

# Trout in the Classroom (TIC) Teacher's Manual

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NH Fish and Game Watershed Education Program (WEP) and  
New Hampshire Trout Unlimited (TU)

Developed 2011 (Revised 2019)



## ACKNOWLEDGMENTS

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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, Retired Principal @ Colebrook Elementary School
- Elaine Marhefka, Previous Teacher @ Garrison Elementary School in Dover
- Judy Ross, Previous Science Curriculum Coordinator @ Lebanon School District

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# 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, releasing them at the swim up stage.
- 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.

## Case Studies:

In New Hampshire, many schools at all grade levels, participate in the TIC program.

- In Dover, the elementary, middle, and high schools all participate in raising trout eggs and then release them into the Cocheco River. All three schools have studied the water quality and macroinvertebrate populations of the river. The Children’s Museum of New Hampshire has also added the TIC program to their educational outreach to the public about the Cocheco River watershed, the “Cochecosystem”. This program includes a dynamic partnership with the Great Bay chapter of Trout Unlimited who provide chillers and liaison duties with the schools. The year culminates with a River Day in May when the fingerlings are stocked and the community is invited to see what the students have done.
- In Lebanon, the fourth grades from two schools work together to study the watershed of Great Brook and determine if the water quality is good enough to release the trout they raise in the classroom. The schools visit the brook before release day to test water quality and macroinvertebrate populations and also study the riparian habitat. The year culminates with a Watershed Congress which is an aquatic field day designed to offer the students more opportunities to learn about their watershed from various natural resource professionals. The students also provide management suggestions to improve Great Brook habitat to the local government officials on the conservation commission and planning board.
- In Colebrook, two different grades raise Eastern brook trout. The focus in the fourth grade is on brook trout being the New Hampshire state fish and an example of a living thing’s place in the ecosystem of a stream or river. The life cycle is also studied. Seventh grade is much more in-depth, with discussions of water quality, temperature variations and their effects on the development of fish, how brook trout are related to other trout, adaptations they have developed in order to survive in their habitat, limiting factors, evaluation of different habitats for suitability for brook trout, and threats to their survival.

## Learning Objectives:

Students will be able to:

- Understand the life cycle of the brook trout
- Understand the habitat needs for the brook trout
- Understand the need to maintain a healthy watershed
- Use Science Skills as outlined in the NGSS
- Be responsible stewards of their local water resources

## TIC Curriculum Expectations:

The TIC program is part of the NHF&G Watershed Education Program (WEP), funded by a federal Aquatic Resources Education (ARE) grant. For more information about WEP, see: <http://www.wildlife.state.nh.us/education/watershed.html>.

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 (ArcGIS) 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 (warm water tank).
  - ◆ Salmonid eggs may also be provided to be raised in the classroom and released in an appropriate river (cold water tank).
- 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 (Citizen Science).

All of the NH WEP curriculum materials are located in the “NHF&G Watershed Education Program Teacher Manual”.

Teachers can find the national Trout Unlimited “Trout in the Classroom” curriculum at [www.troutintheclassroom.org](http://www.troutintheclassroom.org).

For this and other curricula and support materials, see page 17.

## TIC Requirements:

- Schools submit a Trout In The Classroom Registration Form for NH (page 9).
- New teachers and volunteers attend training (sample agenda, page 10).
- Schools are issued a NHF&G permit to raise trout eggs in the school (page 11).
- Schools set up an aquarium, including a chiller to provide cold, clean, fresh water.
  - ◆ Equipment list (page 12).
  - ◆ Tank set up manual: From Egg to Stream: A Guide to Building and Maintaining Classroom Incubators for Atlantic Salmon
- Schools use a state-approved source of eggs (list of NHF&G hatcheries, page 20).
- Students make a commitment to care for and release the trout at the swim up stage.
- Students make a commitment to study their watershed, (see TIC Curriculum Expectations and connection to the WEP program, page 5).
- Teachers regularly submit a time sheet, the hours are a match to the federal ARE grant (page 26).
- Teachers submit an evaluation of the program at the end of the year (page 24).
- Classrooms share what they have done with other schools and partners (page 22).



## **TIC partners:**

The Watershed Education Specialist Judy Tumosa at NH Fish & Game (NHF&G) provides oversight and resources to support the state TIC programs. NHF&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, information about brook trout ecology, habitat and management, 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.

