TroutKids Guide

A manual to help educators implement the TroutKids Program in the classroom

Portland Water District
1 White Rock Road
Standish, ME 04084

For more information:
Contact the Environmental Education Department
sebagolake@pwd.org | (207) 699-5134 ext. 3995

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1 Program Overview

1.1 Background

The Portland Water District (PWD) has coordinated the TroutKids Program since 2006. Students raise brook trout in a classroom tank, creating opportunities to learn about topics such as trout anatomy and physiology, ecology, human impacts, water quality, watershed protection, and Maine's economy. The Program spans four to five months, beginning when classes receive approximately 300 brook trout eggs around late January. Over the next few months, students monitor tank conditions and brook trout development as the eggs hatch and trout grow.

PWD collaborates with the Maine Department of Inland Fisheries and Wildlife (MDIFW) to obtain brook trout eggs for participating schools, and to secure permits to release the trout into local water bodies in the spring. Special equipment, purchased by schools, is needed to support the trout throughout the winter, but many of the costs are one-time purchases; ongoing costs are not substantial.

TroutKids is an incredible learning opportunity with diverse teaching options. PWD commits substantial resources to TroutKids with the expectation that participating teachers will provide a rich, correlated experience for their students. Participants must demonstrate student involvement and related curriculum. The Program is not intended to provide an aquarium as a stand-alone item with no related curriculum. Participants are required to purchase and set up approved equipment and follow the timeline provided.

Any school within the Sebago Lake Watershed or PWD service area may participate in the TroutKids Program. Due to our limited capacity, a select number of classes will receive a fully staffed, free, coordinated trout release. For classes not receiving a PWD coordinated release, teachers must organize their own trout releases, with optional planning support provided by PWD. Planning for trout releases begins in the late winter with trout releases taking place throughout the month of May.

1.2 Requirements

The TroutKids Program is a partnership between PWD and participating teachers – with each partner contributing resources to the successful outcome of students being engaged in environmental science, stewardship, and local water resources.

Portland Water District Responsibilities
PWD will provide the program to a sustainable amount of classes by committing to the following:

- Provide TroutKids Guide with program implementation information
- Select and notify participating schools by November

- Communicate with MDIFW and teachers to coordinate egg delivery
- Drop off trout eggs at participating schools (late January/early February)
- Loan lesson supplies and provide lesson plans for two PWD lessons ("Swim for your Life" and "Benthic Bugs & Bioassessment")
- Secure permits from MDIFW for trout release site and confirm release sites with teachers
- Serve as a resource for questions and support
- For a limited number of classes: coordinate a fully staffed trout release for up to 200 students

Participating Teacher Responsibilities
When deciding whether to participate in TroutKids, please ensure you are committed to completing the following requirements:

- Follow the timeline provided in the TroutKids Guide
- Provide description to PWD of TroutKids Program integration into your curriculum, including how ALL students will be involved in monitoring the tank and trout development
  Note: ALL students that attend PWD-coordinated trout releases are required to have consistent and frequent exposure to trout development and tank maintenance. If you are conducting your release independently, we highly recommend long-term participation by all students.
- Purchase, maintain, replace, clean, and store all necessary equipment
- Set up all equipment so it is operating by early January
- Select release date, calculate and adjust tank temperature to ensure trout are developmentally ready to be released

Additional Teacher Responsibilities for PWD-Coordinated Trout Releases
Students are best prepared when they have received relevant lessons close to the release. The lessons listed are required for this group, but are also available and recommended for teachers conducting releases independently. When deciding whether to request a PWD-coordinated trout release, please ensure you are committed to completing the following requirements:

- Request and transport lesson materials for two required lessons from PWD
- Teach PWD lesson "Swim for Your Life" within 3 weeks of your trout release
- Teach PWD lesson "Benthic Bugs and Bioassessment" within 2 weeks of your trout release
- Ensure a maximum of 50 students per release
- Provide a minimum of 3 school staff to accompany each trout release
- Ensure a minimum of 2 hours on site
- Provide transportation to trout release field trip

1.3 Application Process

It is PWD's goal to provide effective programming to as many students in eligible schools as possible. Teachers that have previously participated in TroutKids will receive a participation interest email from PWD in the late summer/early fall. Determination of which schools receive a PWD-coordinated trout release is based on several variables and teachers will be selected and notified in the fall. Teachers who are interested in participating but have never done so before are encouraged to contact PWD Environmental Education Department (sebagolake@pwd.org) for more information.

