Exploring Our Watershed

This lesson is designed to allow you to make connections between climate change and various water issues in the Lake Champlain watershed. At 120 miles long and 400ft. deep at its deepest point, Lake Champlain is the 13th largest lake by surface area in the United States, containing about 6.8 trillion gallons of water. The watershed itself is even bigger – covering 8,234 square miles, it contains areas in New York, Vermont, and Quebec. In this lesson we are going to dive deeper into the challenges facing the lake and its watershed, discover our place in the watershed, and learn more about what can be done to protect the lake and those dependent on it.

Climate change is adding additional stress to our already impacted waterways. As the climate continues to warm these additional impacts have the ability to dramatically change many aspects of life throughout the region. The average temperature in New York State has risen about 2.4°F since 1970. Annual snowfall in the Adirondacks is around 175 inches. It's projected that there will be 28% fewer snowstorms per year throughout the region.

It's also estimated that the amount of snow or frozen precipitation per storm would decrease by one-third by the 2090s. By the 2050s, sea level is expected to be as much as 30 inches (2.5 feet) higher in New York's coastal area. By 2100, New York's coast could see up to 6 feet of sea-level rise. These high sea-levels will lead to severe coastal flooding and storm surges. New York is taking steps to mitigate the harmful effects of climate change through community planning, greenhouse gas reduction programs, investing in renewable energy, and creating green jobs. Unfortunately, we have already begun to see the effects of climate change across the world. In the Lake Champlain watershed we are seeing the effects of climate change impact our local lakes, streams, and rivers. In this lesson we will discuss two topics that are connected to the health of our waterbodies: road salt, and temperature. These topics are heavily influenced by the complications that climate change is creating.

Instructions:

We are going to evaluate the complex relationships in the Lake Champlain watershed during spring, summer, and fall. In particular, we will evaluate three key topic areas: heavy precipitation, aquatic invasive species (AIS), and harmful algal blooms (HABs). These topics can give us insight into changes occurring within the watershed, which ultimately impacts our waterbodies and our communities.

- You will be assigned one of the following water and climate topics: heavy precipitation, aquatic invasive species (AIS), and harmful algal blooms (HABs).
- Read through the Factsheet for your assigned water and climate topic.
- As you read the Factsheet, be sure to click on links (Example: Adirondack Watershed Institute).
- There will be three questions in each Factsheet. You will answer the questions for your assigned water and climate topic on page 10.
- Feel free to look through the Factsheets that aren't assigned to you.
- After completing the Factsheet component of this lesson your teacher will give you instructions on the next steps.

DEFINITIONS & CONCEPTS

These definitions will help you better understand the connections between water and climate change.

Community-Based Science

Community-based science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through community-based science, people share and contribute to data monitoring and collection programs.

Climate Change

Any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

Ecosystem-based Management (EBM)

Ecosystem-based management is an emerging, integrated approach to natural resources management that considers the entire ecosystem, including humans, to achieve improved environmental conditions and sustained ecosystem services that support human needs and social goals.

Watershed

An area of land where all water drains to a central point such as a lake, pond, or river. Also referred to as a drainage basin.

Aquatic Invasive Species (AIS)

Aquatic Invasive Species (AIS) are nonnative species that are fast growing and difficult to control. Invasive plants and organisms that thrive can drastically alter an ecosystem by making it more challenging for native plants and organisms to survive.

Harmful Algal Blooms (HABs)

Cyanobacteria are microorganisms that are often referred to as blue-green algae. These organisms can become problematic with an increase in nutrients such as phosphorus, causing Harmful Algal Blooms.

Heavy Precipitation

Instances during which the amount of rain or snow experienced in a location substantially exceeds what is normal. What constitutes a period of heavy precipitation varies according to location and season.

Road Salt

The use of road salt to de-ice our roads is a common practice during the winter months. High levels of sodium and chloride found in road salt cause problems for humans and lake ecosystems.

Temperature

Water temperature influences several other components of a lake ecosystem. Temperature can alter the physical and chemical properties of water.

