New Jersey School of Conservation
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http://friendsofnjsoc.org • info@friendsofnjsoc.org

Water Ecology

This session is designed to show students that water is a key human resource. Session activities include a brief discussion of water as it relates to all life and to the students' home community, and a survey of water quality and quantity at the Big Flatbrook, using stream flow measurements and aquatic organism sampling.

OBJECTIVES:

1. Students will develop a feel for the amount of water flowing through natural systems by taking stream flow measurements required to calculate an estimate of the quantity of water in the Flatbrook
2. Students will acquire knowledge about how we are able to assess water quality by sampling, recording and analyzing data involving the types of aquatic organisms present in the stream
3. Students will evaluate whether a stream similar to the Flatbrook could adequately supply their school community with water

BACKGROUND INFORMATION:

See information on water fact sheet, stream flow measurement worksheets, macroinvertebrate biotic index laminated identification sheets, and background research pertaining to local watershed of school community

MATERIALS:

- muck boots - advise driving these to the study site in advance to save time
- Dip strainers
- Holding bins and ice cube trays for aquatic invertebrates
- Small plastic magnifying boxes for looking at individual organisms
- Biotic index picture sheet

PROCEDURE:

The activities that follow were used with middle school students during June 2022 and were accomplished within 75 minute lesson sessions

Location 1 - Cayuga Cabin (15 minutes)

What is an objective?
What is an observation? (need not be visual)
Discussion will lead to students distinguishing between qualitative and quantitative observations and how we'll be using both during this session

General discussion of the three objectives from page 1 - a student assistant reads the printed copy (we're hoping to eventually have a large format printed copy available for viewing by all students during this introduction) In discussing each, students can anticipate experiencing examples of quantitative observations and qualitative ones during the field session.

Introduce water usage - students brainstorm daily uses and quantities used for typical activities. Arrive at an estimate of 100 gallons per person per day

Introduce watershed concept
Water soluble marker / bottle sprayer / masking tape / fist crumpled paper demo -
Prior to student arrival, lines were traced with blue soluble marker on the crests of the crumpled paper, the paper is then taped to the lab table surface and a student is asked to simulate precipitation from above using water from the spray bottle. Students will clearly be able to observe where the water flows and pools in distinct regions (watersheds) on the paper

Show physiographic images of NJ, general watershed management regions, and specifically images of their local watershed

Compare to the Big Flatbrook watershed image that shows Stokes State Forest
(An iPad was used to display images)

Present challenge re: the amount of water needed to sustain the school population and their families

Transition to study site(s) (5 minutes) - we chose to exit Cayuga, cross the road by maintenance, descend the hill using the cable handhold to the Flatbrook, and then walk upstream along the Brown Creeper Trail until we reached our study site where the Spillway creek enters the Flatbrook.

Location 2 - Spillway creek where it enters the Flatbrook

Physical measurements site downstream of bridge walkway (15 minutes)
Perhaps a small team of volunteers - [*all observations recorded on data sheet/ clipboard*]
Only one of these is accomplished in each session

- Length (need flagging) *perhaps first team out stakes this out / marks four corners*

- Width (need field tape) *perhaps second team collects transect measurements*
- Depth (need meter / yard sticks) *third team performs numerous depth measurements*
- Flow rate (need orange & stop watch) *last team records numerous float times*

Data needed to address challenge to follow-up with the question re: school population

Biotic sampling site - upstream of the bridge walkway
Biological survey, identification & analysis (40 minutes)
eventually all ten students (volunteers will join following physical measurements)

Sampling / collecting macro-invertebrates

- will require boots or secondary footwear, towel, strainers, small seine net (if possible), white plastic basins for bulk collection drop off, white plastic ice cube trays for sorting & ID, disposable pipets/eye droppers, plastic spoons, magnifiers, laminated identification sheets / biotic index picture cards, portable white board for tallying organisms per category, dry erase markers, eraser

Link to Pollution Tolerance Index data sheet with checklist / calculations

CLOSURE:

1. Students will have collected 1 component (L, W, D or FR) of data to help determine the water's quantity - these students summarize what they accomplished

2. Let them know the three other groups are determining the other components and that back at school they can solve the problem once they collectively have the info.