1.4 Timeline

The timeline below is to be followed independently by participating teachers.

TROUTKIDS PROGRAM - TEACHER TIMELINE	
Timing	**Tasks**
August	PWD sends participation interest email
September	Teachers indicate interest PWD notifies teachers of participation status
Fall	Teachers check/purchase necessary equipment
Early January	Teachers set up tank so it will run for 3 weeks prior to egg delivery
Early January	PWD emails teachers to update on egg development & estimated egg delivery date Teacher prepares students for tank maintenance tasks
Late Jan./Early Feb.	Delivery Day: PWD delivers eggs to participating classrooms
Winter-spring	Students monitor trout development and tank conditions until release in May Teacher implements related curriculum
March	Trout release coordination begins & teachers select a release date: PWD emails teachers that have been selected for PWD trout release Teachers conducting independent releases begin coordinating release, which may include contacting partners
April-May	Tank temperature adjusted based on release date Teachers teach PWD lessons: *Benthic Bugs and Bioassessment* and *Swim For Your Life!**
May	Release your trout!

***Note: Required for classes attending PWD-coordinated trout releases and recommended for all classes*

2 Tank

2.1 Classroom Equipment

Participating teachers are responsible for purchasing, maintaining, replacing, cleaning, and storing all equipment. We recommend the following:

- Save filter and air pump packaging to store equipment
- Save user's manuals for troubleshooting
- Review user's manuals for set up and care, specifically for the air pump, filter and filter cartridges, and chiller

Startup costs (for both required and recommended equipment below) run around $1,200, with most items being a one-time purchase. Ongoing annual costs are not substantial at about $30 per year. Teachers may apply for a Portland Water District educator grant to support program costs. Many teachers have applied for funding through local and national grants and programs for education, science, environmental education and service learning as well as their school district's educational foundation (or similar).

Chilled and insulated tanks mimic the specialized habitat of sensitive brook trout – dark and quiet with cold, clear, oxygen-rich water. The tables below provide information about required and recommended equipment.

TroutKids Program – Required Equipment			
Equipment	**Approx. Cost**	**Purchase frequency**	**Notes**
Tank	$115	One time	Recommended size: 29 -30 gallons
Table	Varies	One time	Able to support 250 pounds
Chiller	$800	One time; may require maintenance	Price includes shipping Recommended product: Glacier Aquarium Chiller (http://www.glaciercorp.com/Pages/aquarium_chill.html?pgid=5)
Filter	$40	Replace as needed; lasts several years	Recommended products: Tetra Whisper EX45 Power Filter (for 30-45 gallon tanks) or Marineland Bio-Wheel Penguin Power Filter 200 (up to 50 gallon tank)
Filter cartridges	$15/year	Annually	New cartridge installed each month Recommended products: Tetra Carbon Filters fits Whisper Filter EX45 or Marineland Bio-Wheel Penguin Rite-Size C Filter Cartridge