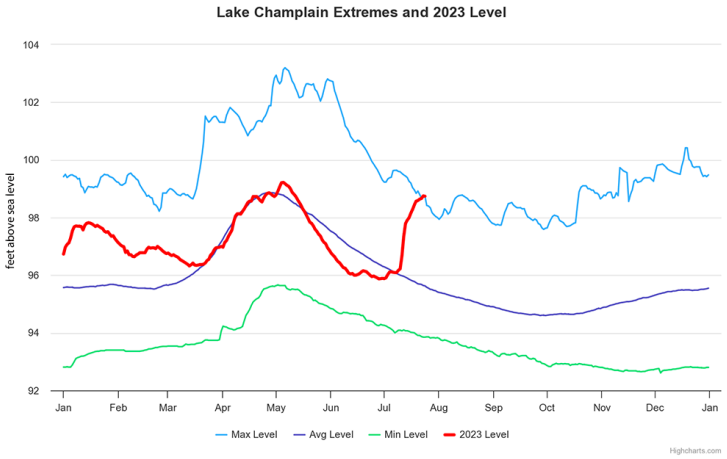
Factsheet: Heavy Precipitation

Heavy precipitation refers to instances where the amount of rain or snow exceeds what is normal in a specific location. The amount of rain or snowfall that is considered heavy precipitation might vary depending on the season. Climate change can impact the frequency and severity of heavy precipitation events. Warmer oceans and lakes increase the amount of water that evaporates into the air. This additional moisture in the air moves over a landscape and converges with a storm system, leading to heavier rainfall or snowfall events. Overall, annual precipitation across New York State has increased since 1900. Increased precipitation is expected to continue as the climate continues to warm. Between 1958 and 2012, the northeastern region of the United States has experienced a 71% increase in heavy precipitation, the highest increase of any region in the country. Sometimes called intense storm events, the increase in heavy precipitation results in localized flooding, such as the flooding experienced along the Ausable River in recent years. These heavy precipitation events don't only occur during the spring, summer, and fall seasons but are also becoming more frequent in the winter months. In December 2023, heavy rain combined with snowpack lead to Lake Champlain being at a higher level (99ft.) than it was during following the July 2023 flood event.

Read:

July 2023 Flooding - LCBP

In July of 2023, Vermont and some areas of New York received a storm that brought seven inches of rain to the region. As a result, ten thousand miles of streams and rivers rose, sending water downstream and into Lake Champlain. Over its 435 square mile area, Lake Champlain rose 3ft. The graph below shows average surface water levels in Lake Champlain, along with maximum and minimum historic levels. Note the red line labeled 2023 Level, which shows a higher-than-average water level in the spring, as well as the elevated July level due to the large rain event.



Source: National Weather Service, Lake Champlain Basin Program, 2023: https://www.lcbp.org/our-goals/thriving-communities/flooding/2023-flooding/

Heavy precipitation events have a great influence on water quality and ecosystem health. When the flow of water is increased, sediment and pollutants are more likely to travel to larger lakes, such as Lake Champlain. Nutrients such as phosphorus are delivered in high quantities.

Factsheet: Heavy Precipitation

Ecosystem-based Management Solutions:

Heavy precipitation can cause a variety of problems for a community. Flooding, runoff, erosion, and landslides are common results of these severe events. Heavy precipitation events can overwhelm septic systems, sending excess wastewater into lakes, rivers, and into the community. Ecosystem-based management solutions for heavy precipitation aim to empower both human and biotic communities. One solution for homeowners and business owners is encouraging the use of rain gardens. Rain gardens are depressions in the ground containing plants that consume a large amount of water. Their purpose is to absorb runoff floodwater that occurs in urban or residential areas. Rain gardens are helpful tools in areas where there are a lot of impervious surfaces, such as urban landscapes, residential or commercial parking areas, or along walkways or roadways.

