TEACHING WITH TROUT

TEACHER MANUAL

MASSACHUSETTS DIVISION OF
FISHERIES & WILDLIFE

APPENDIX

INTRODUCTION

The Division of Fisheries and Wildlife (MassWildlife) is responsible for the conservation—including restoration, protection, and management—of freshwater fish and wildlife resources in Massachusetts for the benefit of and enjoyment by the public. Part of the agency's mission is education. MassWildlife's Teaching with Trout Program can be utilized across all grade levels as a basis to develop an appreciation for the aquatic environment through raising trout in the classroom.

MassWildlife's Teaching with Trout Program provides trout eggs to classrooms so that students can become engaged in learning about trout, aquatic environments, and human connections to the environment. Students care for the trout and eventually release them into local waterbodies. This process allows students to draw comparisons between the artificial environment in the classroom and the natural environment.

Teachers can adapt the program to fit their curriculum needs and students' levels. Teaching with Trout has applications for science, math, language, arts, and social studies. The program is designed to teach Massachusetts students about conservation concepts related to their local aquatic resources. Using resources available online or those a teacher may develop, students in primary grades can be introduced to topics like life cycle, anatomy, and food webs. Students in higher grades can be introduced to concepts including ecology, population biology, water quality, and conservation.

The fish released by students at the end of the Teaching with Trout Program, and the hundreds of thousands of trout stocked my MassWildlife each spring and fall, are not meant to restore or repopulate waterbodies. Aquaculture and stocking activities are meant to ensure abundant fishing opportunities in waters open to the public. In contrast to stocked trout fisheries, wild brook trout populations are protected and restored through habitat restoration projects (e.g. dam removal), land protection, harvest regulations, along with outreach and education efforts.

We hope you find the Teaching with Trout manual and materials helpful. MassWildlife staff are available to help with aquarium questions and troubleshooting. If you are interested in a field trip to a state fish hatchery, please let us know.

How to Get Started

If you want to start using the Teaching with Trout Program in your classroom, start by contacting MassWildlife.

Program Contacts:

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All new participants must attend an orientation workshop. MassWildlife offers this orientation every fall (usually mid- to late-October). Orientation covers tank setup and operation, along with topics like fisheries management and wild brook trout status in Massachusetts.

Eggs are delivered to participating schools each year in late fall. Potential participants are expected to secure funding and purchase the equipment needed for the Program in time for egg delivery. See the Equipment section for more details; contact MassWildlife if you need help ordering equipment. A limited number of chillers are available on a randomly selected basis through MassWildlife each year. (Note: chillers can be loaned to the same participant for a maximum of 2 years. During this time, participants can be raising funds to purchase their own to free up loaned chillers for newer Program participants.) These chillers are made available to MassWildlife through a generous donation by the Massachusetts Outdoor Heritage Foundation.

The Teaching with Trout Program is largely teacher driven. Teachers oversee tank operation and implement related classroom instruction. See the appendix for a list of resources that can support participants.

At the end of each year, students will release the trout into an approved waterbody. Approved locations generally do NOT include waterbodies that support populations of wild trout or waterbodies that are stocked with brook trout. Teachers must get approval of the release location from MassWildlife before liberating the fish in the spring. If you are a new participant or if you plan to change release locations, contact Adam Kautza (adam.kautza@mass.gov).

MassWildlife provides eggs and feed along with technical support for the purchase and operation of the aquarium. MassWildlife can also provide a tour of a hatchery and a guest speaker to address topics of interest related to the program. A permit to raise and release trout is required in Massachusetts (MGL Sec. 4, Ch. 131) and will be issued annually to each participant by MassWildlife.

General timeline

An orientation meeting is held each fall, generally in October for new participants to the program. Teachers must plan to set up and test equipment prior to egg delivery, meaning everything should be ready by Thanksgiving. MassWildlife will provide eggs between November and January. Most eggs are delivered in December.

Fish are raised in the classroom through the spring. Teachers can decide when to release the fish before the end of the school year. MassWildlife encourages teachers to plan an outdoor educational experience for students at the time of release.

BROOK TROUT IN MASSACHUSETTS

Brook trout (*Salvelinus fontinalis*) are technically not even trout. They are charr, more closely related to lake trout (*Salvelinus namaycush*) and artic char (*Salvelinus alpinus*) than they are to other species of trout like the introduced brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). Brook trout are the only remaining native salmonid (Family Salmonidae) in Massachusetts other than a few remnant populations of Atlantic salmon (*Salmo salar*).

Brook trout are true coldwater fish and are unable to tolerate water temperatures much over 20° C (68° F) for extended periods. Brook trout thrive in waters between 11-16° C (52-61° F). They do best when in streams with moderate pH and high alkalinity. Great brook trout habitat consists of areas with lots of pools and cover, a relatively stable stream flows, and a substrate that is free of silt.

Brook trout reproduce in the fall, usually from mid-October until late November. Eggs hatch in the early spring. In the southern portion of their range (which includes Massachusetts), most brook trout live up to three or four years and achieve a maximum length of 200-250 mm (about 8-10 inches). There are exceptions where brook trout have access to more food and/or optimum habitat. For example, in the Swift River in central Massachusetts, the water temperature and stream flows stay in the optimal range brook trout grow much larger. Sea-run brook trout also have the tendency to reach greater size than inland populations because of their ability to access the rich food resources in saltwater. Sea-run brook trout in Massachusetts tend to migrate from freshwater streams to inshore saltwater habitats in late fall following reproduction and then move back into streams in the spring. Sea-run brook trout streams in Massachusetts are concentrated along the shoreline of Buzzards Bay, on Cape Cod and Martha's Vineyard, and scattered areas along Massachusetts' South Shore.

