Ossipee Watershed

Water Literacy Educator Guide

Produced and published by Green Mountain Conservation Group
Written by Dr. Karen Deighan
In collaboration with Blair Folts, Corey Lane, and Noreen Downs

Correlation to Next Generation Science Standards (NGSS)

Green Mountain Conservation Group
196 Huntress Bridge Road
Effingham, NH 03882
603-539-1859
www.gmcg.org

Welcome Educators

Are you interested in your students taking a hands-on approach to learning about their local watershed? Do you want them to practice and expand their 21st Century skills such as critical thinking, problem solving, creativity, collaboration, communication, and media literacy? This Water Literacy Guide will do just that!

Students will take an approach to learning science that encompasses discovery and problem solving to explore and learn about their local watershed. They will learn about watershed health and water quality. All of this correlates to Next Generation Science Standards.

As part of their discovery process, students will explore a research question, conduct investigations, collect evidence, use the evidence to describe their findings, and communicate their findings to an audience. Additionally, students will learn and practice important map skills such as reading and recognizing map components, spatial and geographical awareness, and conveying science through technology.

Questions that guide watershed discovery:

- How healthy is my drinking water? What impacts the health of my water?
- How can observing and analyzing macro invertebrates from my local stream/river indicate water quality?
- How can I impact the system of streams, rivers, and watersheds that sustain me?

I hear and I forget.
I see and I remember.
I do and I understand.
-Confucius

Table of Contents

Acknowledgments

The Green Mountain Conservation Group would like to extend a heartfelt *Thank You* to the schools, teachers, students, and volunteers who have helped guide the creation of this program over the past ten years. We would also like to thank NH Department of Environmental Services for their support of the Volunteer Biological Assessment Program (VBAP); NH Fish and Game and Judy Tumosa for her help in training teachers on the Trout in the Classroom programs; Theresa Thornton, founder of GET WET! for her help training teachers and staff, and all the volunteers who helped participate in, and run these programs. Critical financial support was also provided by a lead grant from the Dorr Foundation and other support from the Little Royal Family Foundation, Adelard and Valeda Lea Roy Foundation, Pequawket Foundation, and Quimby Foundation. GMCG would also like to thank the GMCG membership for their continued support for our ongoing educational programs. Without the expert and tireless efforts of our contributors this project would not have been possible. Their efforts and contributions are both highly valued and greatly appreciated.

Thank you all!

Thanks to the following for their specific help on this project:

- Tara Schroeder, former GMCG Program Director, for her vision in 2006 to start the very first youth program through VBAP and for her long term idea to create a strong water resources program for area youth.
- Schools in Effingham, Freedom, Madison, Ossipee, Sandwich, Tamworth, Moultonborough, Fryeburg, Maine, and teachers, students, and volunteers who have been part of any of the Youth Programs since 2006.

Blair Folts, Executive Director
Green Mountain Conservation Group, May 2017

Introduction

The Ossipee Watershed is located over New Hampshire's largest stratified drift aquifer and contains critical surface and ground water resources essential to the socio-economic and environmental well being of the region's communities. Recreation and drinking water needs depend on clean water in the lakes, streams, and aquifer. The population of this region is increasing, introducing more non-point sources of pollution and threatening the quality of water resources. Increased population will also put a greater demand on water, impacting the quantity available for public and private water supplies.

The purpose of the Ossipee Watershed Water Literacy Educator Guide is to provide water resources and science-based programs to educate area youth about the abundant and critical stratified drift aquifer available in this region. Through an understanding of these resources, youth will come to understand the role they may have as future community leaders. Youth will partner with adult stakeholders on water quality research, best management practices, and public outreach to protect water resources. Students will take on the role of citizen scientists collecting and sharing important data. Educating youth to be environmental stewards is vital to the local environment and economy. This project will initiate long-term economically, sustainable, and community-oriented programs, which can be replicated for years to come and serve as a model for other communities.

Green Mountain Conservation Group (GMCG) is a community-based, charitable organization dedicated to the protection and conservation of natural resources in the Ossipee Watershed in central Carroll County including the towns of Eaton, Effingham, Freedom, Madison, Ossipee, Sandwich, and Tamworth. Since 1997, GMCG has been protecting natural resources in the Ossipee watershed and providing cost-free programs to area youth.

Healthy Water, Healthy Communities

Tools for Success: How to Use this Educator Guide

This educator guide is a resource for educators to help teach students about healthy water and their local watershed. The activities in this guide are designed for students from fourth grade through high school. The guide is divided into three parts. The parts are independent of one another and do not need to be taught in order or even in the same school year. Each part contains science vocabulary and lesson plans connected to the to Next Generation Science Standards. Also, in each unit, students will explore and examine maps. They will have the opportunity to use technology and mapping to record data. In the back of the guide, there is a glossary of terms.

Part one is GET WET! This is a ground water sampling program where students will have the opportunity to test their own well water in the classroom. They will test using six parameters and follow scientific protocol. Part two is Volunteer Biological Assessment Program (VBAP). In this program, students visit a local stream or river and collect, sort, and identify macro invertebrate. They will use the information to determine the quality of the stream water. Part three is Trout in the Classroom. Student and teachers raise trout in the classroom and then release them in their local river or stream.

Important terms:

Understanding the water cycle: The process of water circulating between the earth's oceans, atmosphere, and land. It involves precipitation such as rain and snow, drainage into streams and rivers, and the return to the atmosphere by evaporation and transpiration.

Understanding the watershed: A watershed is the area of land that drains to a particular water body (river, lake, ocean, etc.). Areas of higher elevation called ridgelines or divides separate watersheds from each other.

Understanding the aquifer: An aquifer is a body of saturated rock through which water can easily move. Underlying approximate 22% of watershed, the Ossipee Aquifer is part of the largest and most productive stratified drift aquifer in New Hampshire.

Unit 1: GET WET! Groundwater Sampling Program

How healthy is my drinking water? What impacts the health of my water?

Introduction: The purpose of Groundwater Education Through Water Evaluation & Testing (GET WET!) is for students to understand the process that determines the quality of water, quantify statistics generated through learned sampling techniques, and monitor the potential causes of poor water quality in their homes and neighborhoods. GET WET! was founded by Dr. Theresa Thornton.

This lesson will be presented in four parts:

1. Background knowledge: This portion of the lesson will activate prior knowledge and give the students the information they will need in order to conduct the testing.
2. Testing: In this portion of the lesson, students will test their well water using six parameters: chloride, conductivity, hardness, nitrates/nitrites, pH, iron.
3. Results: Students will analyze the results of their water testing. They will use technology and mapping skills to interpret their data.
4. Presentation: Students will have the opportunity to present their findings to an audience.

Vocabulary:

chloride	nitrites	nitrates	conductivity	hardness
pH	iron	watershed	groundwater	aquifer
condensation	precipitation	evaporation	transpiration	accumulation
dug well	driven well	drilled well	latitude	Longitude

Next Generation Science Standards:

5-PS1-3 Make observations and measurement to identify materials based on their properties.

5-PS1-4 Conduct an investigation to determine whether the mixing of two or more substance results in new substances.

MS-PS1-1 Analyze and interpret data on the properties of substance before and after the substances interact to determine if a chemical reaction has occurred.

MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and ground water resources are the result of past and current geoscience processes.

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 increase in human population and per-capita consumption of natural resources impact Earth's systems.

HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Lesson plans: GET WET

Part I: BACKGROUND KNOWLEDGE

Grade level: 6th to 12th grade

Time: 20 to 30 minutes depending on depth of content and age level of students

Materials:

slide show
empty water bottles
brown paper bag
technology to show slide show
parent letter
well survey
directions for collecting water sample

Set up:

- Prepare audio visual equipment for slide show (Appendix A)
- Print copies of parent letter and well survey (Appendix B)
- Attach directions for collecting water sample to paper bags (Appendix C)
- Collect one water bottle for each student and number all of the water bottles

Procedures:

- Present the slide show to the students. The purpose of this slide show is to give the students the background knowledge and directions needed to be successful on testing day. The slide show should be adapted to the grade level and geographic location of the audience. For example, the maps should be maps of the town where students reside. The use of maps of the local watershed and/or a topographical map will reinforce the concept that water knows no boundaries.

- Give each student a copy of the parent letter and Well Water Survey. Students will also be given the GET WET! Data Sheet (Appendix D). Students will fill out the top and bottom portions of the data sheet with the physical address of where they will take their water sample. They will use Google Earth to look up the latitude and longitude of that address.
- Pass out one water bottle per student and one paper bag (with water collection directions attached) per student. Students will collect well water from their homes or from the home of a neighbor or relative. If any student does not have access to well water, he or she may test town water from their home or water from the school.

Part II: TESTING

Grade level: 6^{th} to 12^{th} grade

Time: 60 to 90 minutes depending on and age level of students and number of students

Materials:

table signs	pH testing meter
testing directions	Conductivity testing meter
goggles	Iron Test Kit
gloves	Nitrates/Nitrites Test Kit
scissors	Chloride Test Kit
student well water samples	Hardness Test Kit

Set up**:**

- Gather the following materials, one per student: pair of gloves and a pair of goggles.
- Prepare six testing station. At each station, place a table sign (Appendix E), directions for testing (Appendix F), and the corresponding test kit.

Procedure:

1. Each student will have their data sheet, sample of his or her well water, a writing utensil, a pair of gloves, and a pair of goggles.
2. In pairs or groups of three, students will rotate among the stations. They will follow the directions at each station to test their water and record the results on their data sheet.

Part III: RESULTS

Grade level: 6th to 12th grade

Time: 30 minutes

Materials:

student data sheets

computers with Google Earth

calculators

Set-up:

- Ensure that you have access to Google Earth and enough electronic devices, such as computers and/or iPads appropriate for the size of your class.

Procedure:

1. Students will make necessary calculations on their data sheet.
2. Students enter their data into an Excel spread sheet.
3. Students can take the mean, mode, and median of all the data.
4. Students can enter their results into GIS mapping to create a visual of their results.
5. Students can create scatter plot graphs of their results.
6. Students work together to come up with creative ways to share their results with an audience.
7. Discuss the meaning of the results with the students. The discussion will answer the following guiding questions: How healthy is my drinking water? What could have impacted the health of my water? What could have impacted the results of my testing?

Part IV: PRESENTATION

The students and the teacher will work together to create a presentation to share with an audience. One option is to create a power point of the results. The results can include graphs of the data and pictures of the students doing the testing. It can also include information on what the data means. See Appendix G for a sample slide show.

EXTENSION ACTIVITIES:

Make 3-D models of the water cycle, test water from different locations in the school and compare results, research water quality issues in your area, research water issues (globally) such as the availability of clean water, make a 3-D model of the aquifer, research the different types of wells and compare and contrast them, visit a local water treatment plant, invite a speaker from your local conservation group or from NH Department of Environmental Services, research the role of plants in water filtration, build your own watershed, research recharge and discharge areas and the impact on ground water, or make a brochure or poster which may serve as a public service announcement about the importance of clean water.

Unit 2: Volunteer Biological Assessment Program (VBAP)

How can observing and analyzing macro invertebrates from my local stream/ river indicate water quality?

Introduction: The Volunteer Biological Assessment Program (VBAP) is a successful program, adapted from the New Hampshire Department of Environmental Services (NHDES) by Green Mountain Conservation Group (GMCG). Since 2006, GMCG has been working with teachers and students around the Ossipee Watershed of New Hampshire to incorporate this program into schools. This program encompasses a wide variety of subject areas, making it a beneficial educational experience for students as well as teachers. This protocol is designed for individuals with or without professional training.

This lesson will be presented in four parts:

1. Background knowledge: This portion of the lesson will activate prior knowledge and give the students the information they will need in order to be successful during macro invertebrate sampling at the water.
2. Macro Invertebrate Sampling: In this portion of the lesson, student will visit a local stream and collect, sort, and analyze macro invertebrates.
3. Results: Students will analyze the results.
4. Presentation: Students will have the opportunity to present their findings to an audience.

Vocabulary:

run	riffle	pool	erosion	water cycle
watershed	sediments	protocol	habitat	macro invertebrate
conductivity	turbidity	temperature	stream	oxygen (dissolved)
biomonitoring	aquifer	groundwater	pH	aquatic

Next Generation Science Standards

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

5-PS1-3 Make observations and measurements to identify materials based on their properties.

5-PS3-1 Use models to describe that energy in animals' food was once energy from the sun.

5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environments.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved**.**

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

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-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organism and populations of organisms in an ecosystem.

Lesson plans: VBAP

Part I: BACKGROUND KNOWLEDGE

Grade level: 4^{th} to 12^{th} grade

Time: 30 minutes

Materials:

slide show
samples of macros
technology to show slide show
permission form
kick net

Set up:
- Prepare audio visual equipment for slide show (Appendix H)
- Gather samples of macro invertebrates (preserved or pictures)

Procedures:
- Present the slide show (Appendix H) to students. The purpose of this slide show is to give the students the background knowledge and directions needed to be successful on testing day. The slide show should be adapted to the grade level and geographic location of the audience. For example, the maps of the town where students reside. The use of maps of the local watershed and/or a topographical map will reinforce the concept that water knows no boundaries.
- As an interactive component of the slide show, pass out samples of macro invertebrates (preserved or pictures). Discuss the attributes of the macros to aid in identification. Students will use the macro key to identify the macros.
- Use kick net and student volunteers to demonstrate protocol (as outlined in the slide show).

Part II: SAMPLING

Grade level: 4^{th} to 12^{th} grade

Time: 2 hours, 30 minutes

Materials (Appendix I):

kick net
wire mesh dish pan
yardstick
clipboards, pencils
pipettes
chemical sampling equipment
gloves
trash bag
reference book & ID keys
dish-pans
measuring tape
hand lenses
data sheets
plastic spoons
wash bottle
folding table and chairs
first aid kit
tarps

ice cube trays magnifying cubes

Set up:

- Before students arrive: set out tarps for groups of students to sit on.
- On each tarp, place dishpan, ice cube tray, hand lenses, magnifying cubes, plastic spoons, and pipettes.

Procedures:

- Students will follow the NH Department of Environmental Services (2008) protocol to collect, sort, identify, and analyze macro invertebrates. See Appendix I for the complete VBAP Protocol from NHDES. All data will be compiled on one data sheet.
- First, students will record site information including physical and chemical parameters.
- Second, students will collect macro invertebrates.
- Third, students will sort macro invertebrates
- Fourth, students will identify sorted macro invertebrates
- Finally, students will calculate the Biological Water Score.

Part III: Results

Grade level: 4th to 12th grade

Time: 30 minutes

Materials:
data sheets
calculators
technology

Set up:

- Give each student should a copy of the data sheet.