3. Determine the water quality using the ID sheets, tallies and calculations on reverse side of laminated card

Return organisms to stream
Leave equipment/boots streamside for next group
Walk students to next class

NJ Student Learning Standards

This field lesson touches upon the following NJ Science Performance Expectations and can be tailored to focus on any of the following standards

MS-LS2: Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-ESS3: Earth and Human Activity

Students who demonstrate understanding can:

- MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Climate Change

- MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Scientific and Engineering Practices / NGSS

This field lesson (along with the optional follow-up activity) has students directly involved with

- Asking Questions and Defining Problems
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Using Mathematics and Computational Thinking
- Obtaining, Evaluating, and Communicating Information

Comprehensive Health and Physical Education

- 2.2.8.MSC.7 Effectively manage emotions during physical activity (e.g., anger, frustration, excitement) in a safe manner to self and others.

- 2.3.8.PS.1 Assess the degree of risk in a variety of situations, and identify strategies needed to reduce deliberate and non-deliberate injuries to self and others

Social and Emotional Learning

All of our field lessons integrate the concepts of self-awareness, self-management, social awareness, responsible decision-making, and relationship skills found in the New Jersey's Core Social and Emotional Learning (SEL) Competencies.

Related to the optional follow-up activity

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.

Computer Science and Design Thinking

- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

- 8.1.8.DA.4: Transform data to remove errors and improve the accuracy of the data for analysis.

• 8.1.8.DA.5: Test, analyze, and refine computational models.

Social Studies

• 6.1.8.CivicsPI.3.c Distinguish the powers and responsibilities of citizens, political parties, interest groups, and the media in a variety of governmental and nongovernmental contexts.

• 6.1.8.EconNE.4.a Explain how major technological developments revolutionized land and water transportation, as well as the economy, in New Jersey and the nation.

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Please note:
The pages which follow are included for NJSOC instructors as reference re: the types of images and follow up communications that have been utilized / associated with this lesson. They need not be shared with any particular school groups.

Rahway River Watershed

Rahway River Watershed Association
PO Box 1101, Rahway NJ, 07065
RahwayRiver.org

The Rahway River Watershed consists of 24 towns spanning Essex, Union and Middlesex Counties:

Carteret, Clark, Cranford, Edison, Fanwood, Garwood, Kenilworth, Linden, Maplewood, Metuchen, Millburn, Mountainside, Orange, Plainfield, Rahway, Scotch Plains, Springfield, South Orange, Summit, Westfield, West Orange, Winfield Park, Woodbridge and Union.

