FINAL REPORT

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FINAL REPORT FOR WIND, WAVES, AND VARIABLES – LESSONS ABOUT THE LAKE CHAMPLAIN BASIN 2022-2023

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EXECUTIVE SUMMARY

Friends of Northern Lake Champlain (FNLC) received a grant from the Large Education and Outreach grant category from the Lake Champlain Basin Program in 2022 to teach a place-based watershed education class to 5th grade students within the northern Lake Champlain Basin. This program was a continuation and expansion of the previous year's Wind, Waves, and Variables program, which was funded by the same grant category. Our organization has been conducting education and outreach initiatives for children and adults focused on protecting Lake Champlain for over a decade. Based on our experience, it is evident that today's grade school students will make the decisions of tomorrow, and as adults, they are more likely to act in an environmentally responsible manner if these values are instilled in their youth. For this reason, we wanted to expand our educational programs to include a year-long watershed science course focused on the Lake Champlain Basin.

The objective of this program was to develop a curriculum and teach lessons about pertinent social and physical sciences of the Lake Champlain Basin to 5th grade students at regional schools located in Grand Isle and Franklin counties. Last year's program included four regional schools and this year, we expanded the program to include six schools. The six schools that participated in the program were Richford Elementary School, Enosburg Elementary School, Montgomery Elementary School, Lowell Graded School, North Hero Elementary School, and Alburgh Community Education Center.

We partnered with educational consultant, Kurt Valenta, to visit each school to teach lessons and provide field trips that focused on sound principles of data collection, interviewing, observation, and interpretation. New this year, we also partnered with the Missisquoi River Basin Association (MRBA) to help teach the classes in the upper watershed, including Lowell and Richford. The course included four (4) three-hour classroom sessions in each 5th grade classroom over the fall and winter and two field trips in the spring. The classroom sessions focused on the social and economic history of the region, plus the elements of the physical, chemical, and biological science that underpin the dynamics of the Lake Champlain watershed. The first field trip to the Missisquoi National Wildlife Refuge focused on the importance and the science underpinning wetland ecosystems and the second field trip to the Goodsell Ridge Preserve in Isle La Motte focused on the geologic history of the Basin.

Throughout the course, we collected photos and sketches to help solidify and foster life-long commitments in the students to educate themselves and make informed decisions about Lake Champlain. We hope this program has helped the students gain confidence in participating and be capable of directing their future actions in a fashion that minimizes deleterious effects to Lake Champlain. In total, 155 students from six schools participated in the program this year.

CONTENTS

1. PROJECT SYNOPSIS

The future health of the Lake Champlain Basin not only relies on our actions today, but the actions that future generations take to preserve healthy ecosystems and clean water. For this reason, it is imperative that today's students and young community members develop an appreciation for the natural resources that the Basin provides, and the steps they can take to reduce land-use pollution. Friends of Northern Lake Champlain (FNLC) is committed to teaching students about the importance of the watershed they live in and how to be good stewards of the Lake and surrounding landscape.

FNLC has been educating the public about the Lake Champlain watershed for almost two decades. Since 2018, our organization has partnered with the Saint Albans Museum to organize "Lake Lessons" for 3rd and 4th grade students from regional elementary schools. This single-day workshop taught the students about Lake Champlain's cultural heritage and water quality issues. However, we have seen the need to expand place-based watershed and Lake education beyond single day events. It is for this reason that we applied to receive funding from the Lake Champlain Basin Program's large education and outreach grant program to teach a series of classes over the entire school year, which we called "Wind, Waves, and Variables".

The Wind, Waves, and Variables program is a place-based watershed science course that we taught in six regional schools in the 2022-2023 school year. The program was a continuation and expansion of the previous year's Wind, Waves, and Variables program, which was also funded by the Lake Champlain Basin Program. We partnered with Kurt Valenta of Exordium Adventures to design and teach a curriculum, in which 5th students at the participating schools learned about the Lake Champlain Basin by collecting and analyzing empirical and observational data, interacting with elders and experts, performing field and classroom work, and creating reports using diverse media. New this year, we also partnered with the Missisquoi River Basin Association (MRBA) to help teach the classes in the upper watershed, including Lowell and Richford. Through this program, the students learned about the social and economic history of the region, plus the elements of the physical, chemical, and biological science that underpin the dynamics of the watershed.

Today's grade school students will make the decisions of tomorrow, and as adults, they are more likely to act in an environmentally responsible manner if these values are instilled in their youth. This course is congruent with the Next Generation Science Standards and was instructed in four (4) three-hour sessions each month over the fall and winter, with two field trips in the spring. The field trips included an examination of the Chazyan reefs exposed at the Isle LaMotte Preservation Trust's Goodsell Ridge Preserve, and an excursion to the Missisquoi National Wildlife Refuge in Swanton, VT. In total, 155 students from six schools participated in the program this year.