Procedure:

1. Students can work in pairs to make the necessary calculations on their data sheets.
2. Students work together to come up with a creative way to share their results with an audience.

Part IV: PRESENTATION:

The students and the teacher will work together to create a presentation to share with an audience. One option is to create a power point of the results. The results can include graphs of the data and pictures of the students doing the testing. It can also include information on what the data means. See Appendix J for a sample slide show of VBAP results.

EXTENSION ACTIVITIES:
Make 3-D models of the water cycle, research water quality issues in your area, research water issues (globally) such as the availability of clean water, make a 3-D model of the aquifer, invite a speaker from your local conservation group or from NH Department of Environmental Services, research the role of plants in water filtration, build your own watershed, make a brochure or poster which may serve as a public service announcement about the importance of clean water, make 3-D models of macros, or develop Best Management Practices for your area.

Unit 3: Trout in the Classroom (TIC)

How can I impact the system of streams, rivers, and watersheds that sustain me?

Introduction: Trout in the Classroom is an environmental education program in which students grades K-12 raise trout from eggs to fry, monitor tank water quality, engage in stream habitat study, learn to appreciate water resources, begin to foster a conservation ethic, and grow to understand ecosystems. TIC is a unique way to teach the relevance of watersheds. Trout are indicator species; their abundance directly reflects the quality of the water in which they live. In the TIC program, students grow to care about their trout and then the habitat in which trout live. As the program progresses, students learn to see connections between the trout, water resources, the environment, and themselves.

Please visit http://www.troutintheclassroom.org for an abundance of lesson plans and activities pertaining to trout. Also, NH Fish and Game offers a free Trout in the Classroom training for educators. This training offers a wealth of information and resources to help educators and students be successful. It is mandatory for anyone wanting to do TIC (with free eggs from NH Fish and Game).

This lesson will be presented in three parts:

1. Background knowledge: This portion of the lesson will activate prior knowledge and give the students the information they will need in order to care for and release the trout.
2. Raising trout: During this phase, students will care for the trout and monitor the health of both the trout and the water.
3. Release: Students will release the trout in a pre-approved (by NH Fish and Game) stream or river.

Vocabulary:

ecosystem	Alevins	larval stage	biodiversity	eutrophication
aquifer	hatching stage	broad angle	habitat	non point source
spawning	fry	juvenile	embryonic	non native species
invasive species	fingerling	watershed	groundwater	broad angle vision

Next Generation Science Standards:

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

5-PS3-1 Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposer, and the environment.

MS-Ls2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organism in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Lesson Plans: TIC

Part I: BACKGROUND KNOWLEDGE

Grade level: 3rd to 12th grade

Time: 30 minutes

Materials:
power point slide show (Appendix K)
technology to show slide show

Set up:

- Prepare audiovisual equipment for slide show (Appendix K).

Procedures:

- Present the students with the TIC background knowledge slide show. The purpose of this slide show is to give the students the background knowledge and directions needed to be successful in raising trout in the classroom and then releasing them in an approved (by NH Fish and Game) stream or river. The slide show should include maps of the local watershed.
- The use of maps of the local watershed and/or a map topographical map will reinforce the concept that water knows no boundaries.

Part II: RAISING TROUT

Grade level: 3rd to 12th grade

Time: 4 months

Materials:

chiller	tank
filter	table
insulation for the tank	gravel
air pump	thermometer
nets	fresh water testing kit
turkey baster	siphon gravel cleaner

Set up**:**

- See Appendix L for complete instructions for setting up the tank.

Procedure:

- Students and teachers will raise the trout in a tank in their classroom. They will monitor the health of the trout and the health of the water on a daily basis. They will follow the protocol and guidelines outline by NH Fish and Game (Appendix L).

Part III: RELEASING TROUT

Grade level: 3rd to 12th grade

Time: 30 to 90 minutes

Materials:
Power point slide show
Technology to show slide show

Set up:

- Prepare audio visual equipment ready for slide show (Appendix M)

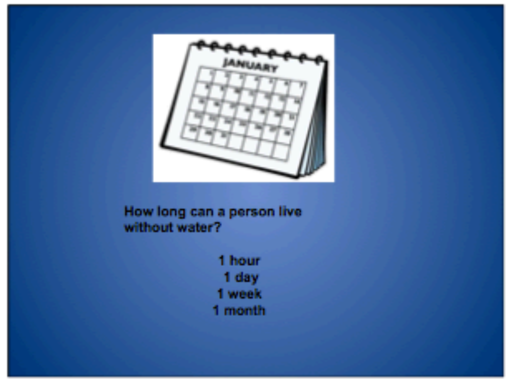
Procedures:

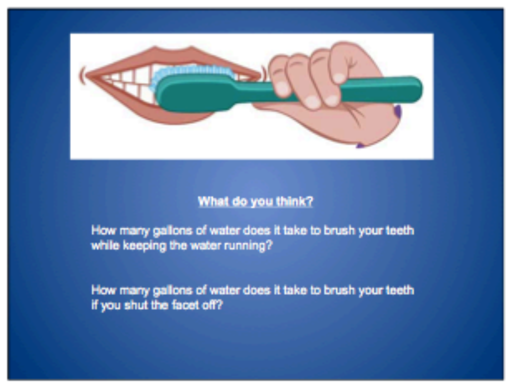
- Present the slide show to the students. The purpose of this slide show is to review what the students have learned about trout and to discuss the process of releasing the trout in the local stream or river. This slide show and discussion will take 30 minutes.
- The teacher will set a date for the students to release the trout. See Appendix M for the protocol on releasing the trout. The release of the trout will take 60 minutes (excluding travel time).

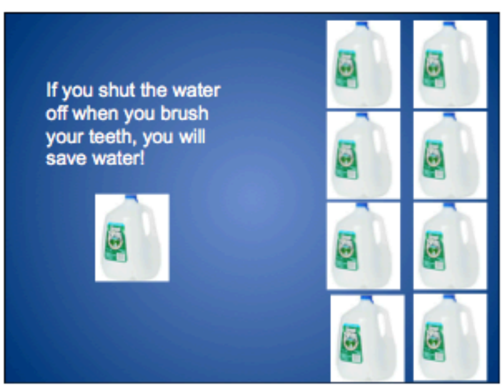
EXTENSION ACTIVITES: Make 3-D models of the water cycle, research water quality issues in your area, research water issues (globally) such as the availability of clean water, make a 3-D model of the aquifer, invite a speaker from your local conservation group or from NH Department of Environmental Services, research the role of plants in water filtration, build your own watershed, make a brochure or poster which may serve as a public service announcement about the importance of clean water. For additional ideas, visit: http://www.troutintheclassroom.org.

Appendix A

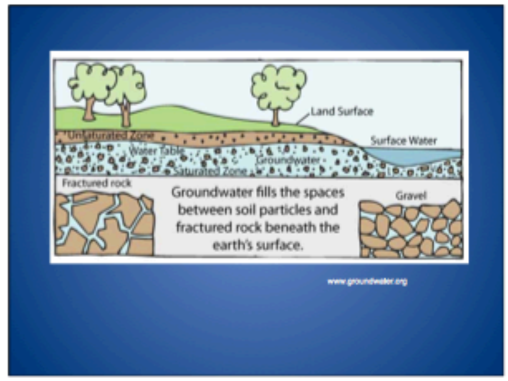
Background Knowledge: GET WET!

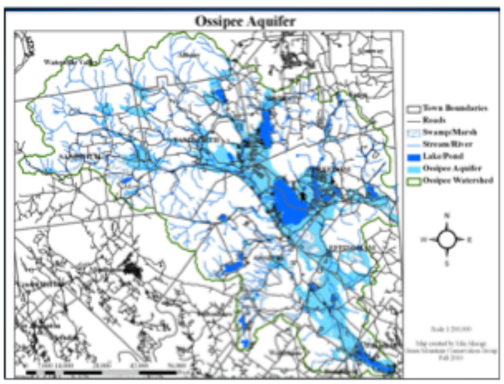




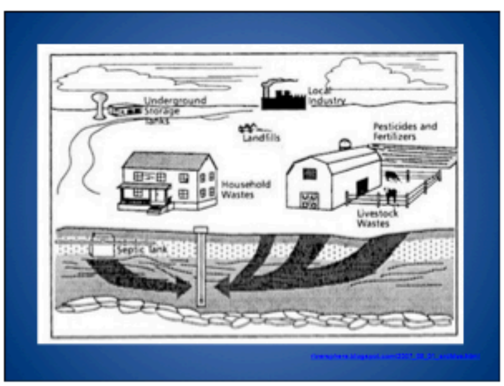


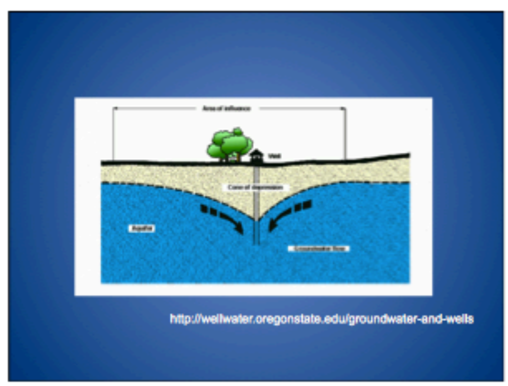

condensation
evaporation
precipitation
surface runoff
soil
lake
ocean
ground water


Land Surface
Unsaturated Zone
Surface Water
Water Table
Groundwater
Saturated Zone
Fractured rock
Gravel
Groundwater fills the spaces between soil particles and fractured rock beneath the earth's surface.
www.groundwater.org

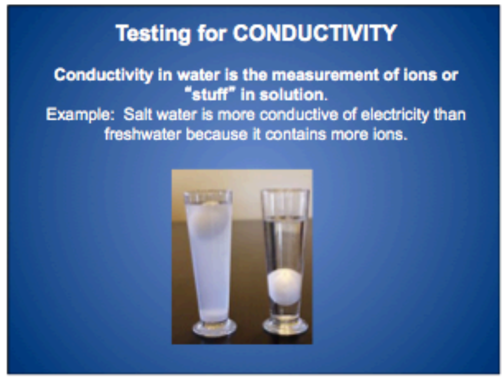

Ossipee Aquifer
Town Boundaries
Roads
Swamp/Marsh
Stream/River
Lake/Pond
Ossipee Aquifer
Ossipee Watershed
N
W
E
S


WHERE DO WE GET DRINKING WATER?
Groundwater Sources:
Aquifers
Water Table
Surface Waters:
Springs
Streams
Lakes
Ponds
Rivers


Underground Storage Tanks
Local Industry
Landfills
Pesticides and Fertilizers
Household Wastes
Livestock Wastes
Septic Tank

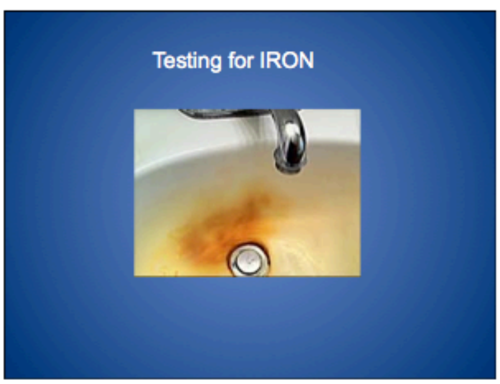

http://wellwater.oregonstate.edu/groundwater-and-wells


Testing for pH
Measure of how much acid is in your water.
Neutral


Testing for CONDUCTIVITY
Conductivity in water is the measurement of ions or "stuff" in solution.
Example: Salt water is more conductive of electricity than freshwater because it contains more ions.


Testing for Hardness
Hardness


Testing for Chloride
CAUTION
4064


Testing for IRON


GET WET!
Data analysis and mapping
Chloride

Appendix B

Parent Letter GET WET!

Dear Families

Your child is invited to participate in a school science project: GET WET! (Groundwater Education Through Water Evaluation & Testing) with Green Mountain Conservation Group. This amazing opportunity allows students to understand scientific procedures while providing citizens and policy-makers with unbiased and credible information that can enhance efforts to achieve healthy ecosystems, strong communities, and robust economies. The data collected will be used to examine the groundwater chemistry in your community.

You will be provided with an empty bottle (to fill) and a questionnaire about your water knowledge. Students will learn the standard safety procedures used by scientists to avoid contamination of samples and each student will be provided with safety goggles and gloves to ensure their safety.

Later in the year, you will be notified of a presentation students will give of their **GET WET!** drinking water results to the community. All are welcome and invited to this event. In order to make this information available to other classrooms and the community at large, both photos and testing information will be available on the **GET WET!** website and in professional publications. All photos will be generic pictures of children participating in **GET WET*!*** activities. **No names, addresses or other information, which would make your child individually identifiable, will be included. At no time will names, addresses, or specific locations be divulged. An information database in GIS form will be used without a photo image and mapped at a distance far enough away that it would be impossible to determine the exact location of any sample.** Any specific information provided will be kept strictly confidential.

I am attaching a permission form for you to sign and a survey about your well. Please return both of theses papers with your child and their bottle of water to school. If you are on town water, your child is encouraged to still bring in a water sample.

Thank you very much for your support! If you have any questions about GET WET!, please do not hesitate to contact me at education@gmcg.org.

Karen Deighan

Dr. Karen Deighan
Education Coordinator
Green Mountain Conservation Group
PO Box 95
Effingham, NH 03882
education@gmcg.org
(603) 539-1859

How much do you know about your well?

Private Well Information sheet

Name:

Physical address:

1. What is your lot size (acres)?_____
2. What is the average lot size of surrounding parcels (acres)?_____
3. Is your well a drilled well or a dug well?________
4. How deep is your well?______
5. What is the estimated yield of your well (gal/min)?_____
6. Do you treat your water (i.e., water softener, carbon filter?_____With what?________
7. Have you had problems with the quality of water supplied by your domestic well (i.e. hardness, staining, odor, taste)?_____________________________________
8. Do you use fertilizers?_______ How often and what type?_____________________
9. What is the distance from your well to a leach field or seepage pit?______________
10. What is the distance from your well to any nearby surface-water (i.e., pond, stream, spring, flowing ditch, lake, etc.)?
11. Is central water or sewer service in use on or near your property?
12. List any non-residential uses occurring adjacent to or within 500 feet of your property lines (i.e., agriculture, commerce, light industry, repair shops).____________________
13. What is the distance to the nearest road? ___(ft.) Type of road? Town, County, State, US?

Date Sampled:____________________ Bottle ID#___________________

Appendix C

Directions for Obtaining Water Sample

GET WET!

Directions for obtaining water sample:

- Remove aerators from faucet
- Run COLD water for 10 minutes
- Fill bottle to the TOP & cap tight
- Place paper bag in refrigerator.
- BRING TO SCHOOL!