Like the RRWA on


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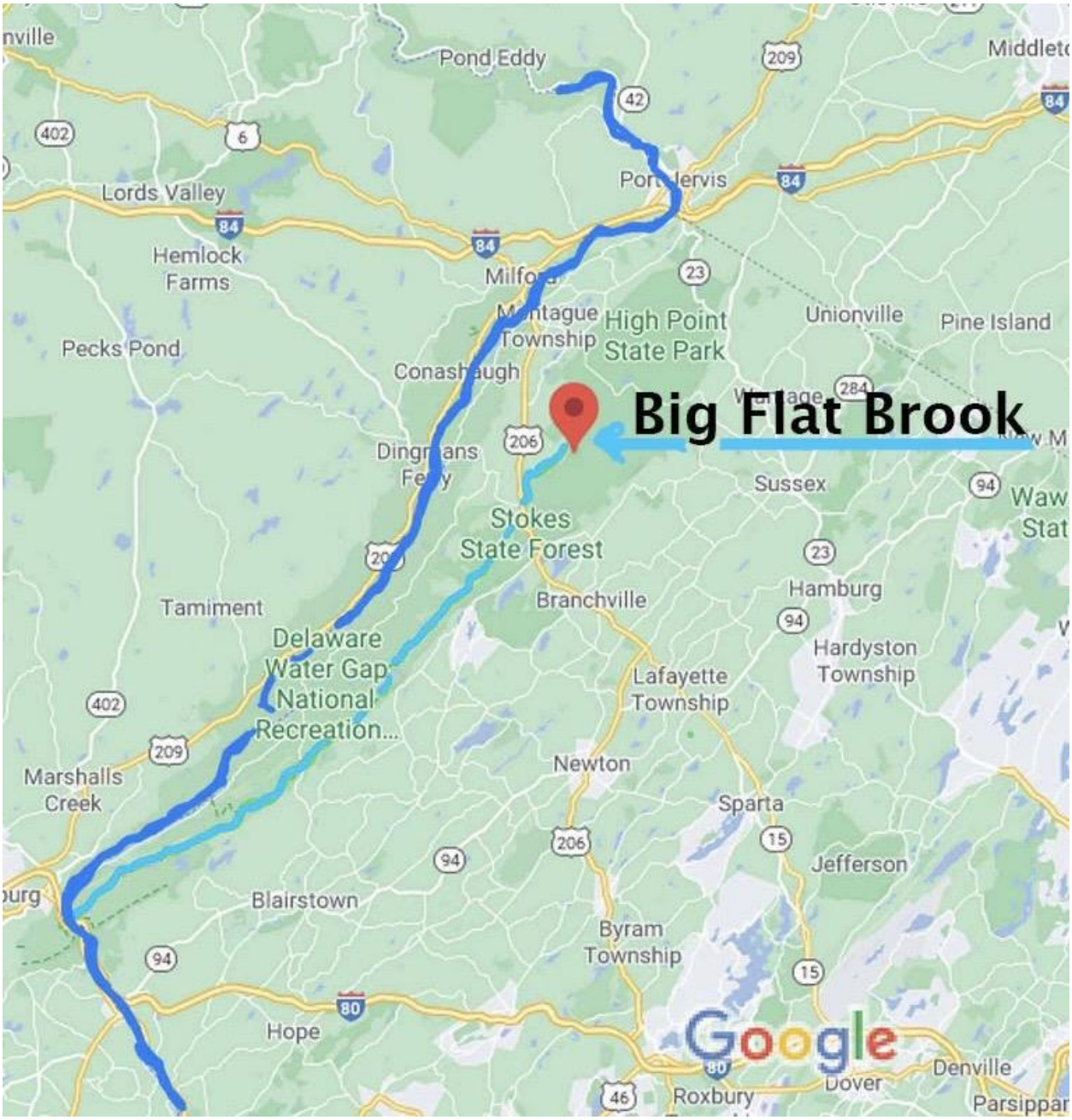
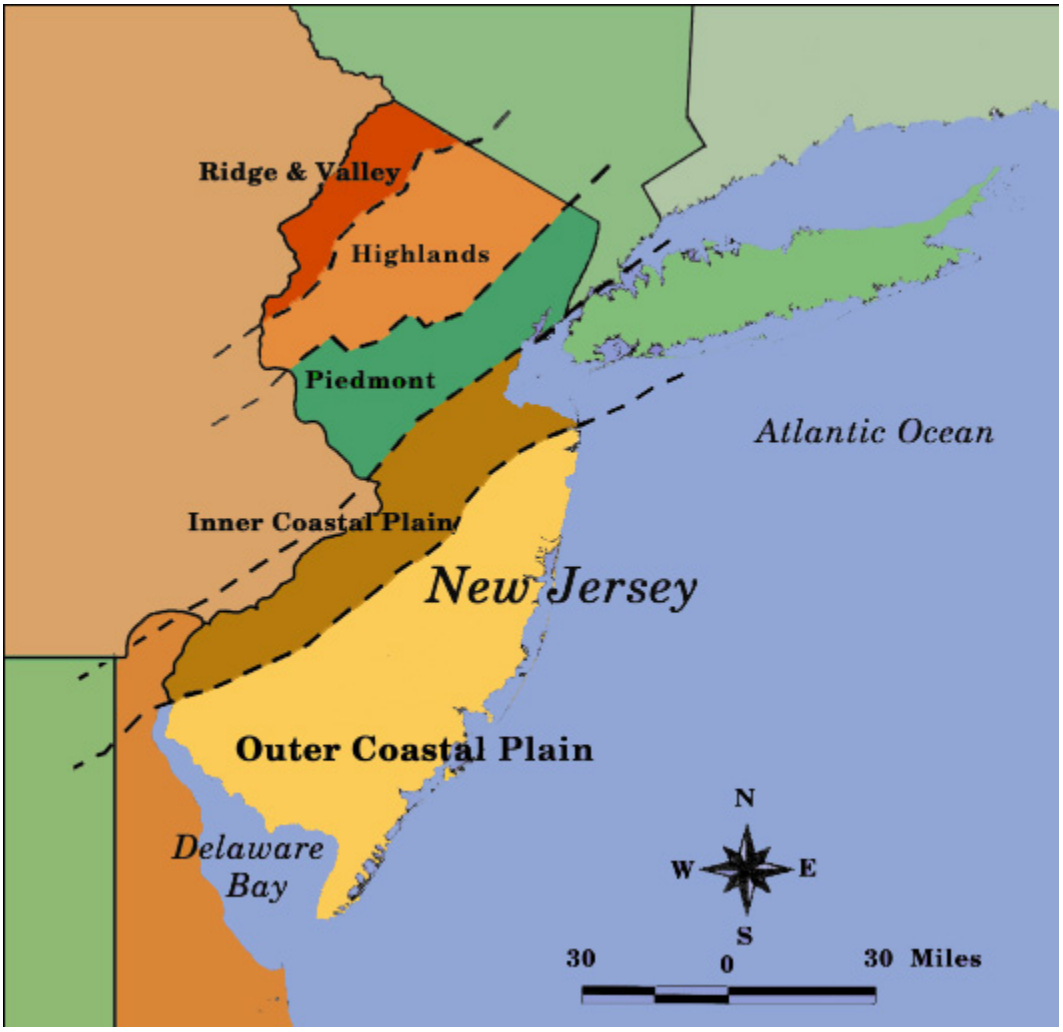
SOUTH ORANGE
Rahway River West Branch
Rahway River East Branch
MAPLEWOOD
MILLBURN
ESSEX
COUNTY
SUMMIT
SPRINGFIELD
UNION
KENILWORTH
MOUNTAINSIDE
Nomahegan Brook
CRANFORD
UNION
COUNTY
GARWOOD
WESTFIELD
Rahway
River
FANWOOD
WINFIELD