2. TASKS COMPLETED

Due to a delay in executing a contract with NEIWPCC in time to start the program in October and keep to the class schedule outlined in our workplan, LCBP issued a PO to start the first two

tasks of this program before a contract was in place. Those two tasks included the school selection and curriculum planning as well as the first classroom session that focused on observation and the scientific method. The final report for the PO, which summarizes those two tasks was submitted on 12/8/2022 and was titled “Wind, Waves, and Variables 2022-23, Tasks 1-2”. The remaining tasks that are included under the grant LS-2022-086 are summarized below.

Task 1 - Society Lessons: Learn cultural history

In the second classroom session, we introduced the fifth-grade students in the six participating schools to Abenaki history and culture. We connected known Native American settlements, tribal territories, and other important locations, such as the Regan site, to the Lake Champlain basin map. Through interactive storytelling, the students learned about what it was like to live in a Western Abenaki community prior to European settlement and how the Abenaki interacted with the land and Lake Champlain. The students learned Abenaki place names, such as “mozodebiwajok” (Mount Mansfield), “bitawbagok” (Lake Champlain), and “masipskortegw” (Missisquoi River). We discussed why many known Abenaki settlements were located along waterways and compared those locations with European settlements and present-day towns. We then taught the students how to read a map using features such as the legend, distance scale, compass, labels, index, and coordinates. The students tested their map reading skills by finding relevant locations within the Lake Champlain Basin, such as the Alburgh Dunes State Park, the Isle La Motte Chazy Reef, the Richelieu River, and the Missisquoi National Wildlife Refuge. Finally, we read a story about the “Thirteen Moons on a Turtle’s Back” to learn about how Native Americans used a turtle shell to recognize the different phases of the moon and examined turtle shell specimens.

Figure 1. Kurt Valenta teaches 5th grade students in Enosburg about Abenaki place names in the Lake Champlain Basin.

Task 2 - Geology Lessons: Geo-time & Basin Geology

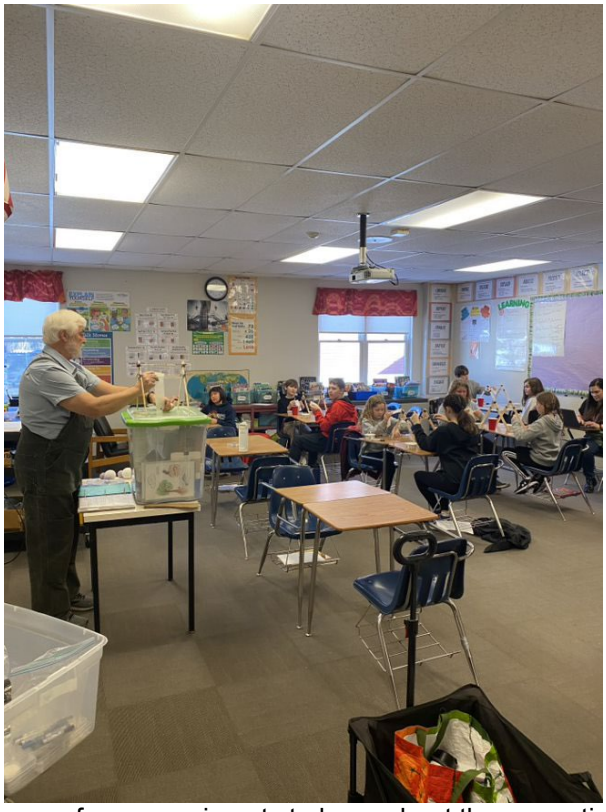
During the third classroom session, the students learned about core geology concepts, including density stratification (core, mantle, crust), plate tectonics, and the rock cycle. The classroom sessions occurred on the following dates: North Hero on January 9th, Lowell on January 10th, Richford on January 11th and 12th, Montgomery on January 25th, Alburgh on January 26th, and Enosburg on January 27th. They connected these geology principles to the creation of the Adirondack and Green Mountains, and the formation of the Lake Champlain Basin. The students also explored how the previous ice aged shaped the Lake and its composition over time. We demonstrated concepts of thermal convection and plate tectonics through live, hands-on experiments. Finally, the students learned how to create topographic and bathymetric maps using elevation data.

Figure 2. Students in Alburgh examine rock samples to learn how to differentiate between sedimentary, metamorphic, and igneous rocks.