Appendix D

GET WET! Data Sheet

Chemist/Recorder: **Date:**

Well Type: **Well Location (Town/State):**

Get Wet!

Groundwater **E**ducation **T**hrough **W**ater **E**valuation & **T**esting
Laboratory Station Sampling Sheet

Maximum Safe Limit or Range

CHLORIDE TEST:
Chloride: # of drops___ x 20 = _____mg/L (ppm) — for Chloride (250)
Salt: # of drops___ x 1.6 = _____mg/L

NITRATE TEST:
Nitrate Result: _____________ mg/L (ppm) — 10 mg/L
Nitrite Result: _____________ mg/L (ppm) — 1 mg/L

pH TEST:
pH Result: __________________ — 6.5-8.5

HARDNESS TEST:
Number of Drops = ___________x 17.1=_________ — < 75 (soft) >300 (hard)

IRON TEST:
Sample result: _______________ µg/L (ppb) — 300 µg/L

CONDUCTIVITY TEST:
Sample Result: ______________________ µS/cm — 625 µS/cm

Latitude: _______________________Longitude:___________________________
Street address____
Town____State____

Appendix E

GET WET! Table Signs

CHLORIDE

NITRATE

pH TEST

HARDNESS

IRON

CONDUCTIVITY

Appendix F

GET WET! Testing Directions

Testing Procedures for **CONDUCTIVITY**

1. Pour a small amount of distilled water into the sample cup. Swirl it around and then dump into waste bucket.
2. Pour about 2 inches of your water sample into the sample cup.
3. Press the ON/OFF switch once to turn the tester on.
4. Remove the protective cap from the bottom.
5. Using the tester, gently stir the sample for several seconds. When the digital display stabilizes, read the conductivity value and record on your testing sheet.
6. Rinse the bottom of the tester with distilled water and replace the cap.

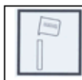
Testing Procedures for IRON

	Fill sample vial half full with **distilled** water. Swirl around and dump into waste bucket.
	Fill sample vial half full with well water.
	Open one foil packet and add powder contents to vial. Cap vial and shake rapidly for 5 seconds.
	Dip a test trip into sample vial and move back and fourth underwater for 15 seconds. Remove and shake excess water from test strip.
	Immediately compare test pad to color chart and record results. Estimate results of color on test pad. Record results on your testing sheet.

Testing Procedures for **CHLORIDE**

	Fill sample vial half full with distilled water. Swirl around and dump into waste bucket.
	Pour your sample water in the square, mixing bottle up to the 23mL mark.
	Add the contents of one Chloride 2 Indicator Power Pillow. Swirl to mix.
	Add the Silver Nitrate Titrant drop by drop to the square bottle. Hold the dropper in a vertical position and swirl the bottle to mix after each drop added. Count each drop as it is added until the water changes from yellow to orange in color.
	To obtain the Chloride content of the water in mg/L, multiply the number of drops there was added by 5. To express the results as mg/L sodium chloride NaCl, multiply the mg/L chloride found in the test by 1.6.

Testing Procedures for **HARDNESS**

	Fill sample vial half full with **distilled** water. Swirl around and dump into waste bucket.
	Fill the tube full (to the top) with your **well** water.
	Pour the contents of the tube into the square, mixing bottle.
	Add the contents of one UniVer3 **Hardness** Pillow into the mixing bottle. Swirl to mix.
	While swirling the mixing bottle, add **Harness Titrant solution** drop by drop. When the sample changes from **red to blue**, record the number of drops added.
	Multiply the number of drops by 17.1.

Testing Procedures for **NITRATE/NITRITE**

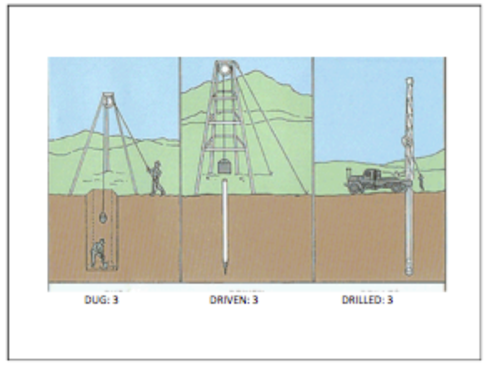
	Pour a small amount of **distilled** water into the sample cup.. Swirl around and dump into waste bucket.
	Pour small amount of your **well water** into the cup.
	Dip a **test strip** into the water for **1 second** and remove. **DO NOT SHAKE.** Hold the strip level, with pad side up for **30 seconds**. Compare the **NITRITE** test pad **(bottom)** to the color chart. Record your results.
	At **60 seconds,** compare the **NITRATE** test pad **(top pad**) to the color chart. Record your results.

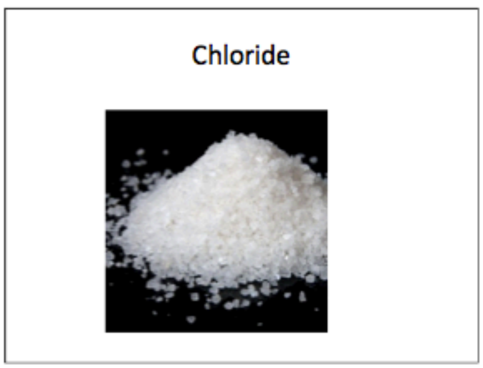
pH Testing Procedures

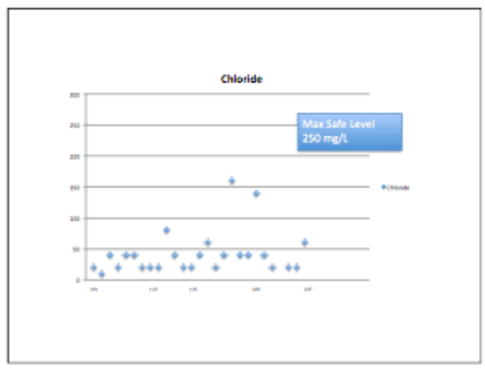
1. Pour a small amount of distilled water into the sample cup. Swirl it around and then dump into waste bucket.
2. Pour about two inches of your well water into the sample cup.
3. Press the ON/OFF switch once to turn the tester on.
4. Remove the protective cap from the bottom.
5. Immerse the bottom of the tester into the water.
6. Using the tester, gently stir the sample for several seconds.
7. When the digital display stabilizes, read the pH value. Record the number on your testing sheet.
8. Rinse the bottom of the tester with distilled water and replace the cap.

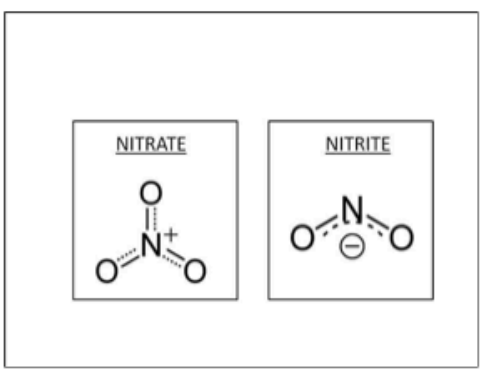
Appendix G

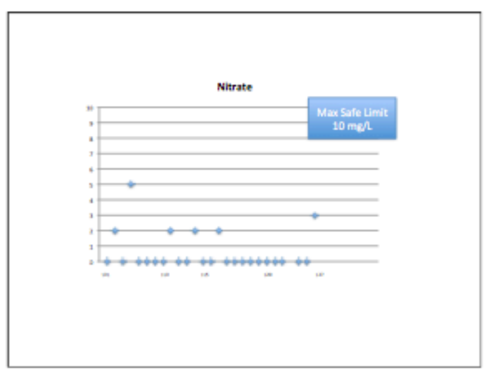
GET WET! Results

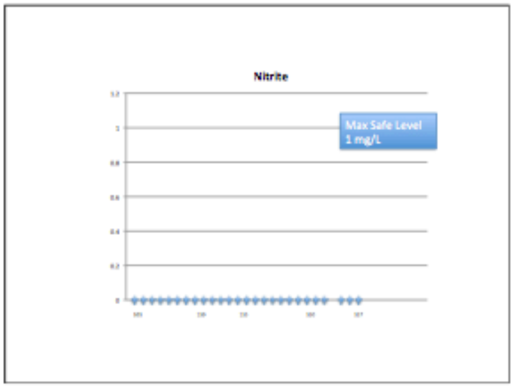




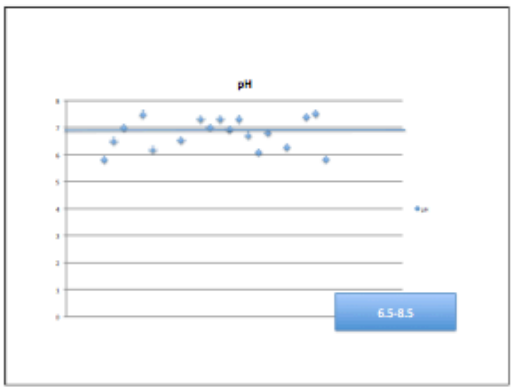




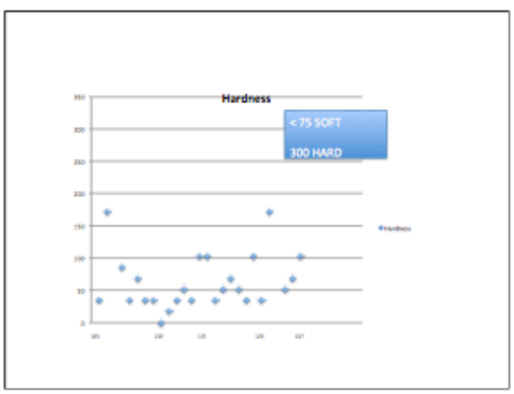



Nitrite
Max Safe Level
1 mg/L

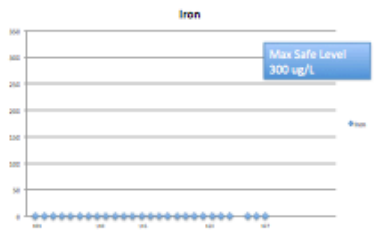

Corrosive
Water

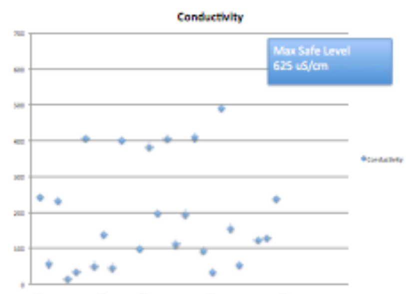

pH
6.5-8.5


HARD WATER


Hardness
< 75 SOFT
300 HARD


IRON

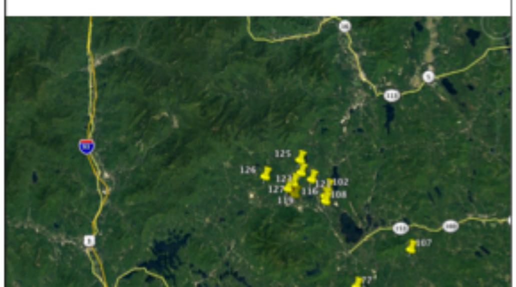




Chloride-Conductivity

119: School
121: Well with filter

119: School
121: Well with filter



How do I get my water tested?

Contact NHDES at (603) 271-2513

Or

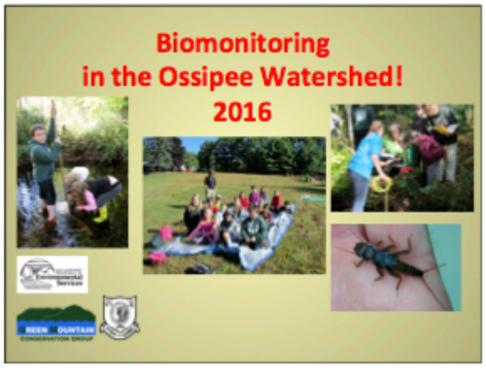
www.des.nh.gov

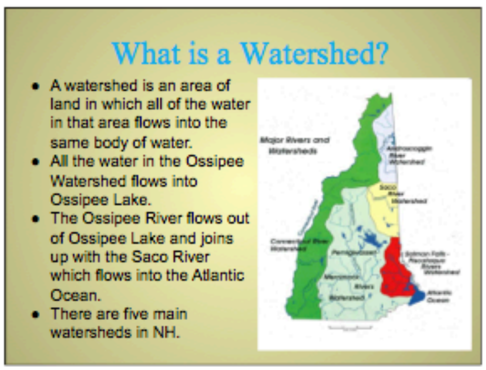
Drinking Water & Groundwater Bureau

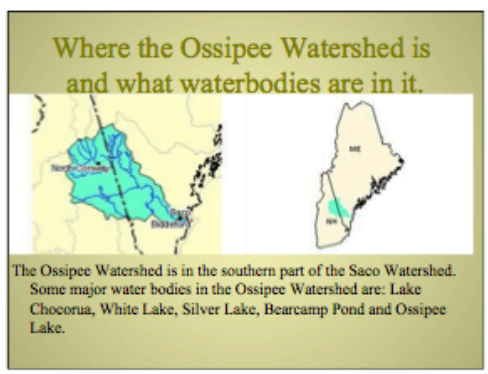
Test your water every 3-5 years

Appendix H

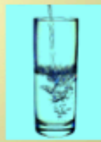
VBAP Pre-Visit Slideshow







Over 300,000 people in Maine get their drinking water from the Saco River!

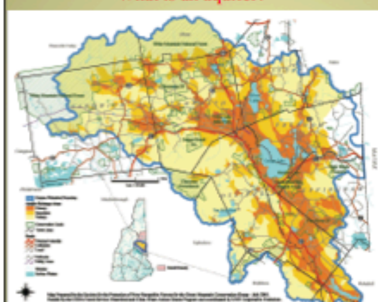


The towns of the Ossipee Watershed

Waterville Valley, Albany, Sandwich, Tamworth, Madison, Eaton, Moultonborough, Ossipee, Freedom, Effingham, Tuftonbough, Wolfeboro, Brookfield and Wakefield.

It is very important that all of these towns work together to protect this important resource.

What is an aquifer?



A body of permeable rock and sand that can contain or transmit groundwater

We live over the largest stratified drift aquifer in NH!

This type of aquifer can be contaminated very quickly and easily

A Stream is a System!