# How to Get Started

## Trout in the Classroom Timeline

### August/September:

NHF&G Watershed Education Specialist sends out 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 NHF&G Watershed Education Specialist 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 to 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. Workshops are typically 3 hours and new teachers are required to attend.

- TU often provides school liaisons to help with tank questions and release days.
- 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 release our fish!! and fill out Trout in the Classroom Evaluation form.

- TU can help with field trips, including release days.



Glenn Normandeau  
Executive Director

# New Hampshire Fish and Game Department

11 Hazen Drive, Concord, NH 03301-6500  
Headquarters: (603) 271-3421  
Web site: [www.WildNH.com](http://www.WildNH.com)

TDD Access: Relay NH 1-800-735-2964  
FAX (603) 271-1438  
E-mail: [info@wildlife.nh.gov](mailto:info@wildlife.nh.gov)

Dear teachers and students: (Sample Registration Letter)

It is time again to register for the Trout in the Classroom program for the upcoming school year! The New Hampshire Fish and Game Department is excited to bring this annual program to schools throughout the state. We have experienced schools returning to the program and invite new schools to sign up. Our state hatcheries are committed to providing the fish eggs and excellent fish culture advice. Our partners with Trout Unlimited will help advertise and coordinate the school registrations, will assist with equipment needs, and will be active liaisons with their local schools.

The first step to participate is to fill out the mandatory Trout registration form, and return it to Judy Tumosa at the New Hampshire Fish and Game Department by the end of September. The registration form provides information about your school and serves as your request to obtain a New Hampshire state permit to raise and release the trout. Be specific about the location of your release site so the department biologists can be sure that you are in acceptable salmonid waters; for example “in the Oh My Gosh stream on River Street by the railroad bridge”.

Supplies for the program include: a chiller (estimated cost \$750.00), and a tank set up consisting of a 20 or 30 gallon fish tank, water filter, air stone and pump, gravel or plastic matting, tank insulation, thermometer, turkey baster, and duct tape (estimated cost \$200.00). The chiller is needed to keep the eggs cold enough to survive and hatch on schedule. There are some available for schools to borrow and your local Trout Unlimited chapter, PTO's, or community service groups may be able to help you obtain one.

New teachers will be required and experienced teachers are encouraged to attend a training session in early November. The session covers salmonid ecology, tank care, water quality assessments of your local river, fish hatchery function and purpose, and science curriculum framework connections. The eggs are available for the classroom in mid-January.

Contact Judy Tumosa with questions at [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov) or #271-0456, and if interested, please fill out and return the forms by the end of September.

Sincerely,

*Judy Tumosa*

Watershed Education Specialist



# Trout in the Classroom Registration Form

School Year Date:

## Teacher and School Information

Teacher Name:

Teacher Email:

School Name:

School Address:

Phone:

Will Attend Training?  Yes  No  Already did

## Classroom Liaison/Volunteer

Name:

Email:

Address:

Will Attend Training?  Yes  No  Already did

## Student/Curriculum Information

Grade:

Number of Students:

Subjects Covered:

Primary Goal:

## Raising/Releasing Information

Chiller Status:  Owned  Borrowed  Need help getting one

No. of Eggs Requested:  100  200

No. of Tanks:

Proposed Release Site (*River & Town*):

Proposed Release Site (*Latitude/Longitude, dec. degrees*):

Return to Judy Tumosa: NH Fish & Game, 11 Hazen Drive, Concord, NH 03301  
Phone: 603-271-0456; FAX 271-0465 Email: judy.l.tumosa@wildlife.nh.gov

# Trout In The Classroom

## Orientation Agenda (Sample)

@ The Children's Museum of New Hampshire, Dover

November 3, 2010 | 3:30 to 6:30 pm

<b>3:30 pm</b>	<b>Registration &amp; Goodies &amp; Materials Table</b>
<b>3:40 pm</b>	<b>Welcome &amp; why are we here?</b>
<b>3:45 pm</b>	<b>Eastern Brook Trout Ecology and Joint Venture</b>
<b>4:15 pm</b>	<b>Tank Set-up and Maintenance and Water Quality Challenges</b>
<b>4:45 pm</b>	<b>Break</b>
<b>4:55 pm</b>	<b>Teacher Successes and Horror Stories or what might occur in your tank – do not be afraid!!</b>
<b>5:05 pm</b>	<b>Fish Development: Developmental Index and/or Trout Temperature Units –</b>
<b>5:35 pm</b>	<b>Permits &amp; Logistics of Picking Up Your Eggs</b>
<b>5:45 pm</b>	<b>Paperwork after the Fun is done</b>
<b>6:00 pm</b>	<b>Watershed study for your stocking river (WEP and AGO)</b>
<b>6:20 pm</b>	<b>Wrap up and Final Questions</b>
<b>6:30 pm</b>	<b>Migration Home</b>