Wild, naturally reproducing brook trout are found in all but two of the major watersheds in the state. While the current extent of brook trout is reduced from the larger historic range, they still occupy over 1,100 streams across Massachusetts. Brook trout have disappeared from many urban and suburban streams due to the negative impacts on habitat from human development including dams, loss of riparian habitat, altered flow regimes, and increased sedimentation. Climate change also poses a major threat to brook trout. When faced with poor habitat conditions, brook trout often recede into smaller, colder, high-gradient headwater streams.

EQUIPMENT

The equipment for the program is based on the use of a 50-gallon tank, and other appropriately sized components. Participants with access to equipment other than that listed may be able to utilize alternate sizes and types of equipment. Please contact MassWildlife to discuss the specifics of your situation and determine if the system components will be adequate for use in the program.

Below you will find a list of equipment needed to build your Teaching with Trout brook trout rearing tank. You may choose to consult resources related to equipment from similar programs such as Trout in the Classroom (troutintheclassroom.org). These resources can be helpful; however, please stick to the recommended items in this manual to build your system. The following recommendations are specifically for brook trout.

Recommended Equipment List

Many of these items can be found through local or online pet supply retailers, while other items may be available at a local hardware or department stores.

When contacting vendors for equipment purchase refer to MassWildlife's Teaching with Trout Program. The descriptions below are of generic types of equipment.

- **Chiller**
  The most expensive piece of equipment needed is a water chiller. Take time to consider the chiller types and models available. There are two options regarding chillers for the program. MassWildlife recommends using a drop-in chiller for a several reasons. Drop-in chillers are more affordable and can be used without additional accessories. Also, since they don't require a pump, there is less turbulence in the tank.
  A drop-in chiller consists of an external component with a compressor and controls and a refrigeration coil that sits inside the tank. This is a standalone unit that does not require additional parts to function. Some people don't like this type of unit because coils are visible in the tank.
  The second option is an in-line chiller that pumps water through an external unit that contains the compressor, refrigeration coil, and controls. This type of unit requires extra accessories (submersible pump, tubing, and fittings) and leads to a higher setup cost.

  A ¼ horsepower unit is recommended for a 50-gallon tank. Pictures of both types of chillers are below.

In-line chiller

Drop-in chiller

- **Aquarium tank**: Standard 50-gallon aquarium, dimensions approx. 48” x 20” x 12”
- **Tank stand** (or structure capable of supporting 500 pounds)
- **Water filter:** Tank mounted water filter, rated for 50-to-110-gallon tank

- **Filter intake cover:** Foam or other porous material to cover filter water inlet
- **Aquarium air pump:** 4 watts, 115-volt, single air outlet

- **Air stone:** 6“to 10” weighted in plastic body

- **Airline check valve**: 1 pk
- **Flexible airline tubing:** vinyl or silicone, 8 to 10 feet length

- **Net breeder:** hatching basket

- **Aquarium gravel vacuum cleaner:** siphon

- **Water conditioner treatment:** (chlorine neutralizer), 16 oz.
- **Bacterial supplement of nitrifying bacteria:** 16 oz. (2 each)
- **Freshwater test kit:** (ammonia, nitrite, nitrite, pH parameters)

- **Hardness test kit:** general hardness (GH) and carbonate hardness (KH)
- **Battery operated digital thermometer**
- **Aquarium net (long handle)**
- **Aquarium gravel (optional):** small natural color pebbles ¼" to ½" size

- **Battery operated aerator:** portable device for fish transport
- **Measuring spoons:** set— 1/8 teaspoon to 1 teaspoon
- **5-gallon plastic buckets**
- **Turkey baster**
- **Styrofoam sheets**: 2 each, 4 ft x 8 ft x ½ inch or poly-fiber insulating cloth to insulate all sides of the tank
- **Duct tape, Velcro, or other fasteners**
- **4-outlet power strip**

- **Portable air supply with air stone, battery-powered**

- **If using an in-line chiller:**
  Additional accessories are needed to pump water from the tank through the chiller and return it to the tank. Component sizes will vary depending on the model of chiller you have. If you have any questions, contact MassWildlife for help before ordering. Components needed to complete an inline chiller system include:
  - **Magnetic drive water pump**: 35 watts, 300 to 400 gph, with 10 ft. cord
  - **Flexible tubing, clear**: diameter compatible with water pump, (length to be determined, approx. 10 to 15 ft.)
  - **Stainless steel hose clamps**: 4
  - **PVC fittings** (compatible with water pump and chiller)
  - **Water return nozzle** (compatible with hose size)

Replace the following items annually:

- Freshwater test kit reagents
- Bacterial supplement of nitrifying bacteria: 16 oz. (2 each)
- Water conditioner treatment: (chlorine neutralizer), 16 oz.
- Airline check valve: 1 pk

EQUIPMENT SETUP

The following are general instructions and suggestions for setting up the Teaching with Trout Program equipment. Please refer to specific equipment instructions provided by the manufacturer of each piece of equipment. There are several on-line instructional videos that demonstrate the set-up process. These include some helpful hints that you may find useful. Search for YouTube videos using the phrase “trout in the classroom.” Contact MassWildlife with any questions you have.

NOTE: Everything that goes into the tank should be rinsed and dried prior to assembly. There is always the potential of introducing a disease to the tank particularly from native stone, plants, and water sources. Any gravel or other natural material installed in a tank should be disinfected with an oxidizing agent, such as chlorine or hydrogen peroxide, and rinsed and completely dried before being placed in the tank.