All parts of the system rely on each other

Without macroinvertebrates, the system would fall apart!

aquatic (lives in water)

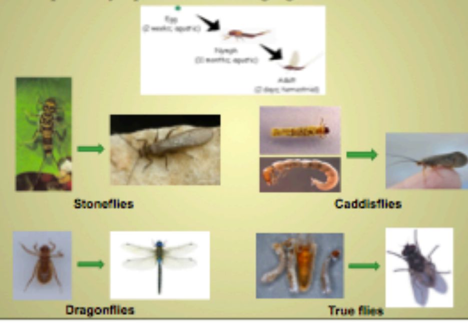
<u>macro</u> (big) <u>in</u> (no) <u>vertebrate</u> (backbone)

Aquatic Macroinvertebrates

What are they: Animals without backbones that live at least part of their life cycle in the water and can be seen with the naked eye.

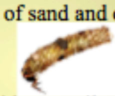
Types:

Macroinvertebrates spend most of their life as aquatic nymphs before emerging into adult insects!



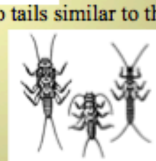
Some Examples of Interesting Macroinvertebrates:

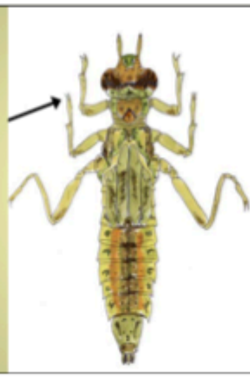
#1) caddis fly: A caddis fly is a macro that makes a tiny case out of sand and other materials.



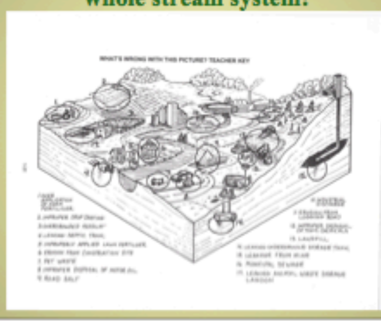
#2) stonefly: a macro with two tails similar to the mayfly.

They do "push-ups" to get oxygen.





Polluted Runoff can affect macro's and the whole stream system!

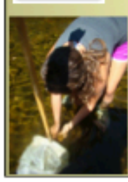


Sources of Water Pollution

- Point Source Pollution:
  Contaminants that come from a specific location.
- Non-Point Source Pollution:
  Contaminants that are introduced to the environment over a large, widespread area.

VBAP
Volunteer Biological Assessment Program

You can help protect our valuable water resources!



What are we going to do?

- Classroom Training
- Field Sampling Day
- Observing Our Results
- Community Presentation

Who will be Involved?

- Sandwich Central School
- Ossipee Central School
- Freedom Elementary School
- Effingham Elementary School
- Madison Elementary School
- Maine Environmental Science Academy (MESA)
- The Community School
- Carroll County 4-H

What is Biomonitoring?

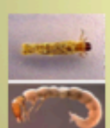
The use of plants or animals to indicate the quality of the environment in which they live.

Biotic Index: A number calculated to represent the overall health of a stream that depends on the tolerance and abundance of macros in a sample

HIGH = Polluted LOW = Clean

Macroinvertebrate Tolerance Levels

Sensitive/Intolerant Macros
Hellgrammite, Water Penny, Stonefly, Mayfly, and Caddisfly

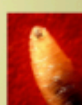


These are pictures of caddis flies.

Somewhat Sensitive/ Intolerant
Dragonfly Nymph, Damselfly Nymph, and Crayfish.

This is a picture of a dragonfly nymph.

Tolerant to pollution
Aquatic worms, and Blackfly Larvae.



This is a picture of blackfly larvae.

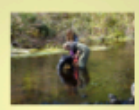
Field Day!

Where will Freedom be Sampling?

Cold Brook, Freedom, NH

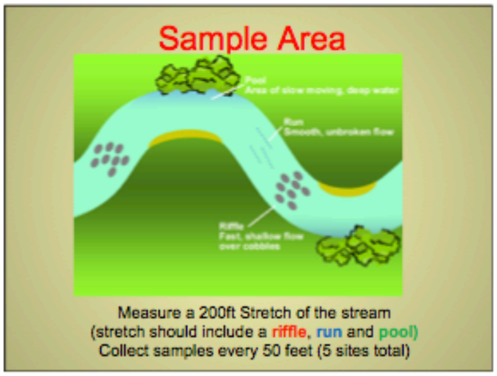
Protocols for Field Day

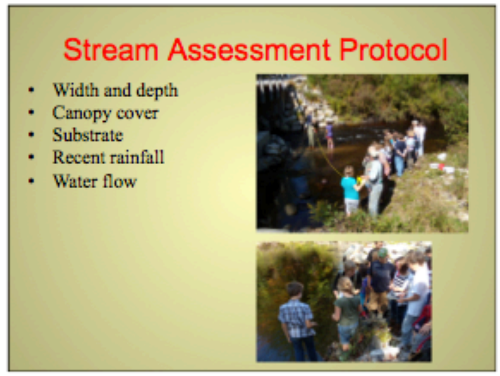
Sampling protocol



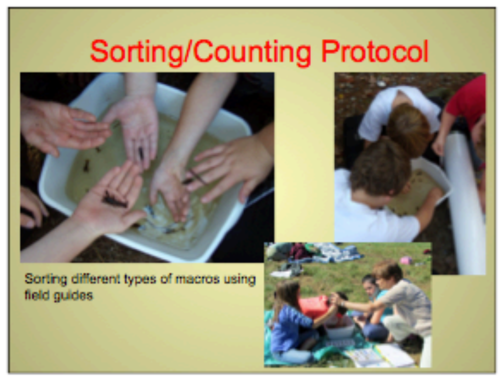
One person holds net
One person scrubs rocks/stirs up sediment
30 seconds with hands/30 seconds with feet

Do the bug dance!


Sample Area
Pool
Area of slow moving, deep water
Run
Smooth, unbroken flow
Riffle
Fast, shallow flow over cobbles
Measure a 200ft Stretch of the stream
(stretch should include a riffle, run and pool)
Collect samples every 50 feet (5 sites total)


Stream Assessment Protocol
Width and depth
Canopy cover
Substrate
Recent rainfall
Water flow


Using Probes and Sensors to Collect Parameters.
Dissolved Oxygen
Conductivity
Turbidity
pH
GMCG has years of data from testing these parameters on the Cold River as well as over 30 other local sites!


Sorting/Counting Protocol
Sorting different types of macros using field guides


Calculating Biotic Score


What to Bring to Field day
Remember, you might get wet!
Change of Clothes
Shoes that can get wet!
Towel
Snack
Sunscreen
Bug Spray
Paper work – YOU MUST HAVE IT
Release Form
No Paperwork = No Field Trip

Appendix I

VBAP Protocol

Macroinvertebrate Sampling Guidelines

Recommended Time of Year to Perform Sampling: summer & early fall.

Time it Will Take to Complete Biological Sampling Activities per Site
In general, sampling consists of a habitat assessment (~1/2 hour), macroinvertebrate collection (~1/2 hour), macroinvertebrate sorting (1 hour) and identification (~1/2 hour), and a simple physical/chemical site assessment (~1/2 hour).

Equipment: Description & Use

Item		Use
Kicknet (at least 500micron mesh size)		to collect the organisms
Dish-pans (i.e. sorting trays) and ice cube trays		to sort and view the organisms
Gridded, wire mesh dish-pan		to composite the kicknet samples and separate a fraction of them.
100' fiberglass measuring Tape		to measure average stream width
Yardstick		to measure average stream depth
Hand lenses		to identify invertebrates
Clipboards, pencils		to record data
Volunteer Biomonitoring Data Sheets:		to record data
	Habitat Data Sheet	to record data
	Macroinvertebrate Data Sheet	to record data
	Biological Water Quality Score Sheet	to record data
	Physical/Chemical Parameters	to record data
Pipettes		to transfer organisms from sorting tray to ice cube tray
Plastic spoons		to transfer organisms from sorting tray to ice cube tray
Waders		to keep you dry
Camera		for photo documentation
Chemical sampling equipment		to measure pH, dissolved oxygen, temperature, and conductivity
Wash bottle		to rinse the bugs out of the kicknet
Reagent grade Ethyl Alcohol & Voucher Vials (3)		to preserve bugs for Quality Control
Calculator		to calculate the number and percentages of invertebrates found
Gloves		To scrub rocks and debris while sampling in river/streambed
Folding Table & Chairs		To use for sorting and identification
Trash Bags		For any trash found at site
First Aid Kit		In case of an emergency
Reference Books & ID Keys		To identify organisms

Sampling Protocols

Step 1. Record Site Information

(603) First, record all general site information on the **Habitat Data Sheet** (Appendix B.1) including:
- Stream Name
- Town
- Volunteer Group
- Staff Present
- Date
- Weather for today and for the past three days

(604) Secondly, walk the stream bank along the section that will be sampled. Become familiar with the stream, its banks, and the riparian habitat. Now, fill in the rest of the information on the **Habitat Data Sheet.** Sketch the stream (riffle / pool prevalence, direction of flow, bank condition) and its surrounding habitat including unique, adjacent geographical indicators (trees, fences, bridges, culverts, homes, lawns, impervious cover, roads, invasive species, etc.).

(605) Lastly, take pictures (if possible) of the section selected for sampling. Label the pictures appropriately and note in top section of Data Sheet.

Step 2. Collect Macroinvertebrates

1.0 Before collecting the bugs, prepare for invertebrate processing by filling one sorting pan (dish-pan) with just enough clear stream water to cover the bottom of the gridded wire mesh dish-pan, when placed inside the sorting pan. Achieving the correct water level will keep the sample wet, but not fully submerged and floating. Also, make sure that your kicknet is free of debris and invertebrates from previous sampling.

1.1 Select the 1st of 5 macroinvertebrate sampling areas, starting with the one furthest downstream within your sampling reach. Work your way upstream to prevent disruption to your next sampling area. If space is limited, samples can be taken side by side. Begin sample collection by having one person position the net immediately downstream of the area to be sampled, perpendicular to the stream flow, and firmly against the bottom of the stream. While holding the net firmly in place, make sure to stand next to, not behind the net.

1.2 With the net in position, have a second person begin collection by scrubbing the surfaces of large rocks and debris found within the sampling area for approximately 30 seconds. After scrubbing each rock or piece of debris, place it outside of the sampling area. Next, using your feet, disturb the substrate within the sampling area for 30 seconds. After a combined minute worth of hand scrubbing and foot disruption, lift the net from the water being careful not to lose any organisms.

(603) Repeat this collection process for 4 more areas, moving upstream after each 1-minute sample. *If the kicknet becomes filled with excess debris before all 5 samples are collected, empty the contents of the net into the empty wire mesh dish-pan*.

(604) You should have plenty of invertebrates in your net after successfully taking 5 kicknet samples within your selected reach.

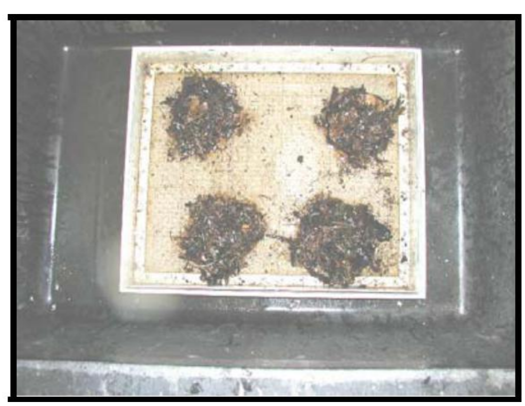
Step 3. Sample a Fraction of the Macroinvertebrates

(603) After completing the 5 1-minute collections, remove large debris (rocks and sticks) from the net and inspect each item for attached bugs. If any macroinvertebrates are found on the debris, place them in the wire mesh dish-pan.

(604) Empty the rest of the contents of the net into the wire mesh dish-pan and nest within the sorting pan with water, making sure debris and organisms are covered in water.

1.0 With a spoon, stir the debris evenly across the wire mesh dish-pan for 15 seconds.

1.1 Gently clump the debris and organism mixture on the wire mesh dish-pan into 4 even piles.



(603) Lift the wire mesh dish-pan from the sorting pan. Randomly select 1 of the 4 piles to sort.

Step 4: Sort Macroinvertebrates

(603) Using the spoon, transfer the entire contents of the selected pile to a separate sorting pan that contains just enough stream water to cover the bottom of the pan. Up to 2 people can use a single sorting pan (splitting the “selected” pile into multiple sorting trays may help speed up sample processing). The 3 remaining piles in the wire mesh dish-pan should be re-submerged in water while the sorting takes place.

(604) Once you have transferred the pile to the separate sorting tray, you are ready to begin sorting! Note your starting time and then keep track of the time during the sorting process. You will sort macroinvertebrates for exactly one hour.

(605) To sort, use the magnifying glass, pipettes, or forceps and carefully transfer all organisms from the debris pile to separate containers (ice cube trays, plastic bowls, etc.) filled with stream water. Organisms that look similar should be placed within the same container. DO NOT spend time trying to identify organisms at this point. It is important to pick both the small and large organisms. Many invertebrates are difficult to see so you will need to look very carefully.

1.0 If you finish sorting the pile before one hour of sorting time has elapsed, select another pile for sorting. If the first pile is NOT completed before 1 hour of sorting time has elapsed, stop sorting. DO NOT spend more than 1 hour sorting organisms.

1.1 After sorting is complete be sure you have recorded the following information on the **Macroinvertebrate Data Sheet** (C.2):
- Number of people sorting
- Total elapsed time-spent sorting (i.e. 4 people x 1-hour of sorting each = 4 hours sorting time)
- Approximate fraction of total sample sorted (i.e. ¼ portion selected x 75% was sorted = 3/8 of total sample was sorted)

Step 5. Identify Sorted Macroinvertebrates

- Use the provided reference book and macroinvertebrate keys to identify the organisms collected and sorted.
- Tally the number of individuals in each group on the **Macroinvertebrate Data Sheet** (Appendix B.2). Refer to **Sample Macroinvertebrate Data Sheet** (Appendix A.1)
- Determine the number of invertebrates for each group and place this number in the
  Totals column.

Volunteer Biomonitoring Macroinvertebrate Data Sheet

Site Number 3 Stream Name Cohas Brook Town Manchester

Volunteer Group Merrimack Grp.

Staff Present John Doe, Jane Doe Date 7/2/03 Replicate Number 1of1

Group		# Individuals (Raw Tally)	Totals
Ephemeroptera	Mayfly Nymph	𝍸 𝍸 𝍸 𝍸 III	23
Plecoptera	Stonefly Nymph	𝍸 𝍸 I	11

- Lastly, sum the **Totals** column and write this value at the bottom of the data sheet by the heading **Total # Individuals Counted for all Groups**.
- Once all the sorted organisms have been counted and identified, return them to the stream.

Step 6. Calculate the Biological Water Quality Score

- Record the total number of organisms found per group onto the **Biological Water Quality Score Sheet** (Appendix B.3) under the **Totals Found** section. Refer to **Sample Biological Water Quality Score Sheet** (Appendix A.2) for further assistance.
- Multiply the **Tolerance Value** by the **Totals Found** for each group of invertebrates and enter this value under the last column labeled **Biotic Score**.

