blooms** are a kind of **cyanobacteria**, and are often confused with green algae because both have species that bloom and form mats on the water. HABs will look like spilled paint or pea soup, they will form streaks or dots on the water's surface.

Cyanobacteria



Green algae/ Chlorophyta



It is always best to avoid and report possible HABs – even if you are not sure!



Discussion Questions

3. Why do Harmful Algal Blooms occur?

HABs occur when there are ideal conditions for photosynthetic organism to grow growth, including: excess nutrients, increased light and temperature, and slower-moving or still water. Some waterways in the Niagara River Watershed are more at risk than others, because of these conditions.

4. How can we prevent Harmful Algal Blooms?

We can prevent HABs by keeping our water clean and free from excess nutrients! Plants along a shoreline can filter water before it runs-off into ponds or lakes. Planting trees near a body of water can also prevent HABs by providing shade and keeping the water cool.



The living shoreline project at **Hyde Park in Niagara Falls** aims to improve water quality and address algae blooms! Plantings of over 1,300 native plants along the shoreline and in the water help to protect the shoreline from erosion, improve water quality by absorbing pollutants and adding oxygen to the water, and provide important habitat for a variety of species. See the Buffalo Niagara Waterkeeper “Living Shorelines” lesson to learn more.

5. What are possible consequences of a sudden increase in algae on fish and other organisms living in the lake?



Fish need oxygen in the water in order to survive. Waterways with greater algae growth tend to have less dissolved oxygen. HABs are decomposed by bacteria, a process which uses up oxygen. This can create anoxic conditions that many animals like fish and macroinvertebrates can not survive in. This has a cascading impact on the entire aquatic ecosystem!



Discussion Questions

6. What is a Living Shoreline?

Living shorelines can include many important habitat features such as:

- Native flowers and grasses
- In-water habitat
- Aquatic vegetation
- Natural shoreline protection
- Gradual transitions between habitats
- Live branch layering
- Nesting boxes
- Shoreline trees
- Fish-spawning area
- Emergent marsh

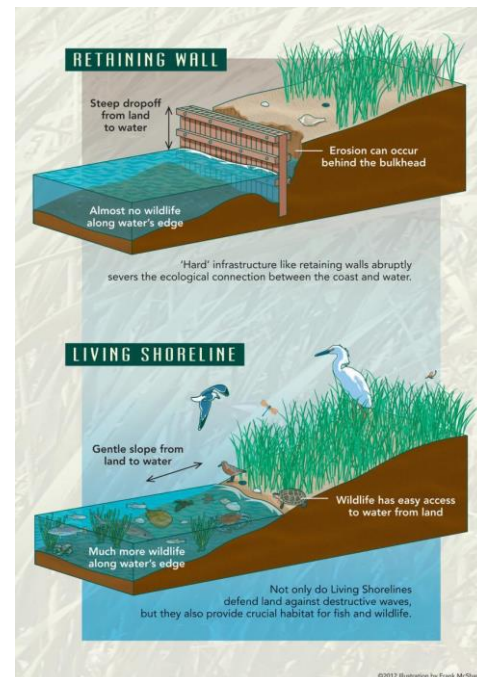
Each of these features provide several benefits to both water quality and wildlife. The most important features include **gradual transitions**, **native species**, and the use of **natural elements**.



7. Why are Living Shorelines important?

Erosion is a natural process, but the rate of erosion has dramatically accelerated due to human activities along water systems. **Mow-to-edge** practices can accelerate erosion and lawns, or habitats that are overtaken with **invasive species** like Japanese Knotweed, lack the ability to adequately intercept stormwater runoff before it enters a waterbody. Untreated stormwater runoff can carry petroleum, pathogens, sediments, and other pollutants like phosphorous and nitrogen. These pollutants can harm aquatic ecosystems and reduce water quality.

A healthy shoreline is key to achieving a healthy waterbody!



A **living shoreline** addresses these issues and improves water quality while providing habitat for wildlife. In contrast to hardened shorelines (structural edges) which becomes weaker over time, a living shoreline grows stronger and more resilient.