**Location: 6 Washington Street, Dover, NH 03820**

**Directions: [www.childrens-museum.org](http://www.childrens-museum.org)**



# New Hampshire Fish and Game Department

**HEADQUARTERS:** 11 Hazen Drive, Concord, NH 03301-6500  
(603) 271-3421  
FAX (603) 271-1438

[www.WildNH.com](http://www.WildNH.com)  
e-mail: [info@wildlife.nh.gov](mailto:info@wildlife.nh.gov)  
TDD Access: Relay NH 1-800-735-2964

January 2, 2015

TO WHOM IT MAY CONCERN:

Under the authority contained in RSA 214:29, permission is hereby granted to **Joe Teacher, Pillsbury Crest Elementary School, 193 Raisin St., Wonderland, NH 03XXX, Tel. 603-555-5555**, to possess eggs and fry of brook trout in the classroom and to release fry into suitable stream habitat in Briney Brook, Wonderland.

**Sub-permittees:** Jeff Raspberry, Joan Strawberry

*This permit, or a copy, shall be carried by the permittee while engaged in any activities allowed under this permit and shall be displayed to any Fish and Game conservation officer or employee upon request.*

**This permit shall expire December 31, 2015, unless sooner revoked or rescinded.**

**The permittee shall furnish the Executive Director with a written report on the disposition of all eggs and fry by January 31, 2016.**

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Glenn Normandeau  
Executive Director

GN/srd

cc: Law Enforcement Division  
Inland Fisheries Division

# Equipment Needs and Information

## Trout in the Classroom Equipment List

**Chiller** - To keep the tank temperature at 38 degrees F, 3 degrees C +/- . Suggested unit: Glacier Corporation Aquarium Chiller. 1/6 Horsepower Immersed Coil Type (Cooling coil is placed in water). No tubing or pump needed for the chiller. Contact: [http://www.glaciercorp.com/Pages/aquarium\\_chill.html?pgid=5](http://www.glaciercorp.com/Pages/aquarium_chill.html?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 SOME of the fingerlings and growing A FEW to a larger size before releasing.

**Filter** - Recommended Fluval canister filter and 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 waste and should support a 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.

**Substrate** - Gravel (pea size) from the pet store or rocks (pea to ping pong size) from the river. 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 tank bottom or 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.

**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:

**Net Breeder**, to allow students to view some eggs up close without disturbing them all. **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.

# **New Hampshire Trout Unlimited Council**

## **LOANED EQUIPMENT AGREEMENT**

As a participant in the Trout in the Classroom program (TIC), starting during the **20XX-20XX** School year, this Agreement is entered into by and between **NAME OF SCHOOL OR PROGRAM AND The New Hampshire Trout Unlimited Council**. This Agreement memorializes the transfer of equipment from **The New Hampshire Trout Unlimited Council** to the designated school or program for the purposes of participating in Trout in the Classroom (TIC), a program designed to advance TU's Coldwater conservation objectives. **The New Hampshire Trout Unlimited Council** is pleased to provide the following equipment for the use by **NAME OF SCHOOL OR PROGRAM**, under the following conditions:

### **EQUIPMENT LIST:**

Chiller Provided:

Chiller Serial Number:

This is necessary equipment for participation in TIC. The equipment is for the use of **NAME OF SCHOOL OR PROGRAM**, for the sole purpose of participating in TIC.

**NAME OF SCHOOL OR PROGRAM** acknowledges receipt of this equipment. By accepting and using this equipment for the stated purposes, **NAME OF SCHOOL OR PROGRAM** assumes all liabilities and responsibility for its use, and agrees to indemnify and hold harmless TU from any claims of any nature whatsoever arising from the use and/or misuse of the equipment, including attorney's fees and costs.