Task 3 – Session 4: Water Lessons: sources of water & pollution

During the fourth and final classroom session, we provided a general review of the water cycle and how the finite resource of water plays an important part in our ecosystem. The importance of water to society and sources of drinking water in the basin were explored. Additionally, sources of pollution and the activities that humans undertake to safeguard and recoup water, plus an exploration of what could be done differently were examined. Hands-on experiments were conducted to demonstrate the properties of water on a smaller scale. For example, the students used filter paper to observe the power of capillary action, which is how trees within the watershed transport water from the ground, into its roots, and up into the tree. The students also

explored the properties of surface tension by counting how many drops of water can fit on top of a penny without it spilling over and by attempting to float a paper clip on the surface of a glass of water. The students learned that surface tension is responsible for allowing boats to float and for insects like water striders to “walk on water”.



Figures 3 and 4. Students in Alburgh and Montgomery perform experiments to learn about the properties of water.

Task 4 – Field Trip to the Missisquoi National Wildlife Refuge

The first fieldtrip to the Missisquoi National Wildlife Refuge (MNWR) was held at the beginning of February, when the ground was sufficiently frozen, to allow the students to view the beaver lodge at the Refuge up close. Alburgh, North Hero, and Richford came to the Refuge on February 7th, and Montgomery, Lowell, and Enosburg came on February 8th. The goal of this trip was to allow students to learn about the importance of wetland ecosystems within a watershed (i.e. habitat for wildlife, flood storage, water filtration, carbon sequestration, etc.), by examining beaver habitat and walking the trails of the Refuge. On both days of the field trip, the students rotated around three stations. The first station was an exploration of the beaver lodge at the Steven Young Marsh and was led by Kurt Valenta. The second station was a demonstration of water quality sampling using water from the pond outside the headquarters building, in addition to a walk on the Discovery Nature Trail to observe wetland plants and animals in the winter. This station was led by Alison Spasyk. The third station was led by Parker Eversoll and included a guided tour of the exhibits at the Refuge, in addition to an in-depth look at the headquarters building to see what designs and applications have been made to address environmental concerns.

Figure 5. Alison Spasyk demonstrates a method for testing water quality using samples from a pond at the Refuge.

Figure 6. Kurt Valenta teaches students about beavers while exploring a beaver lodge at the Refuge.

Task 5 – Field Trip to Goodsell Ridge Preserve in Isle La Motte

The second and final field trip of the program was held at the end of May at the Goodsell Ridge Preserve in Isle La Motte. Students from Alburgh and North Hero came to the Preserve on May 23rd and students from Montgomery Lowell, and Enosburg came on May 24th. The goals for this field trip included:

- Learn about geologic history of the Lake Champlain Basin, with an emphasis on the Islands and the 480-million-year-old fossils from the Chazy Fossil Reef
- Discover how geologic processes create watersheds and how to delineate watersheds using topographic maps
- Gain an appreciation of geologic timescales and how short human history is compared to geologic history of the region

On both days of the field trip, the students rotated around three stations. The first station was an exploration of the fossils on site at the Preserve and an activity focused on gaining an appreciation about the amount of everyday products that incorporate minerals in their constituents. The second station included a discussion of how geologic processes have shaped the Lake Champlain Basin and an activity to show the students how watersheds are delineated by using a topographic map of the region to connect the highest points and draw the watershed boundary. The third station included a geologic history timeline activity that demonstrated to the students relative lengths of time between geologic events through active movement.

Figures 7 and 8. Students learn how to delineate a watershed and about geologic events in the Lake Champlain Basin.

Task 6 – Final Report

FNLC compiled all the deliverables for this project and developed a final report that provided a project synopsis and summarized the tasks completed, methodology, deliverables completed, and post-program conclusions.

3. METHODOLOGY

This program was taught in four (4) three-hour classroom sessions in each school over the fall and winter and concluded with two field trips in the early spring. The lessons and activities for each classroom session focused on specific subject areas and we intentionally included a mix of discussion, games, videos, experiments, and other hands-on activities in each lesson. The first session focused on introducing the students to basic scientific skills such as asking questions, constructing hypotheses, making observations, keeping good notes, and drawing conclusions from data. We also introduced the students to the concept of a watershed and specifically, the watershed they live in, the Lake Champlain Basin. The second session focused on the history of the Basin and including the natural and cultural history of the regions first inhabitants. The third session concentrated on geologic principles and how the Lake Champlain Basin formed. And finally, the fourth session focused on the properties of water, water pollution, and the importance of protecting clean water.

The course was congruent with the Next Generation Science Standards, and the curriculum was developed by Kurt Valenta, who has over a decade of experience teaching place-based science and nature courses to elementary students. All the curriculum outlines and activities can be found the in the Deliverables folder. Both of the field trips were structured in a way where all 155 students who participated in the program were split into 3 groups and rotated around stations for each activity each day.