MassWildlife does not recommend the use of naturally occurring aquatic organisms, neither plants nor decorative items, due to the potential to introduce pathogens to the tank. Not only might the fish be exposed to diseases, but when the fish are released, this may also transfer a pathogen or non-native species into the natural environment where it does not presently occur.

MassWildlife recommends the equipment is set up and tested at least a week prior to anticipated egg delivery. This is generally immediately after the Thanksgiving vacation. Once the tank is set up and all the equipment is tested, only the filter should continue to be run. You can wait to start the chiller until a day or two before the scheduled egg delivery.

Tank

- Locate tank on a sturdy surface capable of supporting the weight of the full tank (up to 500 pounds for 50-gallon tank) and convenient to a power outlet. Locate tank away from direct sunlight and heat sources. Pedestrian activity may also disturb the fish.
- Make a note on power strip and outlet “DO NOT UNPLUG”.
- Clean the inside of the tank with wet cloth or paper towel. DO NOT use soap or cleaning chemicals.
- Enclose tank with insulation on all sides. Cut bottom piece with a minimum excess ½” around on all sides. Use tape, Velcro, or other fasteners to secure edges. Cut insulation as needed to accommodate mounting the hoses and filter. The top cover should be easily removable to facilitate feeding, cleaning, and water changes.
- Cut an opening in the front of the tank to allow for observation. Provide a means of removing the entire front panel for better viewing once feeding is commenced. (See image below)
- Gravel is optional. A shallow layer of gravel provides additional surface area for beneficial bacteria growth. Rinse gravel in fresh water to remove dust before gently placing in tank. Allow a portion of the bottom of the tank to remain free of gravel, this will allow for observation of waste build-up and fry movement.

- Lighting is best provided by ambient classroom lights. Tank should not be in direct sunlight. Avoid use of aquarium lights and harsh direct fluorescent lights. Eggs and hatched fry prefer relative darkness as would be found in the natural environment.

Chiller

- Refer to the manufacturer's instructions for proper set up.
- Be careful with the tubing from the unit to the tank. Avoid kinks or excessive wear that might interfere with proper operation of equipment.
- Provide adequate clearance around the condenser unit so airflow will allow proper ventilation.
- The thermostatic control module should be oriented so the temperature setting can be easily viewed. If the temperature display is not directly visible, a small mirror may be needed to view temperature setting.
- Chiller should be plugged directly into a wall outlet. Avoid plugging it into the power strip.
- DO NOT operate chiller until tank is filled and if using an in-line chiller, water is circulating through the water pump.

Water Pump

- The in-line chiller requires a water pump to circulate water through the unit. The pump must be running before the chiller is turned on.
- Secure the hose ends to the hose adapter on the top of the chiller with hose clamps to ensure the pieces do not separate.
- Cover the pump intake with foam filter to prevent fish from being suctioned into the intake.
- The amount of flexible tubing necessary for connecting the pump to the chiller will be dependent on the location of equipment. Avoid kinks in hose that inhibit flow to the chiller.
- The pump intake should be located away from the air stone to avoid drawing air bubbles into the water inlet.

Filter

- Refer to the manufacturer instructions for assembly.
- Rinse all filter components before placing them in the filter.
- Install the filter on the back or side of the tank.

- Install a foam filter over the inlet end of the water intake tube. This prevents fish from being drawn into the filter.
- Install the water intake tube about mid-level in the tank.
- The filter intake should be located far enough away from the air stone to avoid drawing air into the filter intake.

Air Pump and Air Stone

- Install the check valve about 6 inches from the air pump. If the check valve is not marked with the direction of flow, blow through the valve to determine how it should be oriented. It is vital that a check valve be installed to prevent water siphoning from the tank in the event of a power outage.
- Mount the air pump above and to the side of the tank.
- Cut the airline tubing to a convenient length once you have established where the blower will be located near the tank.
- Gently submerge the air stone toward the back of the tank. Do not place it under the filter to prevent air creating an air lock in the filter.
- Do not place the net breeder basket above the air stone.
- The air pump should be tested after the air stone has been allowed to saturate in the filled tank for 10 minutes. The air stone should produce fine air bubbles.
- Test the air pump and air stone assembly once this is in place. Turn it off once it has been tested. It is not needed until the fish have grown some. It can be turned on once the fish are feeding on the #1 size feed.

Net Breeder (hatching basket) & Platform

- The net breeder basket and/or platform can be used to hold the eggs prior to hatching.
- Place the hatching basket on the front side of the tank away from the water filter. Observation of the eggs and sac fry can be made through a viewing window or from above the tank.
- MassWildlife will provide a platform on which some of the eggs can rest until hatching. Place the platform away from the filter. Movement of the eggs from turbulence can harm the embryos prior to hatching.



Digital Thermometer

- Follow instructions provided to operate the thermometer.
- Install temperature probe in the tank and mount the temperature display on the outside of the tank where it is easily visible. It may be secured to the insulation with tape or Velcro.

Filling and Starting the Tank

- Once set up is complete, fill the tank with tap water to within an inch of the top.
- Add water conditioner treatment according to directions to remove chlorine and metals.
- Fill filter reservoir with aquarium water to prime the system.
- Plug air pump, filter, and water pump (if used) into outlet strip with power turned off.
- Turn power strip on.
- Observe water pump hoses for leaks. Tighten hose clamps if necessary.
- Observe flow through water filter. Adjust flow rate according to instructions.
- Check air stone for bubbling. If air isn't flowing, the check valve may be installed backwards, and this should be reversed.
- Plug the chiller directly into a wall outlet. Follow directions on the temperature control unit to set the chiller temperature for 45 degrees with a 2-degree differential. Allow the chiller to run for several hours to ensure it will maintain the desired temperature.
  **If using an in-line chiller:* Verify proper operation of the water pump with proper flow before activating chiller unit. Follow the manufacturer's instructions for operating the temperature controller. Once testing is complete, increase temperature setting so chiller is not running.
- Once you are satisfied the chiller operates properly, adjust the temperature setting to over 60 degrees. This will cause the chiller to stop running. Then, unplug the unit until a day or two prior to egg receipt.
  **If using an in-line chiller:* Unplug water pump and air pump once testing is complete.
- Allow the water filter to continue to run prior to egg delivery. This will help to remove any particles or debris from the tank.
- Turn off filter and clean foam inlet filter periodically.