Volunteer Biomonitoring Biological Water Quality Score Sheet - Biotic Index Calculation Worksheet

Site Number 3 Stream Name Cohas Brook Town Manchester

Volunteer Group Merrimack Grp.

Staff Present John Doe, Jane Doe Date 7/2/03 Replicate Number 1 of 1

The invertebrate Groups below have different sensitivities to pollution. These sensitivities have both a narrative and numeric ranking as summarized here. Calculate the Final Biotic Score by multiplying the Tolerance Value by the Totals Found. Sum each row in the Biotic Score column and place this value in the Total Biotic Score line. Calculate Final Biotic Score according to calculation below. This is your Biological Water Quality Score.

Group		Tolerance Value	*	Totals Found	=	Biotic Score
Ephemeroptera	Mayfly Nymph	3	*	23	=	69
Plecoptera	Stonefly Nymph	1	*	56	=	56

- Sum the **Biotic Score** column. Enter this value on the line **Total Biotic Score.**

Snails	7	*	0	=	0
Aquatic Worms	8	*	2	=	16
Scuds	8	*	0	=	0
Sowbugs	7	*	0	=	0
Clams and Mussels	7	*	0	=	0

Total Biotic Score 436

$$\text{Final Biotic Score} = \frac{\text{Total Biotic Score}}{\text{Total \# Individuals Counted for all Groups}}$$

$$\text{Final Biotic Score} = \frac{436}{115} = 3.8$$

Circle the Water Quality Score that corresponds to the Final Biotic Score.

Water Quality Score	
0 - 3.5	Excellent
>3.5 - 4.8	Good
>4.8	Fairly Poor

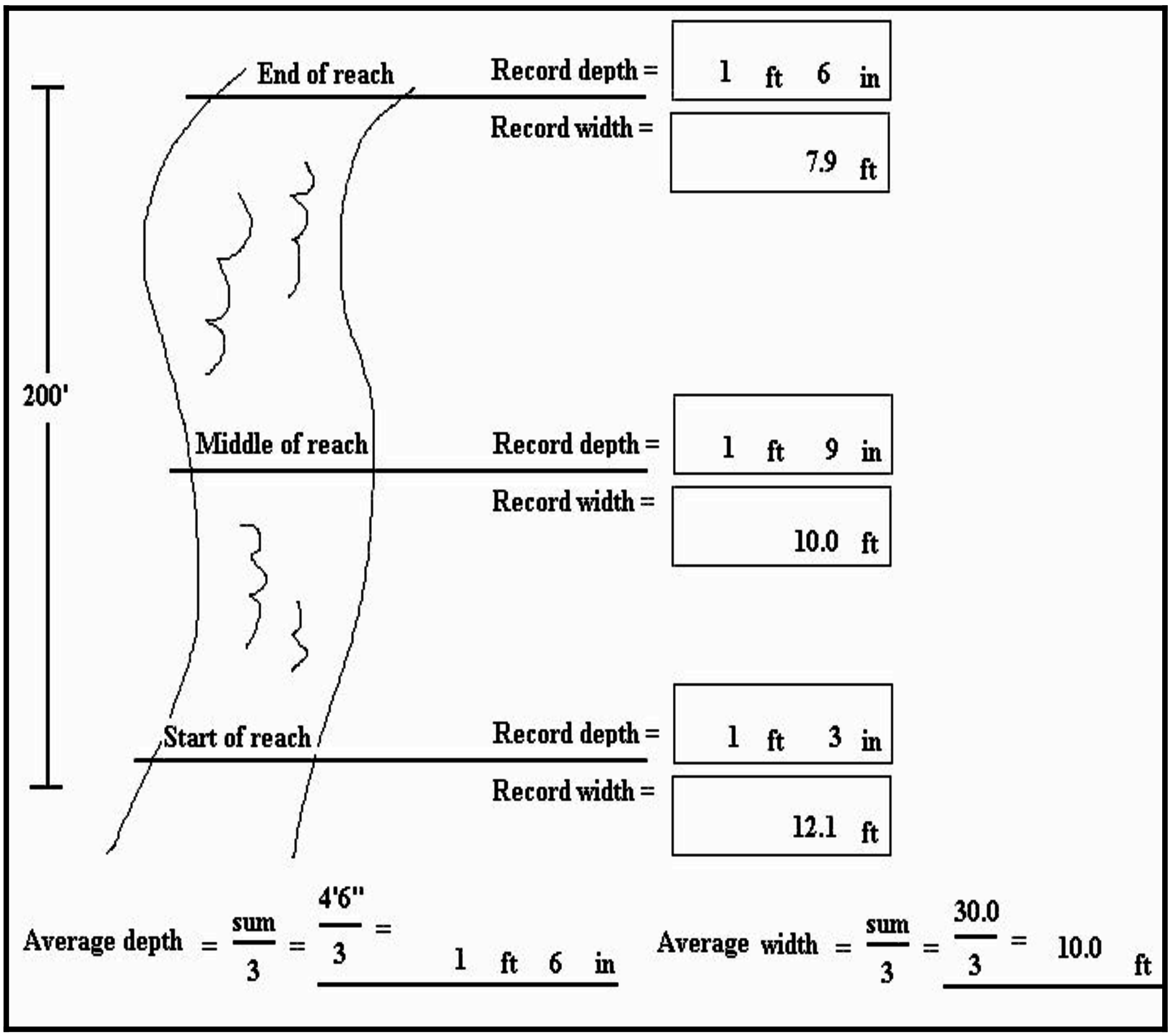
This is your Biological Water Quality Score
Enter this Score on the Site Sheet.

- Calculate the final **Biotic Score** by dividing the **Total Biotic Score** by the **Total # Individuals counted for all Groups**. Circle the Water Quality Score that corresponds to the **Final Biotic Score.**

This is your Biological Water Quality Score
Enter this value on the Site Sheet.

Step 7. Physical/Chemical Parameters

- Using the equipment provided, record both average stream depth and the wetted width of the stream. Take one measurement for each at the beginning, middle, and end of your sampling reach.
- For each of the three points, find the main channel of the stream where the flow is greatest, and measure the depth to the nearest tenths of a foot. After taking the depth measurements, determine the wetted width at each of the three points, by measuring the width of the water's surface from one side of the stream to the other, not from bank to bank. Record the wetted width to the nearest foot.
- Calculate and record the physical parameters as depicted below on the **Physical Parameters** data sheet (Appendix B.4).
- Record any additional chemical parameters separately on the **NH Volunteer River Assessment Program Field Data Sheet** provided by your VBAP staff person.



YOU HAVE COMPLETED ALL SAMPLING REQUIREMENTS FOR THIS SITE!

Step 8. Checklist before leaving the site

- Is all of the required information filled in on the following data sheets:
  - ☐ Habitat Data Sheet (Appendix B.1)
  - ☐ Macroinvertebrate Data Sheet (Appendix B.2)
  - ☐ Biological Water Quality Score Sheet (Appendix B.3)
  - ☐ Physical/Chemical Data Sheet (Appendix B.4)
- Has all equipment been collected and rinsed thoroughly in the stream?
- Have you left “No Trace” of your presence?
- Did you have fun?

Sample Volunteer Biomonitoring Macroinvertebrate Data Sheet

Additional Information:

__4___ Number of people sorting X __1__ Time spent sorting / person (hrs) = ___4____ Total elapsed time-spent sorting

_1/4 __ Fraction of the sample selected for sorting X __75%__ Percentage (estimate) of fraction sorted = __3/8___

Total sample sorted

Site Number 3 Stream Name Cohas Brook Town Manchester

Volunteer Group Merrimack Grp.

Staff Present John Doe, Jane Doe Date 7/2/03 Replicate Number 1of1

New Hampshire Department of Environmental Services

Group			# Individuals (Raw Tally)	Totals
Insects	Ephemeroptera	Mayfly Nymph	卌 卌 卌 卌 III	23
	Plecoptera	Stonefly Nymph	卌 卌 I	11
	Trichoptera	Caddisfly Larvae	卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 I	56
	Odonata	Dragonfly Nymph	0	0
		Damselfly Nymph	0	0
	Diptera	Black fly larvae	0	0
		Midge larvae	卌 III	8
		Most True Flies	III	3
	Megaloptera	Alderfly	0	0
		Fishfly or Helgrammite	I	1
	Coleoptera	Riffle Beetle	卌	5
		Water Penny	II	2
		Beetle & Beetle-like	IIII	4
Non-Insects	Others	Crayfish	0	0
		Snails	0	0
		Aquatic Worms	II	2
		Scuds	0	0
		Sowbugs	0	0
		Clams and Mussels	0	0

Sample Volunteer Biomonitoring Biological Water Quality Score Sheet - Biotic Index Calculation

Worksheet

-

Site Number 3 Stream Name Cohas Brook Town Manchester

Volunteer Group Merrimack Grp.

Staff Present John Doe, Jane Doe Date 7/2/03 Replicate Number 1 of 1

The invertebrate Groups below have different sensitivities to pollution. These sensitivities have both a narrative and numeric ranking as summarized here. Calculate the Final Biotic Score by multiplying the Tolerance Value by the Totals Found. Sum each row in the Biotic Score column and place this value in the Total Biotic Score line. Calculate Final Biotic Score according to calculation below. This is your Biological Water Quality Score.

Group		Tolerance Value	*	Totals Found	=	Biotic Score
Ephemeroptera	Mayfly Nymph	3	*	23	=	69
Plecoptera	Stonefly Nymph	1	*	11	=	11
Trichoptera	Caddisfly Larvae	4	*	56	=	224
Odonata	Dragonfly Nymph	3	*	0	=	0
	Damselfly Nymph	7	*	0	=	0
Diptera	Black fly larvae	7	*	0	=	0
	Midge larvae	6	*	8	=	48
	Most True Flies	4	*	3	=	12
Megaloptera	Alderfly	4	*	0	=	0
	Fishfly or Helgrammite	0	*	1	=	0
Coleoptera	Riffle Beetle	4	*	5	=	20
	Water Penny	4	*	2	=	8
	Beetle & Beetle-like	7	*	4	=	28
Others	Crayfish	6	*	0	=	0
	Snails	7	*	0	=	0
	Aquatic Worms	8	*	2	=	16
	Scuds	8	*	0	=	0
	Sowbugs	7	*	0	=	0
	Clams	8	*	0	=	0

Total Biotic Score: 436

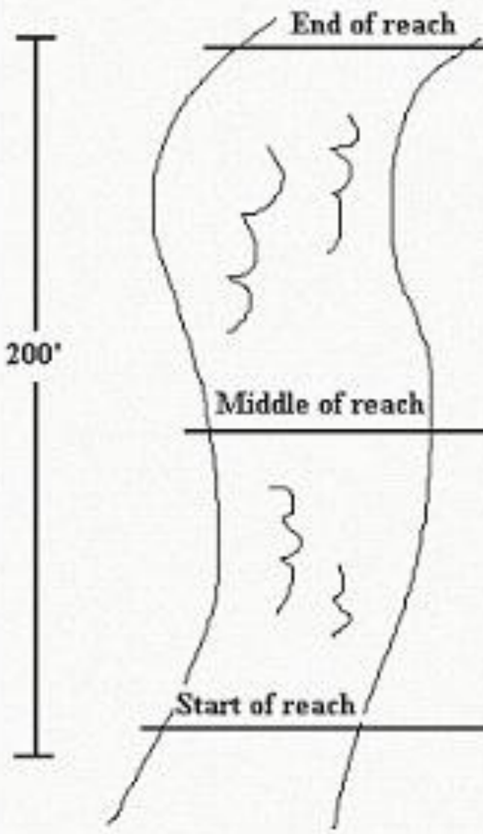
$$\text{Final Biotic Score} = \frac{\text{Total Biotic Score}}{\text{Total \# Individuals Counted for all Groups}}$$

$$\text{Final Biotic Score} = \frac{436}{115} = 3.8$$

Circle the Water Quality Score that corresponds to the Final Biotic Score.

Water Quality Score
0 - 3.5 Excellent
>3.5 - 4.8 Good
>4.8 Fairly Poor

Sample Volunteer Biomonitoring Physical/Chemical Data Sheet



End of reach — Record depth = 1 ft 6 in

Record width = 7.9 ft

Middle of reach — Record depth = 1 ft 9 in

Record width = 10.0 ft

Start of reach — Record depth = 1 ft 3 in

Record width = 12.1 ft

Average depth $= \frac{\text{sum}}{3} = \frac{4'6''}{3} =$ 1 ft 6 in

Average width $= \frac{\text{sum}}{3} = \frac{30.0}{3} =$ 10.0 ft

*All chemical samples should be taken in an undisturbed area before performing all other in-stream sampling activities.

*These are the 4 required parameters. Others may be taken.

Chemical Parameter	Date	Value	Meter #
pH	7/2/03	6.8	16A
Dissolved Oxygen	7/2/03	8.2 mg/L	15B
Temperature	7/2/03	20.1 °C	10A
Conductivity	7/2/03	30 uS/cm	16C

Volunteer Biomonitoring Habitat Data Sheet

Stream Name______________________________ **Town**______________________________________

Volunteer Group___________________________ **VBAP Staff** _________________________________

Date and Time______________________________ **Photo #'s & Labels**__________________________

Weather Conditions

	Past 3 days	**Today**
Heavy rain/ downpour		
Steady rain		
Intermittent rain		
Overcast/ cloudy		
Clear/Sunny		
Air Temperature °F		

Surrounding Land Use (estimate % of each if multiple surrounding land uses)**:**

- ☐ Forest
- ☐ Field/Pasture
- ☐ Agricultural
- ☐ Residential
- ☐ Commercial
- ☐ Industrial
- ☐ Other_____________

Riparian Vegetation (dominant vegetative type)**:**

- ☐ Trees
- ☐ Shrubs
- ☐ Grasses
- ☐ Herbaceous (non-woody, green and leaf-like) Width of Riparian Zone:

-Left Bank ____0-20' ____20-100' ____100-500' ____>500'

-Right Bank ____0-20' ____20-100' ____100-500' ____>500'

Canopy Cover:

____open ____<10% ____10-40% ____40-75% ____>75%

% of tree type (deciduous/coniferous) _____________________________

Eroded or Disturbed Banks:

Left Bank

_____ None noticeable

_____ Slight (some areas of erosion, but no noticeable impacts to streambed)

_____ Moderate (frequent areas of erosion, with minor impacts to streambed)

_____ Heavy (erosion impacts streambed)

Right Bank

_____ None noticeable

_____ Slight (some areas of erosion, but no noticeable impacts to streambed)

_____ Moderate (frequent areas of erosion, with minor impacts to streambed)

_____ Heavy (erosion impacts streambed)

Flow (estimate requires general idea of water levels during sampling period)**:**

- ☐ Low (below average level for the time of the year)
- ☐ Moderate (approximate seasonal average)
- ☐ High (above average level for the time of the year)

Frequency of habitat type within Reach (Chose most prevalent habitat type):

_____Riffles _____Pools _____Run/Glide

Water Color:

- ☐ Clear
- ☐ Green
- ☐ Reddish/orange
- ☐ Cloudy
- ☐ Muddy

Presence Logs or Woody Debris:

_____None _____Occasional (present but not frequently encountered) _____Common (present and frequently encountered

Stream Substrate (Describe the substrate at the sampling site)**:**

- ☐ Clay (hard, slippery, muddy)
- ☐ Silt (smooth, fluffy, easily suspended in water)
- ☐ Sand (smaller than marble and gritty)
- ☐ Gravel (marble to tennis ball)
- ☐ Cobble (tennis ball to basketball)
- ☐ Boulder (basketball size or larger)
- ☐ Bedrock (solid surface)

Embeddedness:

- ☐ Cobble and boulder particles are 0-25% surrounded by sediment (sand, silt).
- ☐ Cobble and boulder particles are 25-50% surrounded by sediment (sand, silt).
- ☐ Cobble and boulder particles are 50-75% surrounded by sediment (sand, silt).
- ☐ Cobble and boulder particles are more than 75% surrounded by sediment (sand, silt).