4. DELIVERABLES COMPLETED

All deliverables can be found in this SharePoint folder: Deliverables. A summary of the deliverables for each task is outlined below:

Task 1 - Society Lessons: Learn cultural history: Photos from the second classroom session lesson notes, and curriculum overview. Completed January 2023. Once the project contract was executed, the program remained on schedule for the remainder of the school year. The only challenge encountered was that the second classroom session with Montgomery Elementary School was rescheduled to January 3, 2023 due to the school being closed from a winter storm on December 16, 2022.

Task 2 - Geology Lessons: Geo-time, basin geology: Photos from session 3, geology notes, and curriculum outline. Completed February 2023. No challenges encountered.

Task 6 - Water Lessons: Sources of water & pollution: Photos from session 4, water cycle notes and basin notes, and curriculum outline. Completed March 2023. No challenges encountered.

Task 7 – Field Trip to MNWR: Photos and field trip activities notes. Completed February 2023. There was some difficulty finding a date that would work for all six schools for the field trip to the Missisquoi National Wildlife Refuge. Due to the large number of students, we split the trip up into two separate days, which made the numbers much more manageable. We also asked for volunteers from the ECO AmeriCorps program to help supervise the students as they rotated around the stations at the Refuge.

Task 8 – Field Trip to Isle La Motte: Photos and field trip activity notes. Completed May 2023. Similar challenges were encountered to the previous field trip for finding a date that works for all the schools. This is especially challenging at the end of the school year when there is scheduled standardized tests and other trips planned. Unfortunately, the students from Richford were not able to attend this field trip due to staffing issues at the school and bad behavior, according to the teachers we worked with. For this trip, we also asked for volunteers from the ECO AmeriCorps program to help supervise the students as they rotated around the stations.

5. CONCLUSIONS

Overall, this program was very successful. In total, six schools and 155 students participated in this year-long watershed education program. Based on the feedback that we received from the teachers whose students we worked with, the varied nature of the curriculum and activities was effective. It was clear that conducting experiments and participating in hands-on activities helped the students understand different scientific principles in a way that kept them engaged and excited to learn. Based on the observations that our teaching team experienced in the classroom, it was also clear that using maps, visuals, and videos, helped students understand what a watershed is and how activities in one areas of a watershed have an effect throughout the watershed.

Although we have not applied to receive funding to continue the program for another year, we are very grateful to the Lake Champlain Basin Program for supporting this program two consecutive years in a row. Our staff took great pleasure in working with the students to help them learn about the Lake Champlain watershed and gain an appreciation for the natural and cultural resources it provides. This year's program was a big undertaking for our organization, and we found that the scheduling of classroom sessions and field trips for six schools was a significant challenge. Thankfully, we had plenty of support from Kurt Valenta and MRBA to make the program run as smooth as possible. We hope to revisit this program and the curriculum in the future, but we will probably opt to include a maximum of four schools, which we found to be much more manageable.

6. APPENDICES

CONTENTS

Wind, Waves & Variables – Section 2
The Social Aspect

1. Review of the Basin
2. Review of the Land Use Map
3. Paleoindian Presence – The Regan Site
    a. Small map of Champlain Sea Shoreline & Paleoindian sites
4. Review Key Tribal Territories
5. Read Western Abenaki History
    a. Read paragraphs outlining Abenaki Life
6. Compare map 2 with main Abenaki settlements after contact on Map 4
7. Discuss the location of Native American villages
    a. Why are they located near or on lakes & rivers?
    b. What are the rivers & lakes used for today?
8. **Student Activity:** Using the Abenaki place name sheet, have the students locate the places on the blank map using the Native American names, followed by the English names in brackets.
9. Map Reading – Laminated Vermont Map
    a. Explain Map components:
        i. Title;
        ii. Direction;
        iii. Legend;
        iv. Distance Scale;
        v. Labels;
        vi. Grid & Index;
        vii. Vermont Attractions Association Member Key
        viii. Public Recreation Areas
        ix. Gateway Map
    b. **Student Activity:** Compass Rose – complete the compass points on hand-out
    c. Use the previously completed map of Native American place names to locate them on the laminated map
    d. Find Additional Sites on Map:

i. Alburgh Dunes State Park
ii. Isle La Motte – Chazy Reef
iii. Richelieu River
iv. Missisquoi National Wildlife Refuge
v. What general direction do lakes run in Vermont?
vi. Winooski River
vii. Franklin Bog
viii. Missisquoi River Source
ix. Paleo-Indian Site in East Highgate (Regan Site)

e. **Student Activity**: Map Quiz

10. The Use of The Turtle as calendar by Native Americans
    a. Book "Thirteen Moons on a Turtle's Back"
    b. Native American story "How The Turtle Flew South For The Winter"
    c. **Student Activity:** Cut out and Assemble Turtle Puzzle
11. Signs & Symbols to Communicate
    a. Modern symbols today
    b. Native American Symbols
    c. **Student Activity:** Translate given phrases from pictographs to English words & vice-versa

Session 3 – Outline

1. **Introduction**
    - **a.** Clarifying Questions
    - **b.** Develop the sense of units (meters, kilometers; kilobytes, megabytes & gigabytes)
    - **c.** What is volume? What is density?