Water Source

The water available in each school is generally a treated municipal supply. To make the water supply suitable for human use, it can be treated to destroy harmful organisms and improve certain characteristics. This source can have a variety of dissolved minerals and compounds in it. The byproducts of the treatment process and the interaction of the water with the distribution piping can create water that is harmful to the fish. Trout are sensitive to certain metals and compounds at level much lower than are of a concern to humans.

MassWildlife recommends that whenever water is drawn to fill the tank or 5-gallon buckets for water exchanges that the water line is allowed to flush for several minutes to rinse potentially harmful substances from the line. Once the line has been flushed then fill a 5-gallon bucket and add water conditioner. Treatment chemicals are discussed below.

EGG DELIVERY

MassWildlife will schedule delivery of eggs to each participant who has registered for the program and attended the orientation meeting. Egg delivery may occur from late November through January, with most deliveries in December. Due to the large number of program participants, deliveries are made to specific geographic regions on specific days. There is little flexibility in the delivery schedule so participants should be prepared for eggs during any time their school is in session.

Two days prior to scheduled egg delivery, plug in the chiller (and the in-line chiller water pump, if used). Start chiller by adjusting temperature setting to begin cooling to the temperature suggested by MassWildlife. This will be dependent on the current state of egg development and when hatching is expected to occur. This temperature will be communicated when scheduling the egg delivery date and may be between low 40s and mid-50s.

At the time of delivery, MassWildlife will provide a supply of fish food, an egg platform, and a permit to raise and release trout. MassWildlife staff will check the equipment setup and provide suggestions or answer any questions a participant might have.

TROUT CARE

Eggs

Your eggs will arrive at the eyed egg stage of development, meaning the eye pigment will be visible through the shell of the egg. The eggs are sensitive to light, excessive handling, and turbulence. Care should be taken to limit light exposure from sunlight and fluorescent lighting.

Upon delivery, MassWildlife will provide a suggested temperature strategy for incubating the eggs which can vary depending on the month in which eggs are delivered. The temperature regime suggested is intended to allow students to observe the hatching phase of development. This is a great time to make observations of the sac fry while the internal organs are clearly visible.

The eggs will be delivered in a resealable bag or small container with water. The number of eggs provided is based on the size of the tank and may range from 100 to more than 200 eggs. The temperature of the tank should be within 3-degrees of the temperature of the eggs in water. If the difference is more than 3 degrees, the eggs should be allowed to gradually adjust to the tank temperature before they are released into the tank. This is accomplished by mixing some tank water in the container and allowing it to float in the tank for 30 minutes or more. This will ensure the egg temperature adjusts slowly to that of the tank environment.

The most natural position for the eggs would be in the gravel during incubation; however, this limits opportunities for students to observe the eggs. Using a platform during incubation allows students to get a better view of the incubating eggs. The net breeder basket can also hold eggs and may be hung on the upper edge of the tank.

Care should be taken to place the eggs on the platform and in the breeder basket by gently pouring them with the bag or container submerged in the water. Any turbulence from the filter or pump may cause the eggs to fall off the platform. It may be necessary to adjust the flow from the filter to prevent the eggs from moving around.

While the eggs are resting on the platform and in the basket, they can be counted. A picture of the eggs blown up on an overhead screen may facilitate this exercise.

Check the eggs daily for any that develop white spots or any abnormalities. White eggs are dead and should be removed from the tank immediately. Remove eggs using a turkey baster or other suctioning device. Dead eggs will develop fungus and bacteria in a short time, so it is vital to remove any dead eggs daily. Be careful not to harm viable eggs.

Hatching

MassWildlife will provide an approximate timeframe of when eggs should hatch. Not all eggs will hatch on the same day, but most will hatch over a two to four-day period. Some fish may only partially emerge from the egg and not completely hatch, these should be removed if they haven't fully hatched after a few days. Once hatched, the sac fry will drop through the mesh of the platform and rest in the gravel during yolk sac absorption. The egg platform can be removed once fry have hatched. Fry hatched in the basket can remain there until feeding behavior is established.

Eggshells will float around after hatching and accumulate on the intake to the filter; use the dip net to remove them from tank. To remove eggshells from the intake filters: turn off the filter, remove the filter intake cover material, and rinse in fresh water. There may be some surface foam that develops due to the release of enzymes as the eggs hatch. This is normal and can be removed by skimming the water surface with a net.

Alevin (Sac-Fry)

Once the fry hatch, they will drop through the screen of the egg platform and disappear in the gravel. It will be difficult to see them during the time it takes to absorb the yolk sac. Full yolk sac absorption will take two to three weeks. During this period fry will remain in the gravel and they will become more active as the yolk sac is absorbed. Fry hatching in the breeder basket can be closely observed during the yolk sac absorption process. Continue to check daily for any fry that die during the alevin stage and remove them immediately.

Alevin can be observed under a dissecting scope or using a hand lens. Because the scales of the fish are very small, the fry appear translucent until the scales grow to obscure the internal organs. This can provide an opportunity to look at the internal anatomy of the fry. Alevins can survive in a Petri dish with a bit of water for a short time. Avoid excessive exposure to light (heat) for long periods.