Aquatic Vegetation:

- ☐ Algae (no stems, leaves or roots)
- ☐ Moss (small plant with stems, leaves and roots, often found in mat-like structures)
- ☐ Plants
- ☐ Invasive Species: ____

Comment Section (Note any unusual items such as water smell, streamside activities, garbage, storm water inputs, drainage pipes, etc.):

____

____

____

Site Sketch:

Features to Include in Site Drawing

Æ Direction of flow

~ Riffle

== Run

O Pool

× Location of each sample

Also include:

Distance from road/bridge

Woody debris/trees, Pipes,

Any anthropogenic or unusual features

Volunteer Biomonitoring Macroinvertebrate Data Sheet

Additional Information:

_______ Number of people sorting X 1 hour = _______ Total elapsed time-spent sorting

_______ Fraction of the portion selected X ______ Percentage of sample sorted = ______ Total sample sorted

Site Number _______ Stream Name _______________________________ Town _______________________

Volunteer Group ____

Staff Present ____ Date ___________________ Replicate Number ______

Group		# Individuals (Raw Tally)	Totals
Ephemeroptera	Mayfly Nymph		
Plecoptera	Stonefly Nymph		
Trichoptera	Caddisfly Larvae		
Odonata	Dragonfly Nymph		
	Damselfly Nymph		
Diptera	Blackfly larvae		
	Midge larvae		
	Most True Flies		
Megaloptera	Alderfly		
	Fishfly or Helgrammite		
Coleoptera	Riffle Beetle		
	Water Penny		
	Beetle & Beetle-like		
Others	Crayfish		
	Aquatic Worms Snails		
	Scuds		
	Sowbugs		
	Clams and Mussels		

** Aim to identify > 100 organisms.

Total # Individuals Counted for all Groups ______

Second sorter Quality Control (i.e. numbers found by second sorter)

Bugs found remaining in the kick net after emptying the net into the pan after 5 kicks _______

Bugs found in each debris pile after initial sort: Square 1 ______ Square 2 ______ Square 3 ______ Square 4 ______

Refer to instructions at Step 3 for these two sorting Quality Control recordings.

Volunteer Biomonitoring Biological Water Quality Score Sheet - Biotic Index Calculation Worksheet

Site Number_______ **Stream Name**________________________________ **Town**________________

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Volunteer Group____

Staff Present____ **Date**____________________ **Replicate Number**________

The invertebrate Groups below have different sensitivities to pollution. These sensitivities have both a narrative and numeric ranking as summarized here. Calculate the Final Biotic Score by multiplying the Tolerance Value by the Totals Found. Sum each row in the Biotic Score column and place this value in the Total Biotic Score line. Calculate Final Biotic Score according to calculation below. This is your Biological Water Quality Score.

Group		Tolerance Value	*	Totals Found	=	Biotic Score
Ephemeroptera	Mayfly Nymph	3	*		=	
Plecoptera	Stonefly Nymph	1	*		=	
Trichoptera	Caddisfly Larvae	4	*		=	
Odonata	Dragonfly Nymph	3	*		=	
	Damselfly Nymph	7	*		=	
Diptera	Black fly larvae	7	*		=	
	Midge larvae	6	*		=	
	Most True Flies	4	*		=	
Megaloptera	Alderfly	4	*		=	
	Fishfly or Helgrammite	0	*		=	
Coleoptera	Riffle Beetle	4	*		=	
	Water Penny	4	*		=	
	Beetle & Beetle-like	7	*		=	
Others	Crayfish	6	*		=	
	Snails	7	*		=	
	Aquatic Worms	8	*		=	
	Scuds	8	*		=	
	Sowbugs	7	*		=	
	Clams and Mussels	7	*		=	

Total Biotic Score__________

$$\text{Final Biotic Score} = \frac{\text{Total Biotic Score}}{\text{Total \# Individuals Counted for all Groups}}$$

Final Biotic Score = ____________ =

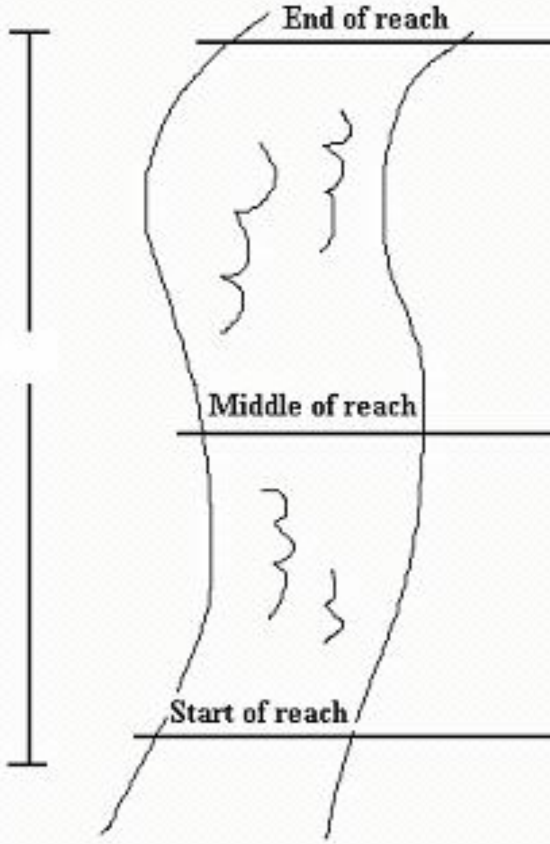
Circle the Water Quality Score that corresponds to the Final Biotic Score.

Water Quality Score	
0 - 3.5	Excellent
>3.5 - 4.8	Good
>4.8	Fairly Poor

This is your Biological Water Quality Score

Enter this Score on the Site Sheet.

Volunteer Biomonitoring Physical/Chemical Data Sheet



End of reach: Record depth = ____ ft ____ in; Record width = ____ ft

Middle of reach: Record depth = ____ ft ____ in; Record width = ____ ft

Start of reach: Record depth = ____ ft ____ in; Record width = ____ ft

Average depth $= \frac{\text{sum}}{3} =$ ________ ft ____ in   Average width $= \frac{\text{sum}}{3} =$ ________ ft

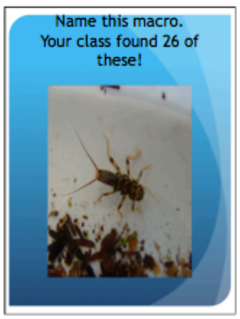
*All chemical samples should be taken in an undisturbed area before performing all other in-stream sampling activities.

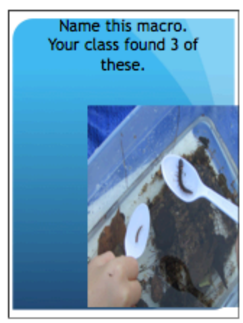
*These are the 4 required parameters. Others may be taken.

Chemical Parameter	Date	Value	Meter #
pH			
Dissolved Oxygen			
Temperature			
Conductivity			

Appendix J

VBAP Results





Your sampling site.

Comparing the results.

Macro & Tolerance Level	[illegible]	[illegible]
Hellgrammite 0	3	1
Stonefly Nymph 1	26	10
Mayfly Nymph 3	28	41
Dragonfly Nymph 3	3	1
Caddisfly Larvae 4	40	17
True Flies 4	36	3
Alderfly 4	2	0
Midge Larvae 6	4	5
Aquatic Worm 8	1	4
Water Penny 4	0	5
Total	143	88

Community Presentation

On December 7th at 6:00pm students from 6 schools will present their water quality data.

What would you like to present?

- Define watershed.
- Why we need to protect it.
- Our results.

A watershed is
an area of land that
catches rain and snow
and drains or seeps into
a marsh, stream, river, lake or
groundwater.

Everyone lives in a watershed!

- Homes, farms, ranches, forests, small towns, big cities and more can make up watersheds
- Some watersheds cross county, state, and even international borders.
- Watersheds come in all shapes and sizes. Some are millions of square miles, others are just a few acres.
- Just as creeks drain into rivers, watersheds are nearly always part of a larger watershed.

There are
five
main
watersheds
in
New Hampshire!

It is very important
that we all work together
to protect our water
resources!

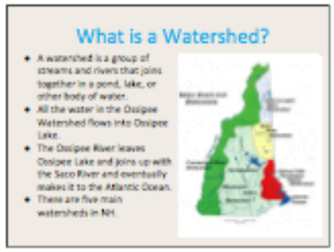

Where is the Ossipee Watershed
and
what waterbodies are in it?
Saco Watershed
Atlantic Ocean
The Ossipee Watershed is a sub-watershed of the Saco Watershed
The Saco Watershed begins in the White Mountains of New Hampshire and flows to the Atlantic Ocea
Some major water bodies in the Ossipee Watershed are:
Chocorua Lake, White Lake, Silver Lake, Bearcamp Pond and Ossipee Lake and Bays.

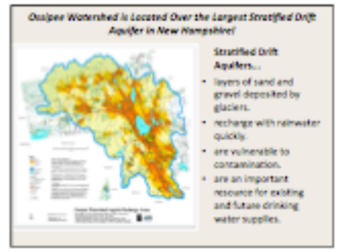

Using meters to collect water quality data
Data recorded at the river includes...
Dissolved Oxygen
Which tells us how much oxygen is in the water.
Fish and macroinvertebrates need oxygen in order to survive.
Electrical Conductivity
Which helps us understand if there is anything contaminating the water such as salt from the roads.
Ph
Which helps us understand how acidic or basic the water is.
Turbidity
Which tells us the levels of suspended particles in the river such as sediment from erosion

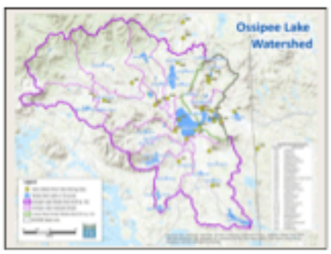

Macros Sandwich Central School found in the Cold River in 2015
Cold River - September 14, 2015
47
10
17
1
5
3
1
1
5
4
Mayfly
Stonefly
Caddisfly
Dragonfly
Midge
Riffle Beetle
Water Penny
Aquatic Worm
88 Macroinvertebrates collected, sorted and identified
Biotic Score for Cold River, Sandwich = 3.43 Excellent Range!

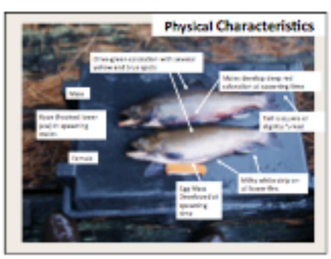
Appendix K

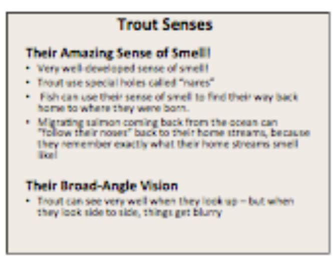
Trout in the Classroom: Background Knowledge

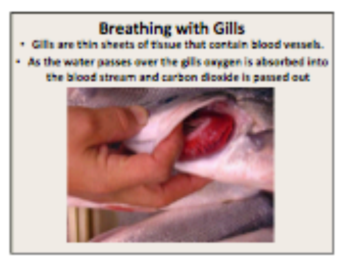


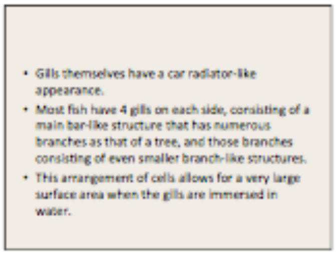


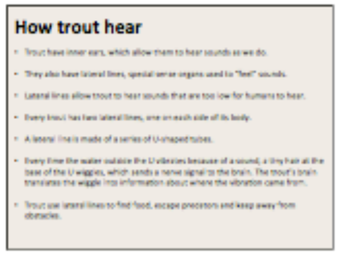


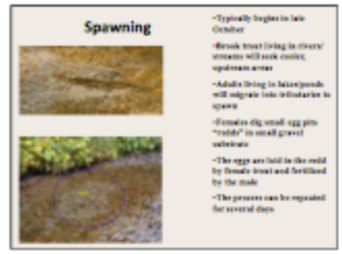




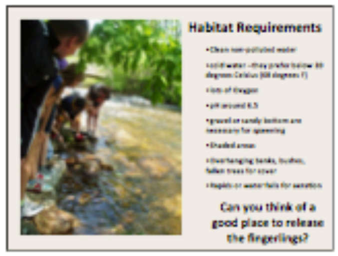



• Gills themselves have a car radiator-like appearance.
• Most fish have 4 gills on each side, consisting of a main bar-like structure that has numerous branches as that of a tree, and those branches consisting of even smaller branch-like structures.
• This arrangement of cells allows for a very large surface area when the gills are immersed in water.


How trout hear
• Trout have inner ears, which allow them to hear sounds as we do.
• They also have lateral lines, special sense organs used to "feel" sounds.
• Lateral lines allow trout to hear sounds that are too low for humans to hear.
• Every trout has two lateral lines, one on each side of its body.
• A lateral line is made of a series of U-shaped tubes.
• Every time the water outside the U vibrates because of a sound, a tiny hair at the base of the U wiggles, which sends a nerve signal to the brain. The trout's brain translates the wiggle into information about where the vibration came from.
• Trout use lateral lines to find food, escape predators and keep away from obstacles.