2. **Earth Materials –What is the Earth composed of?**
    - a. Minerals – look at QUARTZ, FELDSPAR, CALCITE
    - b. Rocks – look at Limestone, Shale, Sandstone, Granite, Marble
    - c. Fossils & How they Form
    - *d.* ROCK CYCLE VIDEO – https://www.youTube.com/watch?v=pm6cCg_Do6k *and the Jelly Bean models of the three rock types*
        - i. Sedimentary
        - ii. Metamorphic
        - iii. Igneous

BRAIN BREAK – divide class into groups of 4, assign a captain and complete the following task: Each team has to come up with a word, that starts with the letter of the preceding word and pertains to the Lake Champlain Basin.

3. **Earth Structure, Convection & Plate Tectonics**
    - a. Earth Structure – The Shells of the Earth & Their Properties (either an apple or an egg cut in half as demonstration – groups of 4 students)
        - i. Shells of the Earth
            1. Core
            2. Mantle- Gooey Mantle
            3. Crust – Brittle Crust
    - b. Density & Convection - (Tea Bag Rocket and/or vial with Hot water immersed into cold water experiments to demonstrate convection currents in fluids)
    - c. Plate Tectonics
        - i. Continental drift – Alfred Wegner Video
            1. Plate tectonics Video
            2. Continental Drift Song
        - ii. Mountain Building
            1. Divergent – UP
            2. Convergent – DOWN
            3. Transform – SLIDE
            4. Adirondack Formation; Green Mountain Formation
            5. Lava Lake Video – https://www.youTube.com/watch?v=UTNRmbb-KN4

4. **Geological Time – An Appreciation of the Span in Time**
    - a. Relative Dating

i. Super Position
ii. Angular unconformity
iii. Faults
iv. Intrusions & Cross-cutting Relationships

b. Discuss the Geological strata puzzle

5. Bedrock Tectonics of the Region

a. What are the Mountain ranges to east and west of Lake Champlain
b. Relate the formation of these over time to Plate Tectonics –Collision
c. Relate the formation of the Lake Champlain valley to rifting – ie. Tension or Pulling Apart

6. Glacial History of the Area

a. Climate Change & Ice Age
b. Weight of Glaciers – Influence on the brittle crust
c. Ice Melt results
d. Marine Incursion & Champlain Sea Present day Lake Champlain

7. Maps & the Champlain Basin

a. Introduction – Maps are a bird's-eye-view
b. Compare a flat map to globe to a topographic map to a 3D topographic map. Note the following:
    i. Which direction is North
    ii. Scale of Map
    iii. Blue, green & brown colors
    iv. Contours – Height above sea level
c. On the maps provided find the following:
    i. Location of this school
    ii. The direction North is in
    iii. Distance from Plattsburg to Burlington
    iv. Find Mt. Mansfield and its height
    v. Find the Missisquoi River
    vi. Find the Winooski River
    vii. Find the Vermont State Capital – is it in the Watershed?
    viii. What are the red lines?
    ix. Where the water hat lands on the West side of Mansfield flow to?

Session 4 – Outline

Index of Activities to explore properties of water

1. Laminated Sheets – Maze or water cycle – **COHESION**
2. Wax paper with water drop and toothpick
3. Water drops on a penny – **HYDROPHILIC PROPERTY**
4. Water drops in a cap
5. Filter paper with black dot in water – **CAPILLARY ACTION**
6. Floating paperclip – **SURFACE TENSION**
7. Hot water in jar covered with ice on top – **EVAPORATION AND CONDENSATION**
8. Floating ice in jar – **DENSITY LOSS IN SOLIDIFICATION**
9. Cold water jar with insertion of hot water vial - **DISPERSION**
10. Salt vs. Fresh water – **A VISUAL REPRESENTATION**
11. Mouthwash in cups – **DILLUTION OF POLLUTION**
12. Tub of muddy water – **CLEANSING BY EVAPORATION**
13. Impervious vs. Pervious surfaces – **INFILTRATION**

MNWR Fieldtrip – 2/7 and 2/8 2023

Themes:

1. A contrast/comparison on how humans and animals relate to and use water in their environments
2. Life forms in winter and how they cope with the harsh environment
3. What are some of water's important characteristics?
4. What do wetland soil strata & flora look like?