The yolk sac is the nutritional source of the fry as they slowly develop. During this period, you may observe fish with deformities including conjoined fish and skeletal anomalies. Deformed fish are not common and should be removed since they will not survive long.

Once the fish have hatched, begin periodically testing the water quality to get some background information. Check water temperature daily. A data collection form is included in the Appendix.

Fry Care and Feeding

As the yolk sac disappears, the trout will start to become more active. The fish are now considered fry. Once a few fry begin to swim up out of the gravel, or about in the breeder basket, feeding can begin. Fry will swim to the surface to inflate their air bladder and may still have a small portion of yolk sac visible. Feed very small pinches of feed initially until most fish are actively swimming and feeding in the tank. It is important not to over feed the fish at this early stage as it can contribute to poor water quality and promote disease.

During the initial stage, it is desirable to stop any water circulation during feeding by shutting off the filter system. This will reduce turbulence in the tank and allow the fry to capture the food particles more easily. **MAKE SURE YOU TURN THE EQUIPMENT BACK ON** once each feeding is completed. Once the fry are feeding well, it isn't necessary to turn off the filter with each feeding.

MassWildlife provides three sizes of feed granules, #0, #1 and #2. Begin by introducing small pinches of #0 feed. Sprinkling a small pinch of food on the water surface will have those swimming near the surface begin to feed, however not all fish readily move to the surface. If you throw the feed at the surface of the water, it will break the surface tension and feed particles will fall through the water column, eliciting a response from fish near the bottom. The trout fry should have food several times a day as they begin to feed. Closely observe their behavior and see if they are ingesting the feed. You may see some spit it out at first—this is normal.

The daily feed amount is offered as a guide. This guidance is based on a population of 100 fish in the tank. You will have to estimate the number you have before deciding how much to feed.

Approximate comparison between grams and teaspoon measurements:

1/8 teaspoon = 0.3 grams
1/4 teaspoon = 0.7 grams
1/2 teaspoon = 1.5 grams
1 teaspoon = 3.0 grams

The change of feed size dispensed to the fry from #0 to #1 to #2, is based on the size of the fish. The following table indicates when a feed size change should be made. The daily ration should be divided into portions for the number of feedings planned for a day. Most food should be consumed in a few minutes. If a considerable amount remains uneaten, adjust the amount for the next day. There should be only a relatively small amount that may end up as waste on the bottom of the tank.

Fish length	Feed size	Daily amount per 100 fish
< 1" to 1.5"	#0	0.5 – 1.5 gram / ¼ to ½ teaspoon
1.5" to 2.0"	#1	1.5 – 3.0 gram / ½ to 1 teaspoon
Over 2"	#2	3.0 – 7.0 gram / 1 to 3 teaspoons

The frequency of feeding the fish can be reduced over time. When feeding #0 size feed, it is recommended that you feed 3 or more times daily. When feeding #1 or #2 size feed, you can decrease to 2 or fewer daily feedings. Once the fish are larger than 1.5 inches, they do not require daily feeding. From this point until their release, you can choose to feed the fish at a frequency and in amounts that are convenient for you. The more you feed, the more metabolic waste will be generated, and more tank

maintenance may be required. Testing of the water for ammonia during the first month or two is important to identify ammonia spikes from excess feeding.

Fish Feed

- Store the feed in a cool dry place. Keep out of direct sunlight.
- When transitioning from one feed size to another, test the larger feed size by observing the ability of the fish to ingest the larger particle. You can mix two sizes together for a period of time.
- Dispose of any excess feed at the end of the school year.

Survival

It is not unusual to have some sac fry which are deformed in some way. This is generally a consequence of genetics. While feeding during the first month or so you may notice that some fish do not feed at all. These fish may have internal issues or physical abnormalities that will prevent them from feeding and developing properly. Any fish that have deformities or are not eating will not survive very long and should be removed from the tank.

There are instances where one or more fish may grow significantly larger than their siblings and cannibalism may result. If this occurs, it is best to separate the large fish from the rest, by isolating in the breeder basket, or removing from the tank.

Generally, the overall survival of brook trout from egg to release is about 50 percent. This is highly variable between schools, due to water quality characteristics, tank care, and a suite of other factors.

Fish/Tank Care During Vacations

Trout can survive for a weekend or several days without any food. Ideally, over longer periods and vacations it is best for someone to check on the tank, conduct water changes, and provide a small amount of food on a regular basis. The guidelines below are intended to allow for a minimal amount of tank care during breaks when few people are available to check and maintain the trout tank. If the assistance of maintenance or other staff is utilized during breaks, provide specific instructions to avoid overfeeding of the tank.

Weekends and Short breaks (up to 4 days): In preparation for a short break, continue to feed normally and check the water quality prior to performing a water change. If the ammonia is above 1.0 ppm or other parameters are slightly high, a larger than normal water change may be warranted.

Long Vacations: Trout are cold-blooded, and their metabolic rate can be controlled through temperature manipulation. This can be advantageous during periods of time when people aren't available to perform routine tank care. Provided the fish are well fed prior to vacation, they can survive a long break of 7 to 10 days without any problem. During these longer periods, it is best to provide

intermittent care and feeding. Manipulating the water temperature during long breaks will help to control fish metabolism and reduce the need for regular feeding.

The first long break schools usually have during the program is February break. At this time the fry are very small and may not have been feeding for very long. To minimize the need for tank care and feeding during this time, fish must be well fed and have built up energy reserves to survive. The fry will need to demonstrate a decent size belly to ensure they can survive with minimal or no care. If the fish do not have much of a belly prior to February vacation it is best to plan on having someone check the tank periodically and feed on occasion. One or two feedings in combination with lower temperature can sustain the fry with minimal care. Expect that after a long break the fish may appear smaller (somewhat emaciated) than when you left on break. Once back on feed, they will recover rapidly.