If a chiller is included in the equipment provided, The New Hampshire Trout Unlimited Council retains full title and ownership. As long as **NAME OF SCHOOL OR PROGRAM** fully participates in TIC, the chiller will be for the sole use of **NAME OF SCHOOL OR PROGRAM**. **NAME OF SCHOOL OR PROGRAM** agrees to promptly notify TU if any repairs or replacements are necessary. Upon receipt of written notice, TU will consider the feasibility of making repairs and/or providing replacements in a timely manner.

In the event that participation in TIC is terminated or diminished, **NAME OF SCHOOL OR PROGRAM** shall notify The New Hampshire Trout Unlimited Council and shall return the loaned equipment to The New Hampshire Trout Unlimited Council.

In the event that the contact person (hereinafter designated) changes for either **NAME OS SCHOOL OR PROGRAM** or The New Hampshire Trout Unlimited Council, it is the responsibility of the outgoing contact to notify the other contact in writing of said change.

# **New Hampshire Trout Unlimited Council LOANED EQUIPMENT AGREEMENT**

**The undersigned, as authorized representatives of the indicated entities, agree to the terms and conditions herein specified:**

## **PARTICIPATING SCHOOL OR PROGRAM**

School or Program Name: \_\_\_\_\_

Participating Teacher (or Principal): \_\_\_\_\_

Phone Number: \_\_\_\_\_

Street Address: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Email: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **TROUT UNLIMITED CHAPTER OR COUNCIL**

Chapter Name: \_\_\_\_\_

Chapter TIC Coordinator (or President): \_\_\_\_\_

Phone Number: \_\_\_\_\_

Street Address: \_\_\_\_\_

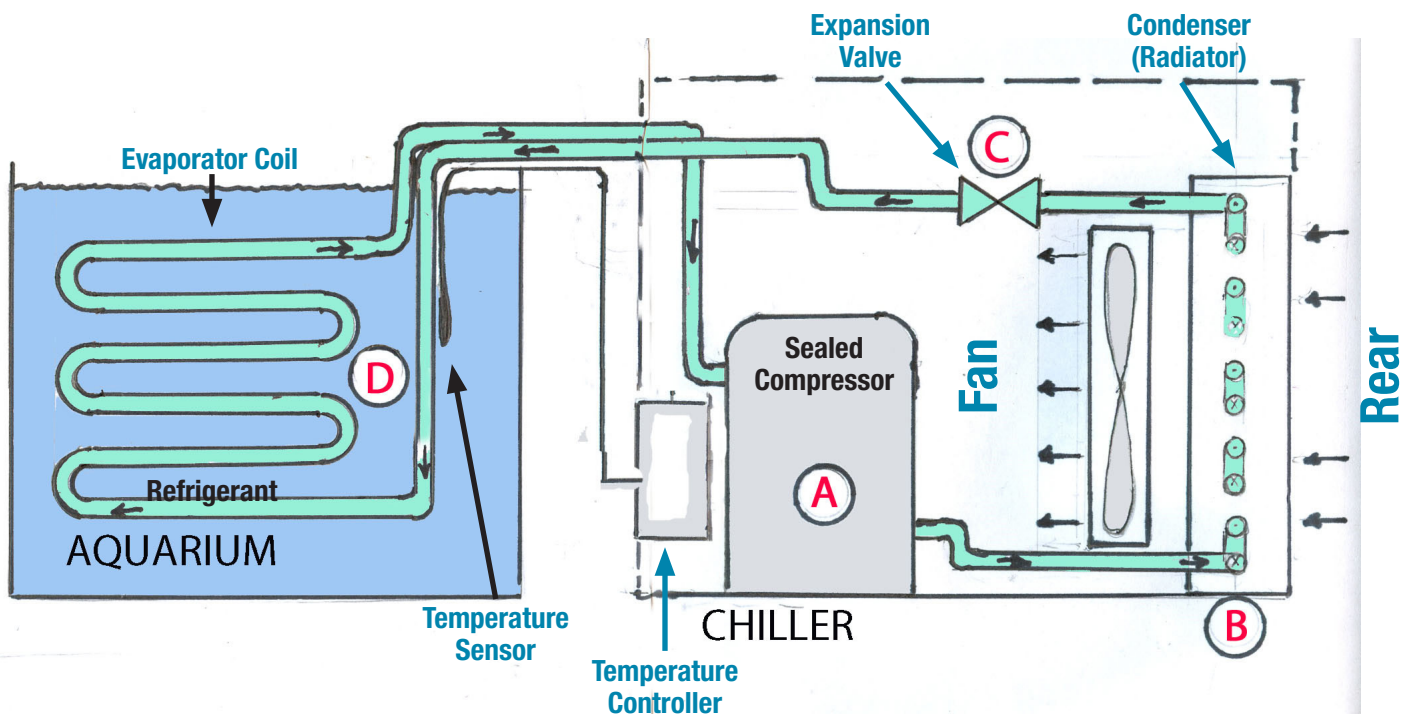
City, State, Zip: \_\_\_\_\_

Email: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



# How the Chiller Works



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 of 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.