TroutKids Program – Required Equipment, continued			
Equipment	**Approx. Cost**	**Purchase frequency**	**Notes**
Aquarium thermometer	$10	Replace as needed; lasts several years	Must measure to freezing temperatures in both °C & °F Ensures tank temperature is consistent with temperature set on chiller Recommended products: Zacro LCD Digital Aquarium Thermometer or Marina Floating Thermometer
Foam insulation	$40 for 2 sheets	Replace as needed; lasts several years	Keeps tank dark, quiet, and insulated for cold and power efficiency Use 2'x 8' sheets that are 1" thick. Cut to size with razor and surround all 6 sides of tank, including bottom; can purchase fabric to decorate
Aquarium net	$5	Replace as needed; lasts several years	Recommended 4" net with long handle Removes foam from top of water and transfers fry to cooler for trout release
Turkey baster + plastic tubing	$10	Replace as needed; lasts several years	Removes dead eggs from bottom of tank Attach approximately 2'-3' of 0.5" plastic tubing to extend reach
Aerator	$3	Replace as needed; lasts several years	Adds oxygen to water and prevents ice formation when placed beneath chiller coils Recommended product: Penn-Plax Total-Air Aeration Kit
Air pump	$15	Replace as needed; lasts several years	Helps aerator work properly Recommended products: Fusion Quiet Power Air Pump 400 or Tetra Whisper 40 Aquarium Air Pump
Flexible airline tubing	$3	Replace as needed; lasts several years	Connects air pump to aerator
pH test strips	$15 for 100	Annual or check expiration date	Tests pH levels of tank water each day
Water conditioner	$5	Annual or check expiration date	Required for tanks using public water; **trout will die if not added!** Removes chlorine, chloramines, and ammonia from water Recommended product: Seachem Prime
Cooler(s)	$10-$25	Replace as needed; lasts several years	Transports fry to trout release Need 3 of 2 quart size for PWD-coordinated trout releases ($8 each) If putting all trout in one cooler will need to be 2 gallon size ($10)

TroutKids Program – Recommended Equipment			
Equipment	**Approx. Cost**	**Purchase frequency**	**Notes**
Suction cups	$5	Replace as needed; last several years	Secures airline tubing in aquarium; make sure they fit your tubing size
Cheesecloth	$5	Replace as needed	Covers filter to prevent trout getting sucked in; only a small new piece is needed each year
Waterproof tablecloth	Varies	Replace as needed; last several years	Protects table from tank condensation
Insulated elbow depth gloves	$20-$40	Replace as needed; lasts several years	Prevents skin contact with water and insulates hands during tank work
Buckets	$10 for 2	Replace as needed; lasts several years	1 of 5 gallon size with lid; more buckets will assist with initial filling of tank 1 bucket stores conditioned water (chlorine, chloramines, and ammonia removed) for water changes
Magnifying glasses/boxes, hand lenses, petri dishes, rulers	Varies	Replace as needed; lasts several years	Containers and visual aids for student observations
Clipboard	$1	Replace as needed; lasts several years	Holds data collection sheets for trout development and tank inspection
Pitcher	$5	Replace as needed; lasts several years	1 gallon size Stores conditioned water (chlorine, chloramines, and ammonia removed) in fridge to top off tank water with cold water
Air valve distributor	$2 - $5	Replace as needed; lasts several years	Allows you to install multiple aerators from one air pump

2.2 Setting Up

Assemble and operate the aquarium *at least three weeks prior* to egg delivery using these step-by-step instructions.

1. Clean the aquarium and equipment

If you previously operated a tank and thoroughly cleaned your equipment after last year's trout release:

- Any equipment that was in contact with water and fish in a previous year must be wiped down with water each new year. Allow equipment to air dry before assembling.

- Vacuum the outsides of the chiller to remove dust that may have collected during storage.

If you previously operated a tank but did not thoroughly clean your equipment after last year's trout release:

- Wipe all equipment with a 1:10 bleach solution (1 part unscented bleach to 10 parts water) and then rinse everything down with water several times. Allow equipment to air dry before assembling.

If this is your first year:

- Your equipment is brand new and will only need to be wiped down with water. Allow equipment to air dry before assembling.

2. Table
Find a spot for a sturdy table (able to support 250+ pounds) to hold your tank, chiller, and other equipment. The table must be near an outlet, away from direct sunlight, and in a quiet location of your classroom. You may cover the table with a waterproof table cloth.

3. Cut Foam Insulation
Cut solid foam insulation to fit all sides of the tank, including the bottom. Cut a hinging viewing window on the front panel so students can peek in without removing insulation.