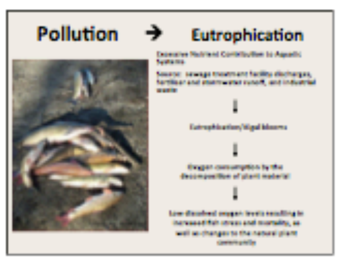

Spawning
-Typically begins in late October
-Brook trout living in rivers/streams will seek cooler, upstream areas
-Adults living in lakes/ponds will migrate into tributaries to spawn
-Females dig small egg pits "redds" in small gravel substrate
-The eggs are laid in the redd by female trout and fertilized by the male
-The process can be repeated for several days


Age and Growth
Egg development and hatching usually takes ~140 days
•Newly hatched brook trout larvae use yolk sacs to feed for a short time
•Upon yolk sac absorption for nutrients (eat as food), the brook trout emerges from the substrate (swim up)
•Growth rates are significantly dependent on habitat characteristics (such as food availability, water temperature)
• This is when we will be releasing the brookies
•Wild brook trout rarely exceed three years in age
•Brook trout can typically spawn at age 2


Habitat Requirements
•Clean non-polluted water
•cold water - they prefer below 20 degrees Celsius (68 degrees F)
•lots of Oxygen
•pH around 6.5
•gravel or sandy bottom are necessary for spawning
•Shaded areas
•Overhanging banks, bushes, fallen trees for cover
•Rapids or waterfalls for aeration
Can you think of a good place to release the fingerlings?

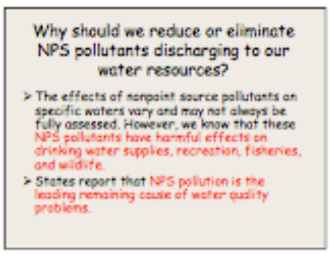

Cold Brook Water Quality Data
Official trout release sites must be approved by the NH Fish and Game Department


Threats to Brook Trout
Invasive Species –
•Twenty-three non native fish species have been introduced into New Hampshire waters to provide sport-fishing opportunities
However, non-native species compete with native species for resources and sometimes prey on native species.

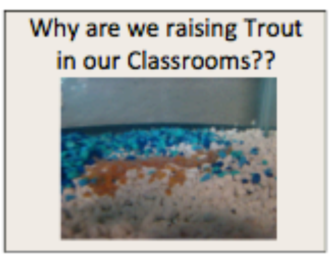

Pollution → Eutrophication
Excessive Nutrient Contribution to Aquatic Systems
Source: sewage treatment facility discharges, fertilizer and stormwater runoff, and industrial waste
Eutrophication/Algal blooms
Oxygen consumption by the decomposition of plant material
Low dissolved oxygen levels resulting in increased fish stress and mortality, as well as changes to the natural plant community


Acid Deposition
Primary Sources: Fossil fuel combustion and automobile exhaust

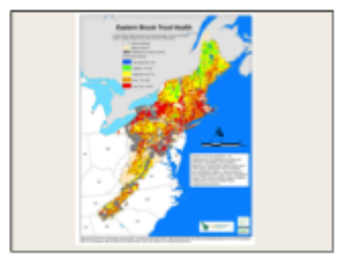

Non point source pollution
Where is all of the sand/pollution going?
It is following gravity and making its way into Broad Bay
also known as... polluted runoff


Why should we reduce or eliminate NPS pollutants discharging to our water resources?
➢ The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, we know that these NPS pollutants have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.
➢ States report that NPS pollution is the leading remaining cause of water quality problems.


Freedom Elementary installing a rain garden at Camp Huckins!


Why are we raising Trout in our Classrooms??

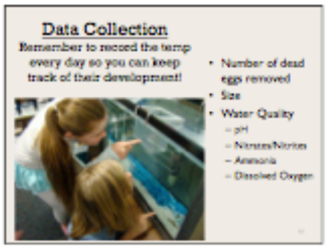

Management of Stocked Trout

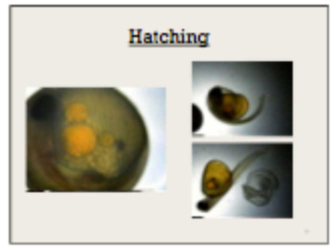

Eastern Brook Trout Health

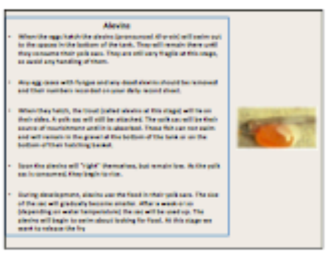

Tank Set up

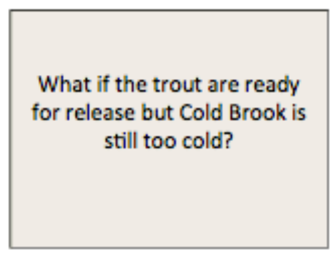

Caring for your Eggs
• Make sure the chiller stays at about 36 – 37 degrees F and record the temp every (school) day!


Remove the Dead Eggs

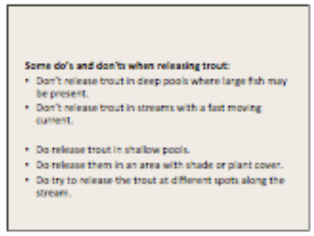

Data Collection
Remember to record the temp every day so you can keep track of their development!
• Number of dead eggs removed
• Size
• Water Quality
– pH
– Nitrates/Nitrites
– Ammonia
– Dissolved Oxygen

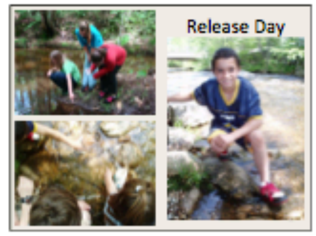

Hatching


Alevins

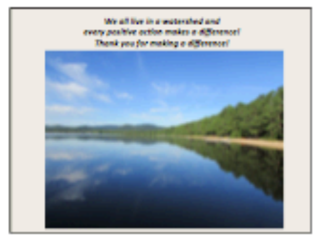

What if the trout are ready for release but Cold Brook is still too cold?


Brookies Love to Eat!
They are sight feeders and usually feed at dawn and dusk
and seek deeper or shaded water during the day
Some things on their diet include

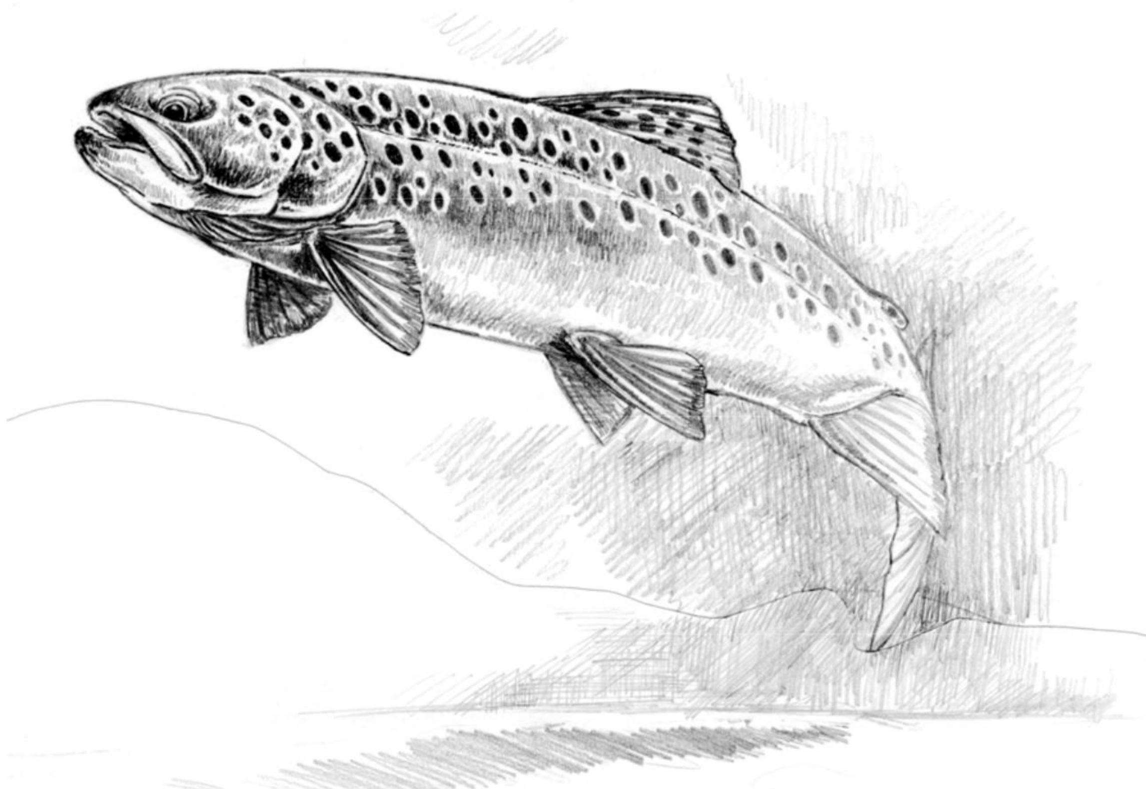

Some do's and don'ts when releasing trout:
Don't release trout in deep pools where large fish may be present.
Don't release trout in streams with a fast moving current.
Do release trout in shallow pools.
Do release them in an area with shade or plant cover.
Do try to release the trout at different spots along the stream.


Release Day


Siamese Trout?
From Mrs. Anderson's class
at Moultonborough Central School three years ago.


We all live in a watershed and
every positive action makes a difference!
Thank you for making a difference!

Eastern Brook Trout in the Classroom Teacher’s Manual



Developed by
NH Fish and Game Watershed Education Program and
New Hampshire Trout Unlimited

ACKNOWLEDGEMENTS

The **Eastern Brook Trout in the Classroom Teacher's Manual** is provided to you because of the efforts of dedicated Trout Unlimited volunteers Mark Seymour (Great Bay Chapter) and George Embley (Basil Woods Jr. Chapter) who have spent many hours assisting in this effort. Without the time, expertise, and resources that these two gentlemen provide, the Trout in the Classroom program would not run as well as it does. Our thanks to both of them.

Our thanks also to the following teachers who volunteered their time and teaching experience to make this a more useful and effective manual and who have offered many examples of curricula and classroom advice to make Trout in the Classroom a much better program.

- Alex Hicks, Science & Technology Teacher @ Shaker Road School in Concord
- Mary Jolles, Principal @ Colebrook Elementary School
- Elaine Marhefka, on leave from Garrison Elementary School in Dover
- Judy Ross, Science Curriculum Coordinator @ Lebanon School District

What is Trout in the Classroom? (TIC)

Program Goals:

Trout in the Classroom (TIC) is an environmental education program in which students in grades k-12:

- raise trout from eggs to fry.
- monitor tank water quality.
- engage in stream habitat study.
- learn to appreciate water resources.
- begin to foster a conservation ethic.
- grow to understand ecosystems.

TIC is a unique way to teach the relevance of watersheds. Trout are indicator species; their abundance directly reflects the quality of the water in which they live. In the TIC program, students grow to care about their trout and then the habitat in which trout live. As the program progresses, students learn to see connections between the trout, water resources, the environment, and themselves.

During the year each teacher tailors the program to fit his or her curricular needs. Therefore, each program is unique. TIC has interdisciplinary applications in science, social studies, mathematics, language arts, fine arts, and physical education. Most programs end the year by releasing their trout in a state-approved stream near the school or within a nearby watershed.

Learning Objectives:
Students will be able to:

- Understand the life cycle of the Eastern brook trout
- Understand the habitat needs for the Eastern brook trout
- Understand the need to maintain a healthy watershed
- Use Science Processing Skills as outlined in the NH Science Curriculum Frameworks (See "Watershed Education Program Connection to the NH Science Curriculum Frameworks", page 22)
- Be responsible stewards of their local water resources

TIC Curriculum Expectations:
The TIC program is part of the Watershed Education Program (see WEP flyer on NH Fish & Game website). Teachers are encouraged to incorporate as much of WEP into their TIC program as possible by having the students:

- Visit their local river or stream to collect water samples, describe the site characteristics, and collect macro-invertebrates to define the level of water quality in their river.
- Explore their watershed through the use of Geographic Information Systems or GIS to facilitate discussion about how human activities may impact the watershed and therefore the river.
- Survey the aquatic resources at the river by performing habitat assessments, and collecting, identifying and measuring fish with NHF&G staff. Some fish may be kept in a tank in the classroom for behavioral studies and observation. Salmonid eggs may also be provided to be raised in the classroom and released in an appropriate river.
- Use all of the information they have collected to identify and share with the community possible management strategies and projects to maintain and improve the water quality in their watershed and in their river.

Teachers can find the Trout Unlimited "Trout in the Classroom" curriculum at www.troutintheclassroom.org.

For other curricula and support materials, see "Eastern Brook Trout Habitat and Curriculum Information", page 20.

TIC requires:

- An aquarium set up to provide cold, clean, fresh water. (See "Trout in the Classroom Equipment List") page 8.
- A state-approved source of eggs. (NHF&G hatcheries)

- Registration for the program by the schools (See "Trout in the Classroom Registration Form for NH") page 30.
- Permit to raise trout eggs in the school (provided by NHF&G)
- Training for the teachers and volunteers (See Sample Orientation Agenda (page 17) and "Trout in the Classroom Volunteer Job Description") page 7.
- A year-long commitment to care for and release the trout.
- A teacher evaluation of the program at the end of the year (See "Trout in the Classroom Evaluation Form for NH") page 31

See "Trout in the Classroom Timeline" on page 5 for month by month timing of the steps.

TIC partners:

The Watershed Education Specialist Judy Tumosa at NH Fish & Game (NHF&G) provides oversight and resources to support the state TIC programs. NH F&G keeps track of teachers, schools, and other organizations that participate and provides eggs and permits for release into local streams. NH F&G also provides training and environmental education resources, and helps to connect teachers with New Hampshire Trout Unlimited (NHTU), local chapters of Trout Unlimited (TU), and other organizations that support TIC.

The NHF&G state hatcheries provide the trout eggs and technical assistance to the schools to help them successfully raise the trout eggs. They also, by appointment, can provide hatchery tours. The fisheries division and biologists provide the permits to raise the trout eggs and advice about acceptable stocking sites.

New Hampshire Trout Unlimited and its associated Chapters are important partners in the state TIC program. The state TU Council, TU chapters, and other partners can sponsor one or more schools by providing funding, equipment, technical support, classroom guest speakers, and guidance during field work. Members of TU can help classes by sharing their expertise in conservation, stream restoration, fly-tying, trout biology, invertebrate identification, and outdoor sports activities.