So, a “maintenance” checklist is pretty brief:

- When setting 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.
- At the end of the school year, clean dirt/dust off of condensing coil and, if possible, blow out unit with air compressor.

# Curriculum and Program Information

## Brook Trout Habitat and Curriculum Information

### New Hampshire Fish and Game Department (NHF&G) information:

- NHF&G Website: [www.wildlife.state.nh.us](http://www.wildlife.state.nh.us)
- Watershed Education Program (WEP) training and curriculum materials:
  - ♦ <http://www.wildlife.state.nh.us/education/watershed.html>
  - ♦ “NHF&G Watershed Education Program Teacher Manual”, provided at all training sessions
    - ❖ “Brook Trout in the Classroom Teacher’s Manual” - Found in section 8
    - ❖ “Fish for the Future A Hatchery Experience” – Found in section 8
- Fish species profiles: <http://www.wildlife.state.nh.us/fishing/species.html>
- Fisheries management in NH: <http://www.wildlife.state.nh.us/fishing/fisheries-mgt.html>
- “Eastern Brook Trout in the Classroom” DVD: <http://youtu.be/nncCKe-6Yww>
- “Trout in the Classroom Tank Set Up” DVD: <https://youtu.be/4shGZ-FNFFQ>

### Websites with macroinvertebrate information:

- Macroinvertebrate flash cards: <http://www.mwpubco.com/titles/invertsflashcards.htm>
- Key to Life in the Pond: <http://watermonitoring.uwex.edu/pdf/level1/pondkey.pdf>
- Key to Macroinvertebrate Life in the River: <http://watermonitoring.uwex.edu/pdf/level1/riverkey.pdf>
- UNH Center for Freshwater Biology, An image Based Key to Stream Insects: <http://cfb.unh.edu/StreamKey/html/index.html>

### NHF&G Wildlife Journal articles on brook trout:

<http://www.wildlife.state.nh.us/pubs/documents/samples/wild-trout-hatchery.pdf>  
<http://www.wildlife.state.nh.us/pubs/documents/samples/nh-native-fish.pdf>  
<http://www.wildlife.state.nh.us/pubs/documents/samples/tale-of-the-trout.pdf>  
<http://www.wildlife.state.nh.us/pubs/documents/samples/forestry-fisheries.pdf>  
<https://www.wildlife.state.nh.us/education/documents/wj-trout-classroom.pdf>

**Tank set up manual:** *From Egg to Stream: A Guide to Building and Maintaining Classroom Incubators for Atlantic Salmon*

### Other curriculum ideas:

- NH TIC website: <http://nhtroutinclassroom.weebly.com/>
- The Children’s Museum of New Hampshire *Rivers: Bringing New Hampshire to Life Natural Science & New Hampshire History Curriculum – Rivers Curriculum guide*
- Colebrook Elementary School curriculum activities:
- For copies, contact Judy Tumosa: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)
- Lebanon Schools Watershed Congress and Great Brook Watershed Study: For copies, contact [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)

### National Trout in the Classroom (TIC) teacher resources:

- Website: [www.troutintheclassroom.org](http://www.troutintheclassroom.org)
- Lesson plans: <http://www.troutintheclassroom.org/teachers/lesson-plans>
- Coldwater Conservation Education Guide: [http://www.troutintheclassroom.org/sites/www.troutintheclassroom.org/files/documents/CCEG\\_ALL.pdf](http://www.troutintheclassroom.org/sites/www.troutintheclassroom.org/files/documents/CCEG_ALL.pdf)
- Stream Explorer Magazine and activity page: <http://www.streamexplorers.org/members/stream-explorers-magazine>
- TIC National List Serve; teachers can all join to share successes, challenges, curriculum ideas. For information, contact Judy Tumosa: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)

### Websites for information about agencies and organizations that contribute to the education, protection, management and restoration of salmonid species:

- Eastern Brook Trout Joint Venture: <http://www.easternbrooktrout.org>
- Trout Unlimited: National website <http://www.tu.org> • NH website: <http://nhcouncil.tu.org/>

# Brook Trout Developmental Index Chart Directions

Brook trout eggs develop so much per day, based on the temperature of the water. The warmer the water, the faster they develop. The Eastern Brook Trout Developmental Index Chart is used to measure that development.