During vacation when the fish are over 1.5 inches, the fish will have more than adequate energy reserves to survive a long break with minimal care.

Prepare for a long break by continue feeding as you normally would until 2 days prior to vacation. Two days prior feed a normal ration of feed and reduce the temperature 4 °F. Test the water quality and perform a 5- to 10-gallon water exchange. The day before the break, reduce the ration by half and reduce the temperature another 4 °F. Check the water chemistry and perform another water change if ammonia is above 1.0 ppm. With the reduced temperature (mid to low 40s), the metabolism of the trout will be reduced.

It is advisable to have someone look in on the fish if the school is normally occupied. If you have someone monitor the tank during a break, leave specific instructions for what should be checked. They do not need to feed the fish frequently, if at all. Consult with MassWildlife on your specific circumstances.

When manipulating the tank temperature by reducing the chiller setting, the reproduction of nitrifying bacteria is slowed or halted. Upon returning to the classroom after break, increase the temperature of the tank to the mid-50s and increase the amount of food over a couple days until the fish can consume a full ration. The addition of bacteria supplements twice a week for two weeks will help re-establish the beneficial nitrifying bacteria.

TANK CARE

Routine tank care

Daily: Check temperature and record, remove dead fish, check proper operation of equipment (filter water flow, chiller, air pump).

Twice weekly: Beginning after fish are fed, test water chemistry and record results, perform water change and clean tank. If water quality deteriorates below acceptable standards, discussed below, more frequent cleaning and water changes may be necessary. **Cleaning and water changes are recommended twice a week.**

The removal of dead fish is very important. Perform daily checks to look for dead eggs or fish. Remove these immediately to prevent transfer of disease to any of the live eggs or fish. You may find that you collect dead fish during the siphoning cleaning process that you have otherwise missed.

Once fish begin feeding, waste feed and metabolic waste will accumulate and begin to affect the water quality in the tank. Prepare water for water exchanges by having a container always ready. Fill and treat one 5-gallon pail of tap water with water conditioner. Allow full container to sit at room temperature to be available as needed to re-fill your tank. The second pail will be left empty and used later to collect wastewater drained from tank.

Clean the tank by siphoning the bottom of the tank into an empty 5-gallon pail. This can be performed twice a week with the regular water change. If you accidently siphon some fish out of the tank, you can net them out of the bucket and return them to the tank. To thoroughly clean the tank, it may be necessary to clean half of it one day and half of it on another day.

Once cleaning has been completed, re-fill the tank to within an inch of the top with pre-treated tap water from a 5-gallon bucket. Re-fill and treat each bucket with water conditioner as it is emptied. By replacing 5 gallons twice a week you are effectively changing close to 20 percent of the water volume. If ammonia levels remain above 1 ppm for an extended period, it is advised that you make water changes of up to 10 gallons at a time.

Regular cleaning of the water intake foam filters on the water pump and water filter should be performed when material is visible on the surface of the filter or when flow through the filter becomes reduced. To accomplish this, turn off each piece of equipment and remove the foam intake filter. Rinse the filter to remove any waste and towel dry before replacing. If the flow through the water filter becomes reduced, it may be necessary to dis-assemble the entire filter to inspect and clean the internal components of the filter. The filter reservoir will need to be filled with water to prime the system when you are ready to restart the filter unit.

Check the chiller regularly for dust accumulation on the air inlet and air filter. Any dust build-up may inhibit efficient operation. Shut down the unit and clean as needed.

Water Testing

Refer to the instructions for your water test kit. Follow all safety precautions, as some of the reagents are irritants. The use of these test kits is not appropriate for younger children. Refer to Material Safety Data Sheets for each reagent.

Test kit should have detection capability to tenths of a unit for pH and ammonia, and to whole units for nitrite and nitrate.

All water quality testing should be performed by an adult or students under their direct supervision. Younger students should not be allowed to perform these tests with solution-based test kits. Proper personal protective equipment should be used according to the manufacturers' instructions. A general recommendation is that eye protection and protective gloves be worn when handling the test reagents.

Water quality testing should be performed twice a week, prior to water changes. All test results should be recorded. Collecting data for each parameter will provide a sense of what is normal for your tank, and you should recognize any trends as they occur. This information may be helpful if there is ever a need to troubleshoot any problems. Re-test the measurements if any value seems unusual.

Test kit reagents: The solutions in each test kit are good for several years. There should be a lot number and/or expiration date indicated on each bottle. So be sure to check the lot number on the bottles in your test kit and only re-order when needed.

pH

Depending on your water source, the desirable level for pH is around 7.0 to 7.5. Trout will tolerate a wide range of pH levels, generally from 6.5 to 8.0. If the pH stays fairly constant, usually within a few tenths of a unit of the baseline reading, your trout will be fine. Regular water changes should keep the pH levels relatively stable.

Ammonia toxicity increases with increasing pH. Contact MassWildlife to discuss options to stabilize the pH if it fluctuates greatly. The use of chemical treatments to increase or decrease pH is not recommended. These agents can interfere with the results of other water quality tests.

Ammonia

Normal ammonia levels should be below 1 ppm. Ammonia levels of over 1 ppm but less than 2 ppm are acceptable until the nitrifying bacteria have developed sufficiently to begin the normal cycling of ammonia in your tank. Regular water changes and addition of bacteria supplements will help to reduce the ammonia to below 1 part per million.