STATION 1 – STEVEN YOUNG MARSH

Station Leader: Kurt Valenta

GOALS:

- To foster an awareness of what is an ecosystem and how it benefits the inhabitants and perhaps others as well.
- Take a closer look at a beaver pond, its lodge, dam and system of canals
- The beaver as" KEYSTONE SPECIES" - discussion
- Inventory plants, structures, signs of animal life by means of a pond/wetland guide
- Sketch a rudimentary map of the pond and the various attributes important to its function
- Practice total sensory input of natural surroundings by using all of the senses in experiencing the pond.

SUGGESTED RESEARCH PRIOR TO THE FIELDTRIP:

- Importance of a wetland as an ecosystem
- Look at a cross-section of a beaver lodge to then be able to imagine the activity that is going on the inside while standing outside on the ice

STATION 2 – DISCOVERY NATURE TRAIL AND WATER QUALITY SAMPLING DEMONSTRATION

Station Leader: Alison Spasyk

GOALS:

- To understand the importance of wetland ecosystems within a watershed (i.e. habitat for wildlife, flood storage, water filtration, carbon sequestration, etc.)
- To document evidence of life during the winter thereby getting an appreciation of how these life forms cope with the harsh environmental conditions.
- Learn how to observe wildlife in their natural habitat, especially birds.
- Learn why it is important to sample water and monitor its health.

- Determine the pH of the pond water and compare it to the values of common substances found in the average household

Directions:

1. Provide binoculars to students. If not enough for every student, break them into groups of two to share.
2. Walk out 10 min on the Discovery Trail to talk about the importance of wetlands, wildlife observation, how wildlife stay warm in the winter.
3. How students to silently observe wildlife (as silently as possible)
1. Walk back to the headquarters building and test and record the pH of different samples including pond water, normal tap water, lemon juice, and baking soda.

Talking point for this station:

Wetlands

- A wetland is an area of inland or coastal land partly covered or saturated by water. They come in many forms, like salt marshes, mangroves and peatlands, and examples are found across all continents.
- Wetlands are vital ecosystems. Home to 40 percent of the world's species, they protect us from flooding, provide food and clean water, and play a crucial role in combating climate change.
- But they are at risk. Around 35 percent of the world's wetlands were lost between 1970 and 2015, and the rate of decline continues to accelerate. In fact, wetlands are disappearing three times faster than forests.

Wildlife:

- Birds
    - Waterfowl: principally established to manage and protect migratory waterfowl, Missisquoi NWR is the single most important fall migration habitat for waterfowl in the state of Vermont.
        - Up to 20,000 ducks and geese will use the refuge during fall migration - Main species include mallard, black duck, ring-necked duck, green-winged teal, blue-winged teal, wood duck, common goldeneye and common merganser
        - Many waterfowl use the refuge to molt post breeding
    - Wading Birds: Known historically as the largest great blue heron rookery in the state with between 300-500 nests each year. In the last few years nesting has been 50-100 total nests.
        - American bitterns utilize marshes and grasslands for feeding and nesting.
        - Great Egrets use the refuge during post-breeding – late summer.
    - Rare Bird Species: The entire state population of state endangered black terns nest on the refuge.
        - 41-43 ospreys typically nest on the refuge (formerly threatened species) or about 30% of all nests in the state.
        - Bald eagles have successfully nested on the refuge since 2012.

        - Other species of concern include: pied-billed grebe, least bittern, and Northern harrier.
- Fish
    - The refuge protects important spawning and foraging habitat for a diverse group of fish. Spring floods provide access into vegetated wetlands for species like northern pike and chain pickerel.
    - Species of Concern: Walleye, lake sturgeon (state endangered) and eastern sand darter (state threatened).
- Mammals
    - A total of 35 species of mammals are known or expected on the refuge. Commonly seen mammals include muskrat, beaver and white-tailed deer. Predators include bobcat, red fox, grey fox and coyote. Moose and bear occasionally use the refuge.
- Fresh Water Mussels
    - The Missisquoi River provides habitat for at least 12 species of fresh water mussels, 6 of which are listed as state endangered (Cylindrical papershell, pocketbook, fluted-shell, fragile papershell, black sandshell, pink heelsplitter and one as a state threatened species (giant floater).
- Reptiles and Amphibians
    - Many turtles, snakes, salamanders and frogs find homes on the refuge. A notable species is the spiny softshell turtle, a state threatened species. A significant portion of the northern lake population uses the refuge exclusively as summer habitat. Blue-spotted salamanders also use the refuge, which are designated as a rare state species.