## Directions to use the chart:

- The left hand column is temperature in degrees F; 35, 36, 37, etc.
- The row across the top is tenths of degrees of temperature F; 35.0, 35.1, 35.2, 35.3, etc.
- The decimal figures represent how much the eggs have developed at a given temperature;
  - ♦ @ 35.0 degrees F, the eggs have developed 0.410 percent for that day at that temperature
  - ♦ @35.1 degrees F, the eggs have developed 0.416 percent for that day at that temperature
  - ♦ @35.2 degrees F, the eggs have developed 0.422 percent for that day at that temperature, etc.
- When using the chart, DO NOT move any decimal points, use the number as is

## Directions to track trout egg development:

- When picking up the eggs, ask the hatchery about the percent development. They have tallied this figure based on when the eggs were fertilized at the hatchery and the hatchery water temperature. That is the figure that you start with to measure egg development.
- Put the eggs in your tank.
- The next day, look at the temperature in the tank.
- Using the chart, figure out the per cent development of the eggs for that day at that temperature.
- Add that figure as is (DO NOT move any decimal points) to the original per cent development figure you obtained for the hatchery.
- The next day after that, look at the temperature in the tank.
- Using the chart, figure out the per cent development of the eggs for that day at that temperature.
- Add that figure to the previous per cent development figure that you measured the day before.
- Keep repeating this step so you can track the cumulative development of the eggs.
  - ♦ At 73%, the eggs should be hatching and this does NOT mean they are ready to stock (put in the river) – it just means the eggs are hatching out into sac fry and they will absorb their yolk sacs.
  - ♦ At 95-100%, the fry have absorbed their yolk sacs, should be swimming up to find food, and should be stocked or fed within 3 days of this behavior.

**Sample Calculation:** When you get your eggs, the hatchery percent development = 42.300%

First day that the eggs are in the school, the tank temperature is 35.0. Using the chart, you determine that the percent development for that day at 35.0 degrees F = 0.410. Add the two figures:  $42.300\% + 0.410\% = 42.710\%$ , this represents the **cumulative** percent development for the eggs.

Second day that the eggs are in the school, the tank temperature is 36.0. Using the chart, you determine that the percent development for that day at 36.0 degrees F = 0.471. Add that to the previous cumulative per cent development:  $42.710\% + 0.471\% = 43.181\%$ .

Third day that the eggs are in the school, the tank temperature is 37.0. Using the chart, you determine that the percent development for that day at 37.0 degrees F = 0.532. Add that to the previous cumulative per cent development:  $43.181\% + 0.532\% = 43.713\%$ . And so on until you reach 95-100% development and swim up.

Note: The Watershed Education Specialist may provide an Excel spreadsheet to make these calculations easier.

# Brook Trout Developmental Index Chart

Developed by: Jason Smith, Powder Mill Hatchery 3/13/08

Temp F	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
35	0.410	0.416	0.422	0.428	0.434	0.441	0.447	0.453	0.459	0.465
36	0.471	0.477	0.483	0.489	0.495	0.502	0.508	0.514	0.520	0.526
37	0.532	0.538	0.544	0.550	0.556	0.562	0.568	0.574	0.580	0.586
38	0.592	0.598	0.604	0.610	0.616	0.623	0.629	0.635	0.641	0.647
39	0.653	0.659	0.665	0.671	0.677	0.684	0.690	0.696	0.702	0.708
40	0.714	0.722	0.729	0.737	0.745	0.753	0.760	0.768	0.776	0.783
41	0.791	0.799	0.806	0.814	0.822	0.830	0.837	0.845	0.853	0.860
42	0.868	0.876	0.883	0.891	0.899	0.907	0.914	0.922	0.930	0.937
43	0.945	0.953	0.960	0.968	0.976	0.984	0.991	0.999	1.007	1.014
44	1.022	1.030	1.038	1.046	1.054	1.061	1.069	1.077	1.085	1.093
45	1.100	1.111	1.123	1.134	1.146	1.157	1.168	1.180	1.191	1.203
46	1.214	1.225	1.237	1.248	1.260	1.271	1.282	1.294	1.305	1.317
47	1.328	1.339	1.351	1.362	1.374	1.850	1.396	1.408	1.419	1.431
48	1.442	1.453	1.465	1.476	1.488	1.499	1.510	1.522	1.533	1.545
49	1.556	1.567	1.579	1.590	1.602	1.613	1.624	1.636	1.647	1.659
50	1.670	1.678	1.686	1.695	1.703	1.711	1.719	1.727	1.736	1.744
51	1.752	1.760	1.768	1.777	1.785	1.793	1.801	1.809	1.818	1.826
52	1.834	1.842	1.850	1.859	1.867	1.875	1.883	1.891	1.900	1.908
53	1.916	1.924	1.932	1.941	1.949	1.957	1.965	1.975	1.982	1.990
54	1.998	2.006	2.014	2.023	2.031	2.039	2.047	2.055	2.064	2.072
55	2.080									