4. Tank Placement
Place the tank on the table with the bottom insulation panel beneath the tank.

5. Chiller
Position the chiller unit (the "box", not the coils) to the side or behind the tank, ensuring sufficient space for required airflow (marked on chiller unit). Place the coils into the tank so they hang over the back side into the tank. **Do not plug the chiller in yet.**

6. Air Pump, Aerator, and Airline Tubing
Place the air pump above the aquarium so the power cord includes a drip loop (read user's manual for air pump). Attach one end of the airline tubing to the air pump. Place the aerator on the bottom of the tank underneath the chiller coil. Cut the airline tubing so you can attach the other end to the aerator and minimize excessive airline tubing. If the aerator is not weighted, attach suction cups to the airline tubing so it will remain on the bottom. This aerator placement will reduce ice formation on the coils and improve chiller efficiency. **Do not plug the air pump in yet.**

7. Thermometer
Affix a tank thermometer to the inside of the front of your tank. The best placement for the thermometer is the space of the viewing window cut into the insulation, so students may see it for daily tank inspections.

8. Filter
Assemble the aquarium filter based on the manufacturer's instructions and install so it hangs over the back side into the tank. **Do not plug the filter in yet.**

9. Fill the Aquarium*
Fill the aquarium with water within 1.5 inches of the rim. Be sure that the water covers the chiller coil. PWD tap water contains chlorine, chloramines, and ammonia that ***must*** be removed by adding a water conditioner before the eggs arrive. Letting water sit will not remove these and your trout will die. You may add a water conditioner to any water as it will not adversely affect the trout and provides another level of water readiness. Fill the filter with the conditioned water.

Once the tank is filled, inspect all sides to check for leaks. Fix leaks or replace the tank if you find a leak.

**Some teachers place rocks or gravel at the bottom of their tanks to mimic a natural stream habitat. These additions require more upkeep (they need to be cleaned using a special gravel vacuum) and make it more difficult for students to see developing trout. Success in raising brook trout is not known to be different between tanks with rocks versus no rocks. If you decide to use rocks, we recommend no more than a dozen 2" – 3" sized rocks.*

10. Powering on
With your aquarium filled, plug all electrical equipment in. Plug the chiller directly into the wall outlet. Other equipment can be plugged into a power strip. Equipment is working properly if you observe the following:

- Steady flow of water coming out of the filter
- Constant flow of bubbles coming out of the aerator
- Set the chiller temperature to 3.0°C or 4.0°C. After a few hours, when the chiller unit indicates the water temperature is at your target temperature, ensure the tank thermometer is within 1.0°C of the target temperature. Check to make sure no ice has accumulated on the chiller coil.

If equipment is not working properly, refer to the section below, Verifying Equipment is Running Properly, to troubleshoot.

11. Add Foam Insulation
Attach the rest of the insulation to the tank and secure the panels to each other. Cut out any necessary space from the insulation to fit snuggly around equipment like the filter or chiller. To secure insulation panels to each other and to the tank, use either fabric tape, Velcro tape, or another fastening mechanism. Tank condensation and frequent maintenance and observation may make adherence challenging, so be creative and use strong fasteners!

2.3 Maintenance

Brook trout require clean, pristine water throughout all stages of their life cycle but are most sensitive during the stages they'll be in your care (eyed egg and alevin). While the equipment of your tank mimics a natural, healthy, functioning stream setting, technical difficulties and biological activity will cause changes to your tank's water quality and require your attention. It's the teacher's responsibility to make sure that the tank is inspected daily, with help from your students (guidance for getting students involved described in section 4 Learning About Trout). A Tank Inspection must be completed on the first day after a weekend and on the last day before a weekend.

A Tank Inspection includes the following steps, described in more detail below:

1. Verify Equipment is Running Properly
2. Cleaning the tank
3. Testing Water Quality Parameters
4. Record all findings on Tank Inspection Data Sheet (process described in section 4 Learning About Trout, Record Keeping)

Tank signs, posters, data collection sheets, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

Verify Equipment is Running Properly

Check that all of the equipment is running properly daily by using this checklist:

- ☐ Chiller coil covered by water
- ☐ No ice on chiller coil
- ☐ Thermometer within 1.0°C of the chiller temperature setting
- ☐ Water flowing from filter
- ☐ Filter intake clear of debris
- ☐ Aerator bubbling

If the equipment checks listed below are not meeting expectations, refer to the questions in the Chiller section below to address the issue(s).