The Eastern Brook Trout Joint Venture (EBTJV) is a recognized Fish Habitat Partnership operating under the National Fish Habitat Action Plan. The EBTJV coordinates efforts that build private and public partnerships to improve brook trout habitat. The long-term goals of the EBTJV are to implement a comprehensive conservation strategy to improve aquatic habitat, raise public awareness, and prioritize the use of federal, state and local funds for brook trout conservation. TIC assists in this public awareness with the students and with the public.

For specific contact information see page 29: "Trout in the Classroom Contact Information."

TROUT IN THE CLASSROOM TIMELINE

- August/September:
  NHF&G sends out introduction letter and **Trout in the School Registration Form** to the schools to sign up for the program. All schools need a permit to raise and release the eggs and fish so they must go through me to get their eggs. Schools should be arranging to get their equipment.

  TU can help with school contacts of interested schools. TU can help with equipment needs.

- September/October:
  NHF&G processes registration forms and sends them onto the fisheries biologists for approval of the stocking sites, egg numbers, and permit information.

- November:
  NHF&G and partners train new teachers and liaisons in salmonid life history, restoration program, tank set up and care, and fisheries activities. Typically lasts 4-6 hours, can be moved around the state and can include a tour of a hatchery.

  TU can be school liaisons to help with tank questions and stocking field trips. TU can help with training locations and curriculum.

- December/January:
  NHF&G sends out permits for the schools.
  NHF&G coordinates with the hatcheries to get the eggs to the schools. Schools should set up their tanks at least a week ahead of time to make sure the chillers will work.

  TU can help with egg delivery from the hatcheries to the schools. TU can help with tank questions.

- January – April:
  Schools are raising their eggs and doing watershed and fish culture activities such as testing their local river and visiting their local hatchery. Schools track the development of salmon/trout using the Developmental Index (DI).

  TU can help with tank questions and DI calculations.

- May:
  We stock our fish!! and fill out **Trout in the School Evaluation form.**
  TU can help with stocking field trips.

Trout in the Classroom Equipment List

Equipment everyone will need:

Chiller to keep the tank temperature at 38 degrees F
+/-. Suggested unit: **Glacier Corporation** Chiller
1/6 Horsepower Immersed Coil Type (Cooling coil is placed in water). No tubing or pump needed for the chiller.
Contact info: http://www.glaciercorp.com/page.cfm?pgid=5 or #714-557-2826.

Tank
20 gallon is acceptable if releasing the fish after they absorb the yolk sac with no feeding
30 gallon or larger is recommended if feeding the fingerlings and growing to a larger size before releasing

Filter: Recommended Fluval canister filter and filter media appropriate for the size of the tank you are using.
Follow the advice of your supplier for a heavy load. The filter media you choose should be able to handle a high quantity of waste and should support a large colony of beneficial nitrifying bacteria.

Table, counter, or stand strong enough to support the tank and water.

Insulation for the tank (foam board from a home store, bubble wrap, or the like) to stabilize the tank temperature and reduce wear on the chiller.
Be sure to make a cover for the tank top to shade out UV light and cut a window in the front so students can see the eggs as they develop.

Gravel (pea size) from the pet store or rocks (pea to ping pong size) from the river to provide a substrate.
The gravel (not pink) will make it easier to see the eggs, the rocks will provide a natural substrate. Some prefer to have a bare bottomed tank or prefer to use plastic netting to support the eggs.
Thoroughly rinse the gravel and clean the rocks.

Air Pump & Airstone to maintain oxygen levels.

Thermometer to measure water temperature and track development of the eggs.

Nets to capture fish in the tank when taking to the river to stock.

Net Breeder (optional) to allow students to view some eggs up close without disturbing them all.

Freshwater Testing Kit to track oxygen, pH, and ammonia and nitrite
levels. Turkey Baster to remove dead eggs and extra food/waste from
the tank

Siphon Gravel Cleaner to clean the bottom of fish waste and unused food.

Optional Equipment as needed:

Buckets (2 or more), to age water before putting in the tank

Battery-operated aerator, to give the trout oxygen during transportation (available at pet stores) Ammonia removal compound, for use in ammonia emergencies (available at pet stores) Tap-water-safe compound, for use in emergency water changes (available at pet stores)

Clean ice packs, for use in transportation and/or chiller emergencies

Equipment Replaced Yearly:

Filter pads or cartridges—some parts of the filter can just be rinsed, scrubbed, and dried, but consumable components such as charcoal filters should be replaced.

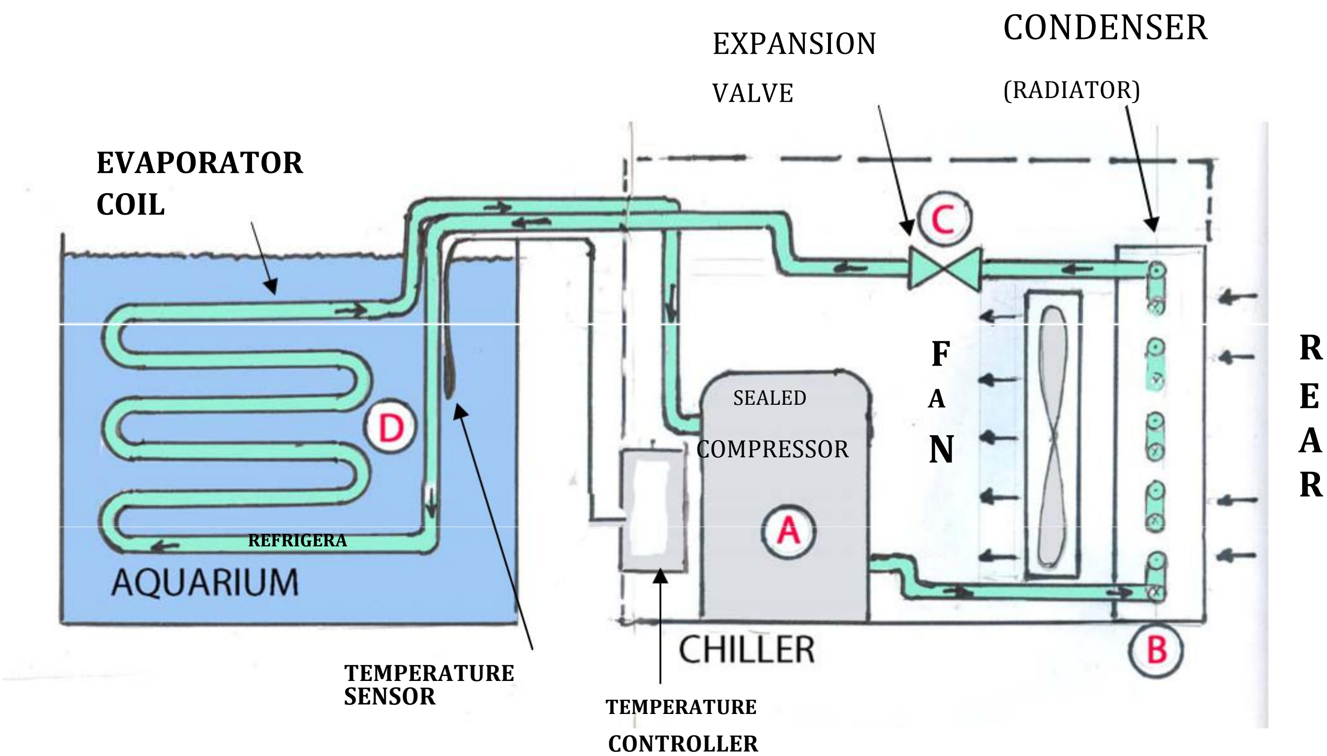
Airstone and check valve-- these two pieces can degrade or get gummed up with waste. Water Quality Test Kit--at the end of one school year, you may have used up most of the reagents and other testing materials.

Aquarium compounds you are using to boost the bacterial population and manage water chemistry.

HOW THE CHILLER WORKS (Refer to Sketch)

An aquarium chiller operates on the same principles as a refrigerator or air conditioner. There is a temperature controller and temperature sensor on all chillers which allow you to set the optimum temperature for your water.

Chillers function using four main parts – a compressor, a condenser (or radiator), an evaporator or cooling coil, and an expansion valve. The operation uses compression and expansion of a refrigerant gas to transfer heat from a low temperature source (the aquarium water) to a higher temperature sink (room temperature air)



Referring to the above diagram, refrigeration gas, such as R134A, is mechanically compressed
(A) to high pressure and high temperature and then run through a condenser (B). The condenser is a heat exchanger which removes heat from the hot compressed gas and allows it to condense into a liquid. The liquid refrigerant is then sent through an expansion valve (C), or capillary tube, where the pressure drops--which lowers the boiling point and makes it easy to evaporate. For a drop-in chiller, the refrigerant then goes through an evaporator coil (D) where it can absorb heat from the tank water. At atmospheric pressure, the boiling point of R134A is -15F so the gas temperature will be well below that of aquarium water, allowing heat from the water to be transferred to the refrigerant. The loop is completed when the refrigerant goes back through the compressor (A) and into the condenser where the heat is transferred to the room air by pulling the air through the condenser (B) with a fan.

For a flow through chiller, the process is identical except that, instead of immersing the evaporator coil in the tank, the coil is inside a chamber which is internal to the chiller and through which aquarium water is pumped.

Two common problems can occur with chillers. Firstly, if the water in the tank is not agitated the drop-in evaporator coil can ice up – causing a significant reduction in the chilling effect. This can be avoided by placing a bubbler under the coil. Secondly, since the fan sucks air from the room in through the condenser (or radiator), dust and dirt come in with the air and can cover or clog the fins on the radiator. This reduces their ability to dissipate heat and the chiller's efficiency can be severely compromised. To avoid this, the dust and dirt must be cleaned off periodically.

CHILLER MAINTENANCE:

The most important item in maintaining a chiller is to clean dust off of the radiator fins annually (There are also instructions for doing this on the national TIC site). Removing the cover to clean inside the chiller is not recommended. The thermocouple and wiring are attached to the cover and it would be too easy to damage stuff. Dirt collecting on the condensing coil is the primary problem because it can reduce efficiency. Most of this can be removed from the back of the chiller. A soft brush on a vacuum hose gets some dirt off but running a clean nylon paint brush over the fins and then vacuuming a second time is better. You can also blow a lot of the dirt out with an air compressor (I would still loosen the dirt on the fins with a brush).

When the aquarium is cleaned out with disinfectant at the end on the year, the chiller tubing that is immersed in the tank can also be wiped off. A rag or soft brush is sufficient. Never use anything metallic (e.g., scouring pad or brush with metal bristles) as this can damage the tubing.

A lot of schools put the equipment away at the end of the year. It seems like moving chillers is when they usually get damaged. For drop-in chillers, there have been cases where the foam covered flexible coolant lines have been damaged and required replacement. This kind of damage probably happens when the lines are overstressed by excessive flexing (or even using them as a handle!). If care is taken by not bending them into a new shape and keeping them under control so they don't flop around when being moved there shouldn't be a problem. There is also a bend in the stainless steel tubing that loops over the tank. It is possible for the tubing to eventually crack at this point if it is force fit over too great a width (say the tank plus an inch of insulation). If the chiller has been moved (or even if it hasn't), it should be checked to make sure it is operational once it is in place and before use. That way, if refrigerant charge has leaked out over the summer, or some other damage has occurred, there would still be time to repair or replace before the eggs arrive. You can check to see if it is cooling without immersing the coil in water but the unit should only be run briefly (less than a minute) if that is the case. During normal operation, temperature should be double checked with an independent measurement.

So, a "maintenance" checklist is pretty brief:

- At the end of the school year, clean dirt/dust off of condensing coil and, if possible, blow out unit with air compressor.
- As early as possible, but after unit is set up for the new school year, confirm that unit is operating properly.
- During operation, confirm that accuracy of thermostat with independent measurement (daily or at least weekly)
- If unit is moved, protect foam covered flexible coolant lines from excessive movement.

End of Year Cleanup

Guidance for end-of-year cleanup is on the TU National Website. It has been reproduced here for convenience.

At the end of the TIC season, it is important to clean your aquarium set-up in order to ensure a successful next year. If you take a few minutes to make sure everything is clean, your equipment will have a much longer life. Here are a few pointers for cleaning the various components of you chilled aquarium set-up.

Aquarium Tank

1. Empty the tank almost all the way, by your usual method—many people like to use the electric pump to do this work. Then turn off the electrical pumps, chiller, filters, ect.
2. Finish emptying the tank, disconnect tubing.
3. Using a solution of 1 part Chlorine bleach (Clorox) and 10 parts water, wipe down the interior and exterior of the tank. A soft sponge (dedicated to this use only) can be used to scrub hard to remove scale and algae growth.
4. You can use the 1:10 bleach solution for cleaning out the tubing (clean tubes using long brushes you can buy at any pet shop).
5. Wipe dry with clean cloth, or let air-dry.
6. If you have any pebbles or gravel in the tank, they should removed, washed, and dried by laying out on a cloth or towel in the sun or a ventilated area. They can also be sterilized with the Clorox solution, but they also MUST be completely dried.

Aquarium Chiller: It is best not to move the chiller any more than necessary as it is delicate and can break.

Drop-in style chiller (Glacier) ***(See also separate guidance for maintenance of drop-in chillers)***

Using bleach solution and a dedicated sponge, you can wipe off the stainless steel Freon tubing.

For hard-to-remove plaque, a small PLASTIC scrub brush can be used. NEVER USE A WIRE BRUSH ON THESE TUBES.

Remove dust and lint from the fins of the coolant tubing (those black thin metal slats on the side of the chiller) . This can be accomplished using a small vacuum cleaner, dusting cloth or soft bristle plastic dust brush. Your chiller will run more efficiently if you clean the lint and dust from this side of it.

Flow-through style chiller (Arctica Titanium, Aquachill, Via Aqua, Polar Bear)

Rinse pre-filter sponge on pump thoroughly with water, and let air-dry.

Tip chiller and drain. Using pump or faucet hose, flush chiller with clean tap water in each outlet, to ensure any dirt is washed out of the cooling tank. Then tip further to ensure it is fully drained.

Remove dust and lint from all vents on the chiller, using a small vacuum cleaner, dusting cloth, or soft bristle plastic dust brush.

Filter

Take apart your filter and scrub out the plastic parts with you 1:10 bleach solution. Thoroughly rinse out all filter cartridges (filter sponges, charcoal, etc.) with regular water, and dry them in the sun or a well ventilated area. For most filters, it is suggested that you buy new filter cartridges for the following year. You can also use this year's filters that you rinsed out. Thoroughly air-dry entire filter apparatus.