Big Flat Brook
Pond Eddy
Lords Valley
Hemlock Farms
Pecks Pond
Milford
Montague Township
High Point State Park
Unionville
Pine Island
Conashaugh
Dingmans Ferry
Stokes State Forest
Sussex
Branchville
Hamburg
Tamiment
Delaware Water Gap National Recreation...
Hardyston Township
Lafayette Township
Newton
Marshalls Creek
Sparta
Jefferson
Blairstown
Byram Township
Hope
Roxbury
Dover
Denville
Google


Ridge & Valley
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Piedmont
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Inner Coastal Plain
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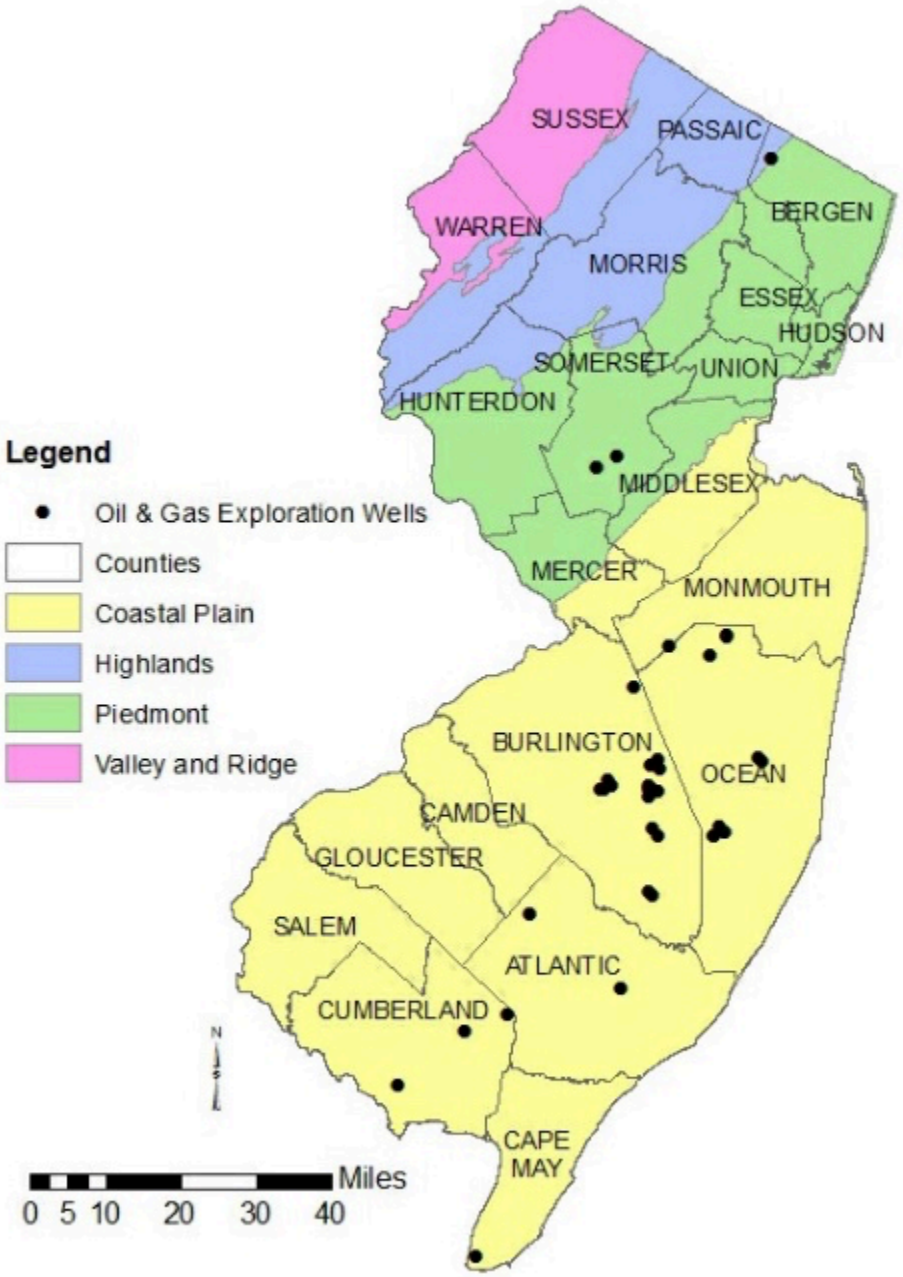
SUSSEX
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MERCER
MONMOUTH
BURLINGTON
OCEAN
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
Legend
Oil & Gas Exploration Wells
Counties
Coastal Plain
Highlands
Piedmont
Valley and Ridge
N
Miles
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For our session, we hope you will