- ☐ Chiller coil covered by water
- ☐ No ice on chiller coil
- ☐ Thermometer within 1.0°C of the chiller temperature setting

If the equipment checks listed below are not meeting expectations, refer to the questions in the Filter section below to address the issue (s).

- ☐ Thermometer within 1°C of the chiller temperature setting
- ☐ Water flowing from filter

If your equipment does not meet the following expectation, refer to the questions in the Aeration System (air pump, aerator, and airline tubing) section below to address the issue.

- ☐ Aerator bubbling

Chiller

1. Is the chiller coil completely submerged in water?
Yes – Perfect. Go to question 2.
No – Slowly add conditioned, cold water. The coils were likely covered by ice if they were not completely submerged; continue to question 2.

2. Is the chiller free of ice?
Yes – Perfect. Go to question 3.
No – Turn the chiller temperature up 2.0^{o}C to allow ice to melt; leave it at this setting for no longer than two hours. If ice remains, turn the chiller off to allow ice to melt, but monitor closely. As soon as ice melts, return the chiller temperature to its original setting and check for ice formation. If ice returns, install another aerator underneath the coil. You will need to purchase an air valve distributor. Air bubbles reduce formation of ice.

3. Is the tank thermometer within 1.0^{o}C of the chiller temperature setting?
Yes – Perfect.
No – Contact the chiller manufacturer for assistance.

If your chiller is still not functional after this troubleshooting, PWD may be able to loan you one for the remainder of the winter/spring. You will need to return it after your trout release and purchase a new one for the next year. Contact the PWD Environmental Education Department (sebagolake@pwd.org) for assistance.

Filter

If you unplug your filter to conduct maintenance, remember to plug it back in!

1. Is a steady flow of water coming out of the filter?
Yes – Perfect. Go to question 3.
No – Go to question 2.

2. Does the filter have enough water in it?
Yes – Go to question 3.
No – Fill the filter up with water from the aquarium and ensure a steady flow of water is coming out of the filter. If water is still not flowing, go to question 3.

*3. Does the filter intake, which is hanging in the aquarium, have debris clogging it?**
Yes – Unplug the filter, detach the filter intake and remove the debris. Reattach the filter intake and plug the filter back in. Ensure a steady flow of water comes out of the filter. If water is not flowing, go to question 4.
No – Go to question 4.

**Note: Once alevin begin swimming, we recommend covering the filter intake with cheesecloth secured by a rubber band to prevent trout from being sucked into the filter.*

4. Have you replaced the filter cartridge within 2 – 3 weeks?
Yes – Refer to your filter's instruction manual for additional help.
No – Unplug the filter. Replace the filter cartridge following the user's manual instructions. Pour water from the tank into the filter to fill it and plug the filter back in. Ensure a steady flow of water is coming out of the filter.

If you've resolved all of these issues and are still having problems, you will need to buy a new filter.

<u>Aeration System (air pump, aerator, and airline tubing)</u>
If your aerator is not bubbling, it could be caused by one of the following three issues.

Issue 1. The air pump has died (If the air pump is dead, it will no longer vibrate or hum).
To fix, follow this step:
1. Replace the air pump.

Issue 2. The airline tubing is disconnected from either A. the air pump or B. the aerator, described below.
<u>A. The air pump.</u> To fix, follow these steps:
1. Unplug the air pump.
2. Remove the airline tubing from the tank with the aerator still connected.
3. This issue will likely result in water in the airline tubing. Drain water from the airline tubing first.
4. Connect the disconnected end of the airline tubing to the air pump.
5. Plug the air pump back in.
6. Wait for air to reach the aerator – this will sound and look like bubbling/fizzing on the surface of the aerator – and then put the aerator back into the tank.

<u>B. The aerator.</u> To fix, follow these steps:
1. The disconnected end of the airline tubing should still have air bubbles coming out of it. If this is not the case, your air pump has died (Issue 1), and you need to replace the air pump.
2. Remove the airline tubing from the tank and empty any water that may have entered.
3. Insert the disconnected end of the airline tubing to the aerator.
4. Wait for air to reach the aerator – this will sound and look like bubbling/fizzing on the surface of the aerator – and then put the aerator back into the tank.