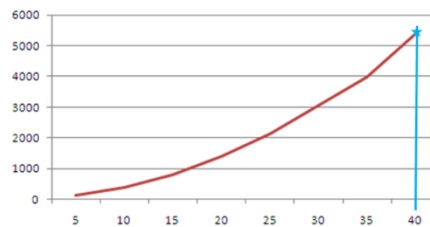
Discussion Questions

8. How can trees prevent water pollution?

The trees we walk by in our cities and towns provide a wide array of benefits — beauty, habitat for our animals and cleaning the air we breathe. But one benefit is often overlooked: how trees help ensure the rain from our sky does not become storm water runoff that harms our creeks, waterways and wildlife. Because they capture rainfall and release it gradually, trees improve water quality by limiting the flow of water and pollutants downstream.

- Tree roots and leaf litter promote slow absorption of water back into the ground
- The tree canopy intercepts raindrops, preventing erosion
- Reduced volume of water runoff reduce erosion and pollution downstream

Stormwater Interception by Hackberries vs. Age of Tree



5 yr. old hackberry intercepts 133 gal. rain/yr.
20 yr. old hackberry intercepts 1,394 gal. rain/yr.
40 yr. old hackberry intercepts 5,387 gal. rain/yr.



Celtis occidentalis
'Hackberry Tree'

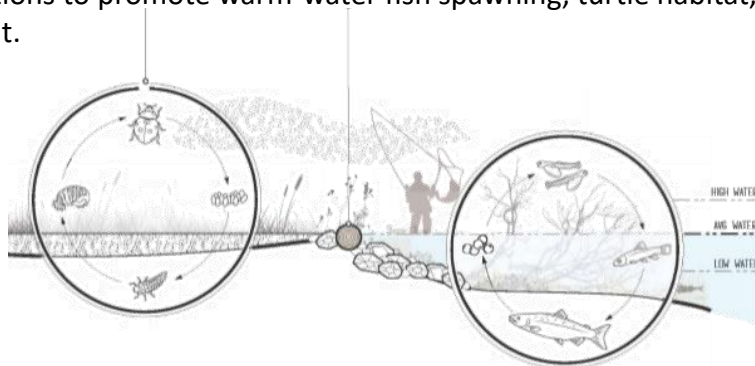
9. Why is it important to plant native plants?

Native plants attract pollinator species, support wildlife, and their deep root systems reduce erosion and filter harmful runoff before entering waterways.

- Native plants have evolved over thousands of years in a particular region. Communities with native plants tend to be more resilient and stable. They support native pollinators and other wildlife.
- Invasive plants displace native plants, provide inadequate food and habitat for native wildlife and spread very aggressively

10. Why is aquatic habitat important?

Aquatic vegetation provide important habitat for species like fish and amphibians. The plants also protect shorelines from erosion and improve water quality and clarity. In-water habitat features can also create ideal conditions to promote warm-water fish spawning, turtle habitat, and bird habitat.



Homework Opportunities

- Why should you choose to plant native species over exotic species? Use the Native plant guide to answer this question and design a garden habitat for your yard. List 5 native species, why you chose them, if you think they will survive in your yard, and what wildlife will be attracted to your garden. Lastly, is there anyway you could design your garden to reduce stormwater runoff?

Native Plant Guide: <https://bnwaterkeeper.org/projects/nativeplantguide/>

- What is the water quality of Gill Creek? Use the Riverwatch report to determine the pH, Temperature, Conductivity, DO, Turbidity, and total dissolved solids of Gill Creek. How does the creek score? Choose either DO or Turbidity and describe the parameter, what is the standard set for the parameter, and how it could impact wildlife. How might stormwater runoff impact this parameter? Does Gill Creek fall within the standard for this parameter?

Riverwatch Water Quality Report: <https://bnwaterkeeper.org/riverwatch/>



Additional Resources

Gill Creek Website: <https://bnwaterkeeper.org/gillcreek/>

Living Shoreline Website: <https://bnwaterkeeper.org/projects/livingshorelines/>

WNY PRISM Invasive Species Info: https://www.wnyprism.org/invasive_species/

Watershed Info: <https://www.epa.gov/hwp/basic-information-and-answers-frequent-questions>