Watch:

Green Stormwater Infrastructure

Read:

Create A Rain Garden - NYDEC
Ask the scientist: Extreme rainfall, why it happens and how we predict it - NOAA

In addition to rain gardens, communities implement unique tools to reduce flood risk. Hamilton County Soil and Water Conservation District (HCSWCD) has utilized a few other methods such as rain barrels and bioswales to control runoff (Hamilton County Green Infrastructure Demonstration Project). Across New York State there are cities, towns, and villages participating in the Climate Smart Communities (CSC) project. CSC is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. This program awards participating communities funding to work on projects that make their area more resilient to the threats of climate change. Examples of projects include conserving additional green spaces for recreation, improving walkable surfaces to reduce flood risk, switching to cleaner energy sources, or including electric charging stations for vehicles. Many CSC communities are found throughout New York State, including several newly certified communities. In Vermont, the Department of Environmental Conservation is working in partnership with the Lake Champlain Sea Grant Program (LCSG) at UVM on the Green Infrastructure Collaborative (GIC) that will promote Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) to manage runoff.

Answer:

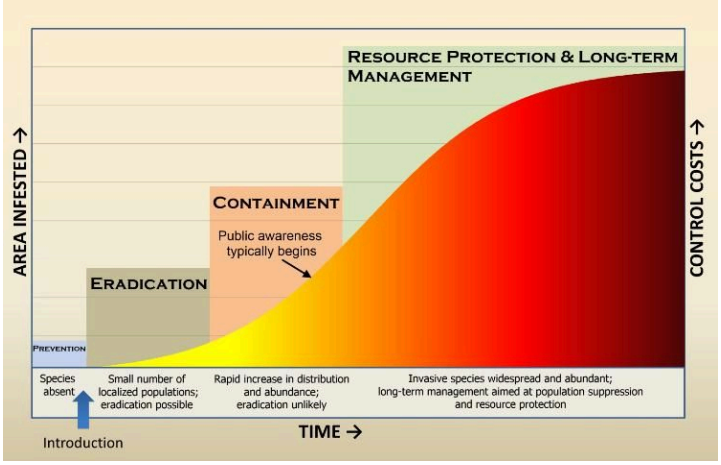
Is your community a Climate Smart Community? (Find out: Climate Smart Communities)
Has your community recently experienced a significant flooding event?
What types of plants might be included in a rain garden?

Factsheet: Aquatic Invasive Species (AIS)

Waterbodies in the Lake Champlain Basin contain a wide variety of aquatic life. A healthy lake, stream, or pond will contain native species of plants, animals, and microorganisms. Healthy waterbodies are vital to both biotic and human communities. Unfortunately, Aquatic Invasive Species (AIS) can impact the health of a watershed. These invasive aquatic plants, animals, and microorganisms are found throughout New York State and Vermont, including Lake Champlain, and often outcompete native organisms for habitat and nutrients. In Lake Champlain alone, there are 51 known aquatic non-native and invasive species that have been identified. AIS are often introduced by hitching a ride on boats, cars, or humans from one waterway to the next. AIS are often faster growing than their native counterparts, quickly establishing territory within the habitat they've invaded. Not only do these organisms outcompete other members of the biotic community, but they can cause disruption to recreation and local economies.

The Northeastern U.S. is experiencing warming weather conditions that is expected to result in the migration of new invasive species as well as higher populations of existing species (Allen and Bradley, 2016). In these instances, early-detection is important for protecting native species and ecosystem health. Hydrilla verticillata is an example of a high priority early-detection invasive species requiring a rapid response to prevent ecological and economic harm.

Other species such as Eurasian watermilfoil (Myriophyllum spicatum), are well established and have passed the early-detection phase requiring ongoing management such as removal. The invasion curve shows the process that invasives undertake when being introduced to a new area and how they must be managed.



Source: The invasion curve. Adapted from Invasive Plants and Animals Policy Framework, State of Victoria, Department of Primary Industries, 2010.

Climate change is impacting the ecological processes of our lakes, ponds, and rivers. Subtle changes in lake ice can cause water bodies to shift their mixing period, lowering oxygen levels. The cycle of lake turnover is essential in mitigating the harmful impacts of low oxygen zones, which impact fish and other aquatic life. A change in oxygen levels might offer an advantage to AIS, allowing them to outcompete native species in less habitable areas of a waterbody.