This chart goes from fertilization to swim-up.

cumulative % development

weakly eyed 29%

shocking 38-42%

strongly eyed 47%

Hatched 73%

swim up 100%

# People to Assist

## Trout in the Classroom Contact Information

### Primary Contacts

- George Embley, Trout Unlimited Basil Woods, Jr. Chapter; Email: [gtembley@gmail.com](mailto:gtembley@gmail.com)
- Mark Seymour, Trout Unlimited Great Bay Chapter; Email: [seymourwoodworking@me.com](mailto:seymourwoodworking@me.com)
- Judy Tumosa, New Hampshire Fish and Game Department, 11 Hazen Drive, Concord, NH 03301; Phone: 603-271-0456; Fax: 603-271-0465; Email: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov) (State coordinator in NH)

### Egg Pick Up

For appointment to pick up trout eggs and arrange NH Fish and Game hatchery tours for your classroom contact:

- Wayne Paschal, Berlin Fish Hatchery  
Off Route 110, Kilkenny Valley, White Mountain National Forest  
York Pond Road, Berlin, N.H. 03570  
603-449-3412  
Educational exhibits for children and adults about raising fish. Group hatchery tours by appointment. Open late May to mid-October.
- Randy Ayer, New Hampton Fish Hatchery  
Route 132, New Hampton 03256  
603-744-3709  
Group hatchery tours by appointment.
- EJ Malone, Powder Mill Hatchery  
288 Merrymeeting Road, New Durham 03855  
603-859-2041  
Visitor's Center with information on fish and wildlife. Group hatchery tours by appointment.

Hatchery website link: <http://www.wildlife.state.nh.us/about/visit.html>



# Trout in the Classroom Volunteer Job Description

A successful Trout in the Classroom program needs volunteers who are willing to give their time to be a resource for the teachers and their students. Volunteer interest, encouragement, and experience with trout and cold water conservation mean a lot to teachers and kids involved in the program.

See **“Trout in the Classroom Timeline”** for details throughout the school year.

1. Assist teachers with obtaining chiller and tank.
2. Assist teachers with chiller and tank set up.
3. Recruit new schools into the program.
4. Attend and participate in the training offered to the new teachers by NH Fish & Game watershed education staff.
5. Contact teachers to make sure tank set up is complete before arrival of the eggs.
6. Pick up eggs from the hatchery and deliver eggs to the schools. Make sure you get the hatchery water temperature and the developmental index from the hatchery staff and share that with the teachers. Successfully transport the eggs into the tank and be prepared to talk with students about the program.
7. Check in with the school on a regular basis to address questions, concerns, problems, and successes. Check on hatchling status, water quality, tank care, need for food, any other problem.
8. Be available in person if possible in case of emergencies.
9. Update NHF&G staff about progress.
10. Relay teacher requests for guest speakers.
11. Participate in spring events such as release days, congresses, river field days.
12. Help teachers clean and store equipment at the end of the school year.
13. Track and record time spent on the program for the ARE federal grant match.
14. Suggest program improvements, training needs, and curriculum changes.