More frequent or larger volume water changes will be needed if the ammonia level is consistently high – over 1 ppm. This usually occurs when the fish are over fed, or the tank is not cleaned adequately. If this problem persists, reduce the amount of feed, and continue water changes.

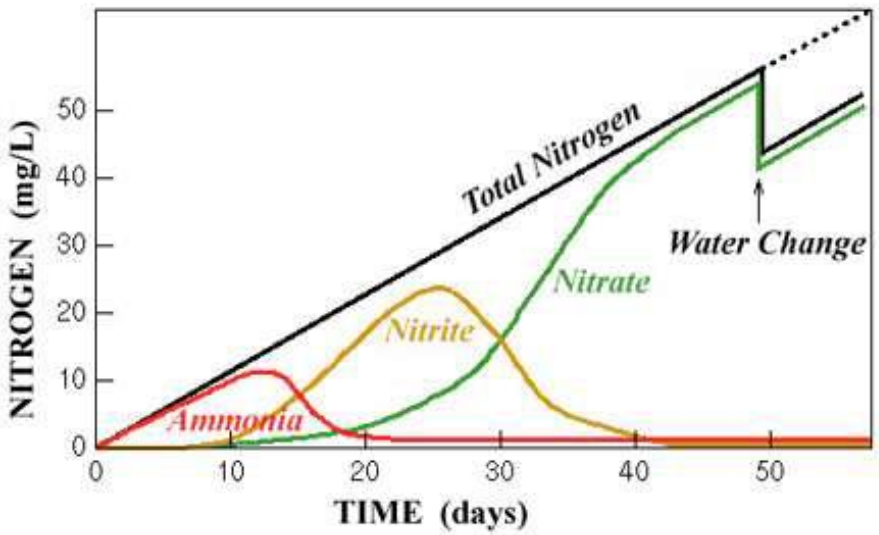
Nitrite

Nitrite is a product of the oxidation of ammonia in water. Nitrite levels should peak after a few weeks of feeding and then subside as the tank cycles. Readings for nitrite should be below 2 ppm. Water changes and the natural cycling of the tank should reduce the nitrite level to an acceptable range.

Nitrate

Nitrites are converted to nitrates in the last stage of the nitrogen cycle. Nitrates are not particularly toxic to fish when below 40 parts per million. Routine water changes should keep nitrate levels at an acceptable range.

Although specific numeric values are provided as reference points for water quality assessment, you should always simply observe the fish behavior to identify significant problems. Even when the ammonia is above 2 ppm, for example, the fish should still behave normally and feed well. If the fish behave abnormally, reduce feeding, and perform water changes of up to 25% of the tank volume daily. Once the water quality parameters are reduced to an acceptable range, continue feeding and routine water changes.



<u>Acceptable range of water quality parameters</u>
Ammonia – 0 - 1 ppm
Nitrite – 0 - 2 ppm
Nitrate – 0 - 40 ppm
pH – 7.0 - 8.0 units

Water Hardness
The hardness of the water, as measured by KH (carbonate alkalinity) and GH (general hardness), can affect the pH of the water and the efficacy of nitrifying bacteria to convert ammonia. Both parameters should be monitored for stability with regular water chemistry tests.

GH is the measure of calcium and magnesium dissolved in water. The value, whether considered hard water (>75 ppm) or soft water (<75 ppm), is dependent on the source of water and if it has been treated. It is desirable to have a GH of between 100 and 150 ppm.

KH (carbonate hardness) is important for the nitrification process. The KH test is a measure of the carbonate and bicarbonate ions dissolved in water. A KH value of 100 is recommended.

In most cases, it is not necessary to adjust for KH if it is between 100 and 150 ppm. If the KH is below 100 ppm, it is best to increase KH by adding baking soda. A teaspoon of baking soda dissolved in tank water can raise the KH between 15 and 20 ppm. If attempting to increase KH, add only one teaspoon a day. Check both pH and KH values the following day after the solution has thoroughly mixed in the tank.

Water treatments

The water treatment solutions prescribed below will maintain water quality for the fry and fingerlings. The use of other products is not recommended. Please contact MassWildlife before using alternate products. By minimizing the number of treatments used in the tank MassWildlife is intending to keep the process simple yet adequate for the health of the fish and the cost manageable.

For reference in measuring solutions: 1 teaspoon = about 5 milliliters

Water Conditioner is recommended for pre-treating all water added to the aquarium. This product neutralizes chlorine and chloramines, stabilizes pH, detoxifies metals and provides electrolytes. Follow label instructions to determine how much to add to the aquarium and all replacement water. If water quality issues are suspected of creating excessive mortality the dosage of water conditioner can be increased.

Bacterial supplement containing several types of nitrifying bacteria. The process of nitrification begins with Nitrosomonas bacteria oxidizing ammonia to nitrite, followed by Nitrobacter and Nitrospira oxidizing nitrite to nitrate. The supplement should be added to the filter beginning with the commencement of feeding.

TRANSPORTATION AND FISH RELEASE

The culmination of the program is the releasing of the fingerling trout. This presents an opportunity to create tangible connections between the classroom rearing environment and the natural world for the student. The greatest value of Teaching with Trout program is enabling students to become aware of the

importance and connectivity of humans to the aquatic environment. Although the release of fish can be considered a fish stocking activity, this is not intended to augment the population of fish in a water body. This program is focused on environmental education promoting the conservation of our water resources.

Preparation

Verify with MassWildlife the release site you wish to use.

Check with the local recreation or parks agency about any special requirements to use the public water body for a release location. Some towns may wish to be notified or have a permitting process for groups to utilize a public area.