- *develop a feel for the amount of water flowing through natural systems by taking stream flow measurements required to calculate an estimate of the quantity of water in the Flatbrook*

- *acquire knowledge about how we are able to assess water quality by sampling, recording and analyzing data involving the types of aquatic organisms present in the stream*

- *evaluate whether a stream similar to the Flatbrook could adequately supply your school community with water*

E-mail describing optional follow-up activity for teachers to use at school

Hi Leslie, Becky & Sally,

Robin and I very much enjoyed working with your curious, eager, and enthusiastic learners yesterday. As we mentioned to you, our session lengths did not allow time to fully address the quantitative aspects of the third objective which we had discussed with the girls (see attached file: Water ecology - objectives.pdf). However, we purposely structured our sessions so that each of your four teams could contribute to the data sets necessary for the final analysis, should you wish to conduct one. [Tadpoles staked out the length of our study site, sunfish obtained representative widths, whirlygigs sampled depths for us, and the newts did a great job estimating flow rates] All of their data, along with step by step suggestions for analysis, is included in the attached pdf (2022-06-03 Kent Place data)

We would be excited if some of the girls (perhaps members of your ecoteam and/or other interested students) could perform the final analysis and then share their findings and experiences in the form of a Google slide show. Doing so would provide for a meaningful post field experience and we would be excited to use their product as an exemplar for future schools should they give us permission to do so.

I've also included a screenshot from All Trails that depicts where we hiked and conducted the study. It also shows how our study site and measurements were specific to the small stream flowing from NJSOC's Lake Wapalanne to the Flatbrook.

Finally - Sofie might enjoy the photos of "her" dragonfly along with your staff members choreographing the final group photo.

Have a great closeout to your academic year.
Best wishes.

- Mike -

cc: Robin and Tanya

Hi Dr. Ellsworth / Mr. Queenan -

If you wish to do so, you can forward this to your research group. You're also welcome to share my email address with any or all of them.

HTHS students:

It was truly my pleasure to work with you up at NJSOC on Monday. Tanya, Jen and I were very much appreciative of your enthusiasm and good nature during our time with you. As you may recall, there were two primary objectives associated with my session. They are copied below.

For this field lesson, we hope you will

- *acquire knowledge about how we are able to assess water quality by sampling, recording and analyzing data involving the types of aquatic organisms present in the stream*

- *collect and compare data related to the types of macroinvertebrates present in two stream study sites*

We definitely had time in the field to come to some closure re: the first objective. I now wanted to share all of the collected data with you (not just your team data sheet) and perhaps challenge you to give a bit more thought to the "compare" part of that second objective. As the focus of your visit involved field research, I chose to adapt our typical stream ecology lesson to allow for this question. Might there be any difference in the populations of aquatic organisms found at these two sites? One was situated under a much heavier canopy layer than the other.