Factsheet: Aquatic Invasive Species (AIS)

Ecosystem-based Management Solutions:
Although AIS are present throughout New York State, the goal is to prevent and limit their spread from one waterway to another. There are a few management practices that accomplish this. Educating the public about AIS spread is the desired first step. Throughout the Adirondacks there are over one hundred Watercraft Inspection Stewards employed by organizations such as the Adirondack Watershed Institute. A similar program exists in Vermont, which is managed by the Lake Champlain Basin Program. Watercraft stewards in the Lake Champlain watershed engage with the public before and after launching a boat, inspecting the watercraft and asking a series of questions to understand where the boat has previously traveled to. Stewards are able to identify and intercept aquatic plants and organisms on site through a decontamination program. If a boat has been identified to be carrying AIS, stewards will clean the vessel with a pressure washer before the boat is launched again.

Watch:

Aquatic Invasive Species

Early detection and rapid response are key for reducing AIS, while established populations necessitate various control methods like dredging, harvesting, and the use of biological or chemical controls. Climate change further complicates AIS prevention and management, potentially requiring new control approaches due to shifting seasonal conditions.

Success Stories:
Communicating the harm that aquatic invasive species can cause has been an effective tool for slowing their spread. Watercraft Inspection Stewards across the Adirondacks interact with thousands of boaters each year, intercepting aquatic invasive species on motorboats, kayaks, canoes, and other watercraft. In 2023 Adirondack Watershed Institute stewards inspected 69,101 boats, performed 3,146 decontaminations (boat washes), and found 1,169 aquatic invasive species.

Read:

Hydrilla and other invasives knocking on doors to the Adirondacks

Knocking on Lake Champlain's Door: The Round Goby

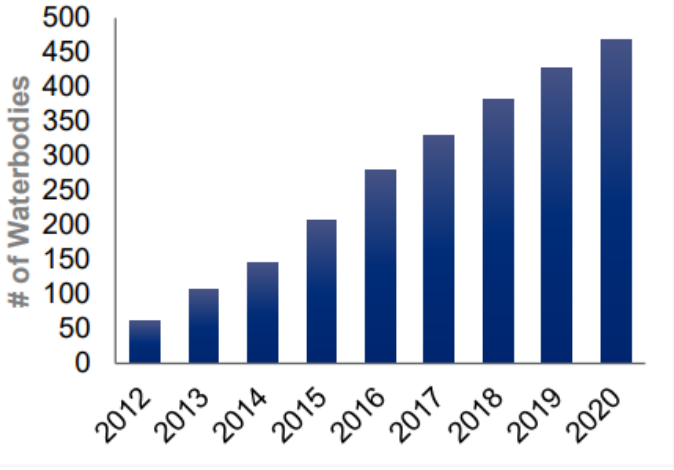
Answer:

What are some AIS that aren't yet in the Lake Champlain Watershed?
What AIS are found in the Adirondacks?
What are current prevention methods?

Factsheet: Harmful Algal Blooms (HABs)

Blooms of algal species that produce toxins are known as Harmful Algal Blooms (HABs). Many of the HABs are not true algae at all, but are photosynthetic bacteria called cyanobacteria. Rapid growth results in surface accumulation that can resemble thick mats, spilled paint, streaking or "dots in the water column." Increased nitrogen and phosphorus, adequate sunlight, warmer temperatures, and slow-moving water create ideal conditions for HABs. Climate change is expected to increase the likelihood of HABs; a warmer climate increases water temperatures and heavy precipitation events are already increasing nutrient runoff into lakes, ponds, rivers and streams. Nutrients such as nitrogen and phosphorus can come from many types of land uses, including agriculture, residential neighborhoods and commercial areas. As waterbodies become more eutrophic, HABs are more likely to occur. Harmful Algal Blooms can lead to human health impacts, loss of aquatic life, and can put dogs and livestock at risk of serious illness or even death. Often when blooms are present, recreation slows as public beaches and boat launches are closed to protect the public. Cyanobacteria blooms occur throughout New York State. The New York State Department of Environmental Conservation (NYSDEC) has been routinely monitoring HABs in New York since 2012.