# Share What You Have Done

## Projects to do Within and Between Schools

### Throughout the Year:

- Contribute to the NH TIC website: <http://nhtroutinclassroom.weebly.com/>
- Use and contribute water quality, macroinvertebrate and fisheries data on the NHF&G WEP ArcGIS Watershed Map: <http://arcg.is/1fpmxSp>
  - ♦ Copy and paste the web link into a browser other than Internet Explorer
  - ♦ Click on an icon and see the data table
    - ❖ Black fish represent fisheries data collected by NHF&G
    - ❖ Colored fish represent fisheries data collected by schools
    - ❖ Water drops represent water quality data collected by schools
    - ❖ If the web link to the map does not work, contact: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)
- Consult these ArcGIS maps
  - ♦ NH Trout in the Classroom (TIC) Schools: <http://arcg.is/2dKZ25z>
  - ♦ NH Trout in the Classroom (TIC) Schools Program Mentors: <http://arcg.is/2dL3hhI>
  - ♦ Click on a school house to see information on other schools participating in the program and a lightbulb to see the mentor information
  - ♦ Contact other neighboring schools to plan activities to study the watershed together
  - ♦ If the web link to the map does not work, contact: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)
- Participate in the national Trout Unlimited TIC list serve (contact [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov) to get signed up)
- Contribute to monthly “conversations” about what all the school are doing
- Participate in Teacher Recognition days, as scheduled
- Contribute articles to local newspapers, newsletters, etc.
  - ♦ Make sure you obtain permission to use student photographic images
  - ♦ Make sure you mention all the partners that make TIC happen; TU, NHF&G, hatcheries, schools, other community partners
- Send in time sheets for the federal ARE grant match.

### At the end of the year:

- Fill out and return the Trout In The Classroom Evaluation Form for NH (page 24).
- Send in final time sheets for the federal ARE grant match (page 26).

# End of Year Responsibilities

## End of Year Cleanup (From the TU National website)

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 your 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 be 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: Do not 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 your 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.

## Trout In The Classroom (TIC) Evaluation

School Year Date:	
<b>Teacher and School Information</b>	
Teacher Name:	
Teacher Email:	
School Name:	
<b>Student/Curriculum Information</b>	
Grade:	Number of Students:
Subjects Covered:	
Primary Goal:	
<b>Raising/Releasing Information (Required by the NHFG Inland Fisheries Division)</b>	
No. of Eggs Received:	No. of Trout Released:
Release Date:	Release Site:

### Connections to the NHF&G Watershed Education Program (WEP) objectives:

- 1. Protecting Aquatic Habitat** – How did your students learn to recognize healthy habitat, and how to maintain it or improve it as needed?
  
- 2. Understanding Watersheds** – How did your students learn to understand that watershed health is dependent on land use and water quality?
  
- 3. Encouraging Community Involvement** – How did you grow community interest and involvement in natural resource stewardship?

**Did you feel adequately trained? If not, how can we improve?**

**Were the curriculum materials useful? If not, how can we improve?**

**Was there adequate technical support? If not, how can we improve?**

**Do you want to participate in the NH Trout in the Classroom Program next year? Yes? No?**

**What additional training in aquatic topics would you like to see offered?**

**Any additional comments?**

Return to Judy Tumosa: NH Fish & Game, 11 Hazen Drive, Concord, NH 03301  
Phone: 603-271-0456; FAX 271-0465 Email: [judy.l.tumosa@wildlife.nh.gov](mailto:judy.l.tumosa@wildlife.nh.gov)

THANK YOU for your interest in watershed education and keeping the fish and wildlife of the state healthy!

# Watershed Education Program Teacher Timesheet

Name: \_\_\_\_\_

School: \_\_\_\_\_

Date (mm/dd/yy)	Course Activity or Description - Enter ArcGIS, Stream Study, Trout in the Classroom, VBAP, Warm Water tank, Watershed Ecology Institute (WEI)	Hours for In-Class, Field Trip, Prep time, Training	Travel Hours	Total Hours	Miles Round Trip Driver Only

\*\* Please calculate time to nearest quarter hour • 1.00 = 1 hour; 0.75 = ¾ hour; 0.50 = ½ hour; 0.25 = ¼ hour

**When completed, please FAX or mail to:**  
 NH Fish and Game Department, ARE Unit  
 11 Hazen Drive  
 Concord, NH 03301

(603) 271-0456 Phone  
 (603) 271-0465 Fax  
 judy.l.tamosa@wildlife.nh.gov

\_\_\_\_\_  
 Teacher Signature (each page)

\_\_\_\_\_  
 Aquatic Resource Educator NHF&G Signature