Water Quality Monitoring:

Explain why pH is an important factor when testing water quality. Feel free to use some of the information below:

- Like all water, wetland water has a pH measurement. **PH is the acidity of the water, and wetlands can have different levels of acidity that the plants and animals living in them require to thrive**. When the pH changes, it can kill these plants and animals as well as prevent the wetlands from functioning. There are three main factors that can affect the pH of water in wetlands.
- **Waste Water** - is the main factor that can alter the pH of any wetland. Waste water is any water altered by human settlement and can include pool water, sewage water as well as can storm drain water. Waste water can be treated with chemicals to clean out any dangerous compounds as in the case of municipal waste water, or it can be untreated as in the case of storm drain runoff. The removal or addition of chemicals to this water, as well as the existing pH of the water itself can significantly alter the pH of a wetland. For example, water in large cities is often treated to be "soft," or more acidic than in rural areas. This water has a very low pH, or high acid level, raising the pH of a wetland. If the wetland has plants that do not tolerate acidic water, they can die off.
- **Minerals** - Minerals that exist in the soil surrounding the wetlands, such as salt, can affect the pH of wetlands. While most wetlands are acclimated to the minerals in the surrounding soil, human development, mining, construction and industrial operations can put different minerals into the soil that don't exist there naturally. Rainfall will filter through these

minerals, dissolving them and carrying them into the wetlands. Depending on the mineral, the wetland's pH can rise or fall. A mineral like diabase rock for example, which is common in quarries and mines, can increase the pH of a wetland if it is unearthed nearby.

- **Acid Rain** - Unlike waste water and dissolved minerals which can cause the pH of a wetland to fluctuate any which way, acid rain will only lower the pH, or make the water in the wetland more acidic. Acid rain is caused by compounds in the atmosphere that react with one another to form acids, which then fall back to the earth as rain. Some of these compounds include sulfur and nitrogen.

STATION 3 – HEADQUARTER BUILDING - DESIGN & SYSTEMS REVIEW

Station Leader: Parker?

GOAL:

- To take an in-depth look at the headquarters building and see what designs and applications have been made to address environmental concerns. Then look back at what was observed at the beaver pond and see if it has any of the same applications for nature.

Directions:

1. Review the conservation strategies of the headquarters building.
2. Allow students to explore the exhibits and learning material in the headquarters building (10 min.)
3. Allow time for lunch/snack in the classroom.
4. While the students eat, talk about the history of the Refuge (using the talking points below) and what they have learned on the trip so far.

Talking Points for this station:

Conservation Strategies of the Headquarters Building

- Wind Turbine – High winds coming off the Lake generate electricity.
- Building Insulation - However, high winds also tend to remove the envelope of air around the building. Building insulation incorporates recycled components such as wood chips, plastics, and paper products.
- Large Energy-Rate Windows – Allow passive solar gain for both light and energy savings in the winter when the light is at a low angle. Also can be opened in the summer for natural ventilation.
- Dark-Stained Flooring – Absorbs passive solar energy during the day and releases heat in the evening.
- Large Roof Overhangs – Prevent solar heat gain during the day in the summer when the sun is higher in the sky. The roof overhangs also provide nesting habitat for cliff and barn swallows, which eat up to 600 mosquitoes per day.
- Light-Colored Metal Roofing – reflects sun/heat back into the atmosphere during the summer.

- Waterless urinals and low-flow toilets – Save water
- Compact fluorescent lighting – Saves energy
- Solal Panels – The panels and the wind turbine provide a combined 35-40% of the headquarters energy needs.
- Geothermal Energy – Direct groundwater cooling loop takes water from underground to cool the building and returns the water to the ponds.
- Bioswales – manages stormwater by slowing the movement of water from parking lots and allow sediment (dirt) and potential pollutants to settle out. Plants absorb excess nutrients to avoid runoff from entering the Lake.

Natural History

- Missisquoi National Wildlife Refuge was established in 1943 to protect and manage habitat for migratory birds. Old farmland and vacant natural lands were purchased to create the refuge. The refuge consists of 6,729 acres (over 50 football fields), much of which is wetland habitats, which supports a variety of migratory birds and other wildlife. It includes the Missisquoi River delta where the river flows into the Missisquoi Bay and Lake Champlain. The refuge is located on the Atlantic flyway where birds migrate from South America to the northern reaches of Canada. Missisquoi serves as a stopover or nesting area for over 200 species of birds.
- The refuge sits at the mouth (delta) of the 767,000-acre Missisquoi River watershed that drains portions of Quebec and Vermont. Each spring, its waters submerge large portions of the refuge. The 88-mile river flows through the refuge and then into Lake Champlain at Missisquoi Bay.
- The geomorphology of the Missisquoi Delta is always changing. Precipitation (carrying and depositing sediments) in the Missisiquoi River watershed and in Lake Champlain, and wind (creating wave action) in the Lake Champlain Valley affect the deposition and erosion of sediments in the delta. The period of Missisquoi River Delta Landscape Setting Chapter 3. Summary of Refuge and Resource Descriptions Landscape Setting 3-4 greatest sediment discharge, and therefore, of greatest delta-building activity is in April and May.
- Three major tributary rivers—Missisquoi, Rock, and Pike—feed into Missisquoi Bay. The bay receives the highest phosphorus load of any section of Lake Champlain. Discharge from wastewater treatment plants and runoff from nonpoint sources, including lawns, farms, and urban areas, carry phosphorus into the waterways.