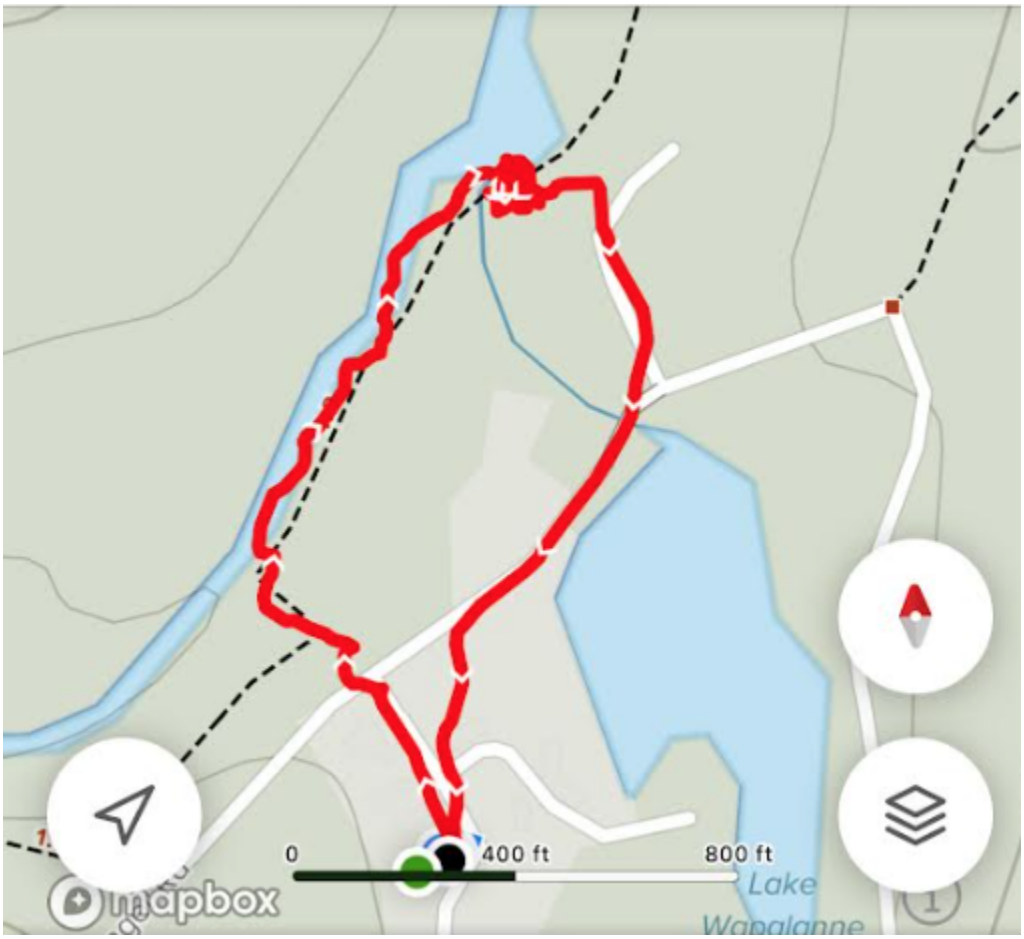
There are two pdfs attached; the one labeled bridge site was under a more dense canopy, the spillway file had far fewer trees nearby. And apologies for the condition of the last sheet in each file that was somewhat damaged due to the rain.

As you peruse the six data sheets, I'm curious to hear any of your thoughts re: any of these questions:

- *Does the data from Monday suggest any difference in the populations of aquatic organisms found at the two sites?*
- *Does the limited data suggest an opportunity for designing a future study to test a hypothesis that you might suggest?*
- *Were there any other observations you may have made that day which were not recorded on the data sheets that might suggest an idea for a future study?*

From my experience working with research students for many decades at HT, the hardest part of our research requirement involved them coming up with a meaningful question worthy of investigation. If you have some time to review the attached data sheets and consider these questions, perhaps you might be willing to share your thoughts. I would enjoy continuing the conversation with any or all of you.

Best wishes for a rewarding 2022-23 academic year.



All trails map showing start / end points (Cayuga Cabin) crossing over road by maintenance to hike down to Flatbrook continuing upstream along Brown Creeper trail to the bridge where the Spillway creek enters the Flatbrook