The process of loading and transporting fish adds additional stress to the fish and increases their respiration and oxygen needs. Plan to meet the oxygen requirements by assembling the necessary equipment. Also, plan the activities the class will participate in while on-site at the release location. There are many types of activities student can enjoy while investigating the characteristics of the environment into which the trout are liberated.

You will need:

- Sturdy cooler or buckets with lids, to prevent fish from jumping or sloshing out
- Electric air pump and air stones, or other form of aeration
- Ice (made from dechlorinated water)
- Small net
- Small cups for students to release fish from
- Boots and appropriate clothing for weather conditions.

1 day prior to release: Adjust the tank temperature up or down a couple degrees, based on the excepted temperature of the receiving body of water. Do not increase the temperature of the tank to more than 60 degrees.

The day of release: Do not feed the fish. Use aquarium water to fill the transport containers. If necessary, add pre-treated water. Split the fish into several buckets or containers, each with their own air stone.

If you anticipate a long trip during which the water temperature may increase. It is advisable to put a small amount of de-chlorinated ice in each container to prevent a significant increase in temperature.

Minimize the time the fish are in transport before release. Do not plan a full day of activities culminating with a late-day release unless you are certain the fish will survive for an extended period in the container.

At the release site: Acclimate the fish to the receiving water by mixing water from the receiving water body into your container with the fish. Monitoring the temperature of your cooler or bucket, slowly add water from the receiving water body periodically. The goal is to gently change the temperature and water chemistry of your water container to near the temperature of the release water. Allow the temperature to change no more than a few degrees every ten minutes. Once the bucket/cooler temperature is within a few degrees of the stream/pond temperature, fingerlings can be released.

While at the release site, MassWildlife encourages activities that help connect the student to the environment. These activities may consist of searching for stream macro-invertebrates, collecting water chemistry data, discussing physical characteristics of water body and factors affecting water quality.

NOTE: Before releasing fish into ANY body of water, you must have MassWildlife approval. Be certain to coordinate the release location with MassWildlife prior to release.

END OF YEAR CLEANUP

At the end of the Teaching with Trout Program, it is important to clean your aquarium set-up before storing it. 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:

- It may be useful to take a picture to remind yourself how the equipment is set up for next year, prior to disassembly.
- Turn off the electrical pumps, chillers, filters, etc. Remove and disassemble the pumps, filter, and chiller.
- Remove dust and lint from the chiller air inlet filter. This can be accomplished using a small vacuum cleaner, dusting cloth or soft bristle plastic dust brush. Do not use any tools that will damage the filter or tubing materials.
- Use compressed air to blow out the tubing of the chiller – perform this where the water can be safely discharged as it sprays out of the tubing.
- Empty the tank almost all the way - siphoning is a convenient method. Then carefully remove the gravel. Finish emptying the tank. Wipe down all wetted surfaces to remove scum and algae. Thoroughly rinse all surfaces, wipe down and allow to air dry.
- Wash and dry the gravel by laying out in the sun or a ventilated area. Put the dried gravel inside the tank or small container. Store the tank in a safe place covering the top with any dust-proof covering.
- Clean chiller tubing while still damp. This can be accomplished with a cleaning brush attached to a string or small diameter rope.
- Break down the water filter. Clean and rinse all components and let dry.
- Clean the foam pre-filters on the water pump and water filter.
- When all components are dry, store in a secure and dry environment.
- Dispose of any excess feed.
- Check test kit reagents for expiration dates and quantity to determine what should be re-stocked.

Trout tank inspection

Week of _____ Inspectors _____

	Temp. 50 – 54°F	Mortality Remove and count	Water condition Clear? Level?	Equipment Everything working?	Ammonia < 1.0 ppm	Nitrates < 80 ppm	Nitrites < 5 ppm	pH	Feed amount	Initials of inspectors
Monday				Filter _____ Chiller ____ Air _____						
Tuesday				Filter _____ Chiller ____ Air _____						
Wednesday				Filter _____ Chiller ____ Air _____						
Thursday				Filter _____ Chiller ____ Air _____						
Friday				Filter _____ Chiller ____ Air _____						

Notes:

CURRICULUM RESOURCES AND LINKS

The Teaching with Trout Program is similar to the Trout in the Classroom (TIC) Program. You may find curriculum resources for TIC that are applicable to the Teaching with Trout Program.

National Trout in the Classroom website
There is a wealth of information available here - contains lesson plans and other resources.
https://www.troutintheclassroom.org

Trout in the Classroom Google Group
https://groups.google.com/g/ticsic-national-network

MassWildlife links
https://www.youtube.com/user/masswildlife

https://www.mass.gov/fish-conservation-in-massachusetts

Climate change related resources
https://www.fs.usda.gov/ccrc/education

https://www.globalchange.gov/browse/educators/wildlife-wildlands-toolkit/materials

LICENSE DOLLARS AT WORK

Massachusetts Division of Fisheries and Wildlife (MassWildlife) is responsible for the conservation of freshwater fish and wildlife in the Commonwealth, including endangered plants and animals. MassWildlife restores, protects, and manages land for wildlife to thrive and for people to enjoy.

Did you know that hunting and freshwater fishing license fees and a federal excise tax on hunting and fishing equipment pays for most of MassWildlife's fish, wildlife, and habitat management and its other conservation programs? Since 1938, MassWildlife has partnered with the U. S. Fish and Wildlife Service, sportsmen and women, and the fishing, hunting, shooting, and boating industries to fund fish and wildlife projects through the Wildlife and Sport Fish Restoration Program. Today, this pioneering program serves as a cost-effective model for fish and wildlife conservation by providing fish and wildlife access to those who both funded and directly benefit from the resource—the anglers and hunters. Their contributions through this "user pay, public benefit" conservation model benefit all Massachusetts residents, fish, wildlife, and their habitats.