Indigenous History and Today:

- Indigenous people were traveling to what is now Missisquoi refuge land starting 6,000-7,000 years ago. Archaeologists have dated pottery, arrow points and fishing spear points found here. In the late 1600s, Europeans encountered the Abenaki people living along the Missisquoi River.
- By 1736 an Abenaki village stood alongside the river in what is now Swanton and Highgate, Vermont. Grey Lock, an important warrior and chief of the Waronoc people, lived near the village in a settlement known as the “Indian Castle.”
- The Abenaki grew corn, squash and beans along the river floodplain. They gathered blueberries, wild strawberries, wild rice, butternuts and hickory nuts. They turned cattail leaves and stems into woven mats. They made string and nets from Indian hemp and dogbane fibers. They fished

in the Missisquoi River and Bay. They hunted deer in the forest and waterfowl in the Missisquoi Delta. They still use the land and waters today of Missisquoi.

- Lake Champlain, known to the Abenaki as Bitawbagok, means “waters that lie between,” a reference to it being situated between two mountain ranges. Missisquoi in Abenaki is a reference to the place “where there is flint”.

Activity Station Schedule 2/7

Time	Station 1 – Beaver Pond	Station 2 – Discovery Trail Walk	Station 3 – Refuge Headquarters Building
10:15 – 11:00	Richford 1	Richford 2	Alburgh and North Hero
Transition Time			
11:15 – 12:00	Alburgh and North Hero	Richford 1	Richford 2
Transition Time			
12:15 – 1:00	Richford 2	Alburgh and North Hero	Richford 1

Activity Station Schedule 2/8

Time	Station 1 – Beaver Pond	Station 2 – Discovery Trail Walk	Station 3 – Refuge Headquarters Building
10:15 – 11:00	Montgomery and Lowell	Enosburg 1	Enosburg 2
Transition Time			
11:05 – 11:50	Enosburg 2	Montgomery and Lowell	Enosburg 1
Transition Time			
11:55 – 12:40	Enosburg 1	Enosburg 2	Montgomery and Lowell

Goodsell Ridge Preserve Fieldtrip – 5/23 and 5/24 2023

Themes:

5. Geologic history of the Lake Champlain Basin, with an emphasis on the Islands and the 480-million-year-old fossils from the Chazy Fossil Reef
6. How geologic processes create watersheds and how to delineate watersheds using topographic maps
7. Gain an appreciation geologic timescales and how short human history is compared to geologic history of the region

STATION 1 – Rock and Minerals Investigation and Fossil Exploration

Station Leader: Kurt Valenta

GOALS:

- To investigate a group of items and decide whether they are made of minerals or of organic material
- Purpose is to impress upon students the amount of products that incorporate minerals in their constituents
- Explore the fossils at the Goodsell Ridge Preserve and learn about the history of the Chazy Fossil Reef

STATION 2 – Watershed Delineation and Natural History of Lake Champlain

Station Leader: Alison

GOALS:

- Learn how watersheds are delineated by using a topographic map of the region to connect the highest points and draw the watershed boundary.
- Learn about how geologic processes have shaped the Lake Champlain Basin, from the last ice age, to Lake Vermont, to the Champlain Sea, and to present day Lake Champlain.

STATION 3 – Geologic History Timeline Activity (and lunch/snack time)

Station Leader: Parker

GOAL:

- Gain and appreciation for the timescales of geologic history through active movement.

Activity Station Schedule 5/23

Time	Station 1 – Rock and Minerals	Station 2 – Watershed Delineation	Station 3 – Geologic Timeline (lunch/snack time)
10:15 – 11:00	Richford 1	Richford 2	Alburgh and North Hero
Transition Time			
11:15 – 12:00	Alburgh and North Hero	Richford 1	Richford 2
Transition Time			
12:15 – 1:00	Richford 2	Alburgh and North Hero	Richford 1

Activity Station Schedule 5/24

Time	Station 1 – Rock and Minerals	Station 2 – Watershed Delineation	Station 3 – Geologic Timeline (lunch/snack time)
10:30 – 11:00	Montgomery and Lowell	Enosburg 1	Enosburg 2
Transition Time			
11:15 – 11:45	Enosburg 2	Montgomery and Lowell	Enosburg 1
Transition Time			
12:00 – 12:30	Enosburg 1	Enosburg 2	Montgomery and Lowell