In 2018 harmful algal bloom action was prioritized to include the development of waterbody-specific HABs Action Plans and mitigation studies, including one for Lake Champlain. Included in the large Lake Champlain watershed are 235 significant freshwater lakes, ponds, and reservoirs, as well as 4,883 miles of freshwater rivers and streams. With heavy rain events expected to increase, these rivers and streams will carry more sediment and pollutants with them to larger lakes, ponds, and to Lake Champlain. When more phosphorus or nitrogen is made available to these waterbodies, the higher the likelihood that a bloom could occur. The chart below includes the cumulative number of waterbodies in New York State which HABs have been documented by the NYS Department of Environmental Conservation.



Source: HABs Research Guide, NYS Department of Environmental Conservation.

Factsheet: Harmful Algal Blooms (HABs)

Ecosystem-based Management Solutions:
Lake Champlain has been impacted by cyanobacteria blooms for many years. In addition to creating watershed action plans for the watershed, several other mitigation efforts are underway. In 2012 the Lake Champlain Committee (LCC) started a volunteer cyanobacteria monitoring program. LCC trains the volunteer monitors to identify harmful algal blooms, from mid-June through the fall. Monitors collect water samples from their location and submit observations by using an online form. This example of community-based science empowers local residents and visitors to take action on water quality challenges in their community. Another resource for community members is the NYSDEC Suspicious Algal Bloom Report Form. This tool enables community members to be engaged in reporting methods, as those that live, visit, and depend on the lake are likely to notice changes to water quality. The Paul Smith's College Adirondack Watershed Institute is working with partners to increase capacity to identify, respond to, and educate others about harmful algal blooms in the Adirondacks.

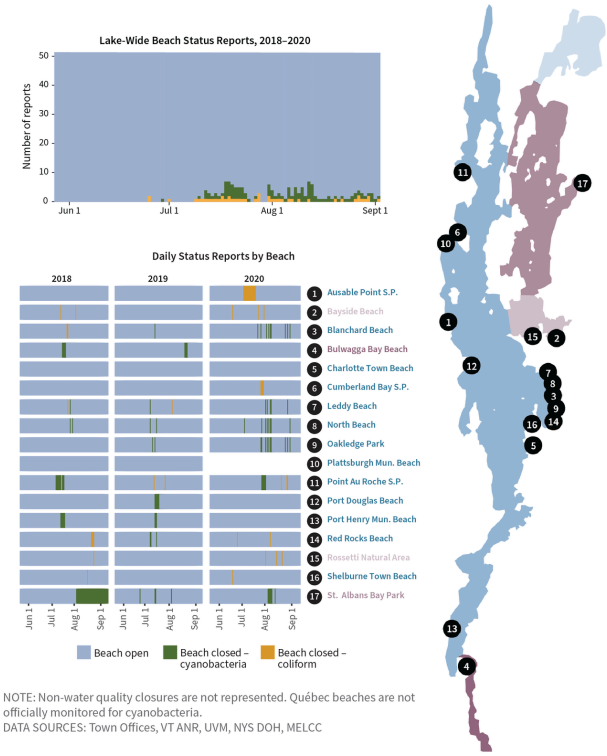
Watch:

Diving In: Volunteer Monitoring for Cyanobacteria

Read:

Understanding algal blooms - Adirondack Explorer

Beach closures are a common result of harmful algal blooms. The chart below shows beach closures along Lake Champlain from 2018-2020, many of these closures a result of HABs.



Source: Lake Wide Beach Status Reports, 2018-2020. Lake Champlain Basin Program (LCBP): https://www.lcbp.org/our-goals/clean-water/nutrients-and-cyanobacteria/cyanobacteria/.

Answer:

What are some impacts of harmful algal blooms?
What are the ideal conditions for a HAB to form?
How can community members get involved in reporting harmful algal blooms?

1. After reading your assigned individual issue Factsheet, respond to the questions below:
   a) What is the issue you read about and how does it relate to water and climate change?

   b) In your assigned Factsheet there are three questions. Use the space below to respond:

   c) What supporting evidence did you read about in your Factsheet that connects your issue to water and climate change? Give two examples.

   d) How has this water and climate issue affected local waterbodies in your region?

2. What are two additional things you learned from the individual issue Factsheet?
   a.

   b.