If these disconnection issues repeatedly occur, replace your airline tubing.

Issue 3. The airline tubing has water in it.
To fix, follow these steps:
1. Unplug the air pump.

2. Disconnect the airline tubing from the air pump, pull the aerator and connected airline tubing out of the tank, and drain all water out.
3. Reconnect the airline tube to the air pump.
4. Plug the air pump back in.
5. Wait for air to reach the aerator – this will sound and look like bubbling/fizzing on the surface of the aerator – and then put the aerator back into the tank.

Cleaning the Tank
Once the eggs arrive, keeping your tank clean will ensure your trout survive! Cleaning your tank, which is part of the daily Tank Inspection, *must be completed* on the first day after a weekend and on the last day before a weekend. Cleaning the tank includes the following steps, when necessary:

1. Removing Dead Trout
2. Removing Debris
3. Make Water Changes

<u>1. Removing Dead Trout</u>
Removing dead trout will help avoid water quality issues that may occur because of the decomposition process. Daily removal of dead trout helps prevent the spread of fungus or bacteria that may affect more trout if left in the tank. Look for these signs of dead trout:

Egg Stage
- Lack of pink or orange coloration
- Milky white appearance
- Fungus growing on eggs

Alevin/early fry
- Non-moving
- Stiffly curled body
- White yolk sac
- Fungus growing on body

Removal Process
Use the turkey baster* with attached tubing to suction out dead trout. First, get a container ready for suctioned water and dead trout. Use insulated gloves when removing from the tank to avoid bodily contact with the water. Commonly, live trout get mixed in with the dead in this process. Be sure to sort out living trout and return them to the tank. You can compost, flush, or dispose of dead trout in the trash.

**You can practice this process ahead of time using the turkey baster with attached tubing in a bucket of water using items similar in size to trout eggs (beads, frozen peas, etc.). Be sure to clean equipment before using in the tank.*

Normal Mortality Numbers
Your trout are most vulnerable during the eyed egg and alevin stages. Expect to see the highest numbers of mortality during these stages. In a healthy tank with a healthy batch of brook trout, it is normal for 100 – 200 trout to die from the time they arrive to the time they are released. Deaths typically occur in low numbers, gradually. If you are experiencing high mortality numbers even with daily tank cleaning, conduct a partial water change; guidance provided in the section 3. Making Water Changes.

Low, Normal	1 – 15 mortalities daily, on a gradual basis (ex. day one-7, day two-8, day three-2)
High, Abnormal	20 – 30 mortalities daily, repeatedly over several days (ex. day one-30, day two-25, day three-20)

If you are experiencing high/abnormal mortalities or all or most of your trout die quickly, contact the Environmental Education Department (sebagolake@pwd.org). If the mortalities occur during the eyed egg stage, we may be able to request more from MDIFW. Brook trout are too fragile to be transported from the hatchery at any other stage.

2. Removing Debris
Since this is a contained system, there should be little debris. Debris will primarily include foam and egg shells, which typically appear just during hatching. Your tank's filter does not have the ability to keep up with the hundreds of hatching trout so daily cleaning is extremely important to maintain water quality when trout are hatching.

Foam
During hatching, the embryo produces an enzyme that dissolves the egg shell. This results in white foam on the surface of the water. This is normal. Each day during the hatching stage, use the net to remove as much of the foam as possible. The filter will do the rest.

Egg Shells
Just after hatching, egg shells must be removed to prevent the growth of fungus. You can squeeze the turkey baster in the water to loosen the egg shells from the bottom and then use the net or the turkey baster to remove as much as possible.

Filter Intake
Debris from eggs shells and dead trout may stick to and/or clog the filter intake. Some of this can be rubbed off easily with the end of the tubing attached to the turkey baster and then suctioned up. Debris clogging the filter needs a more thorough cleaning. To do this properly, follow these steps:

1. Unplug the filter.
2. Detach the filter intake.
3. Clear the filter intake of debris with a sponge in a sink.
4. Once all debris is removed, use aquarium water to rinse the filter intake.
5. Reattach the filter intake.

6. Plug the filter back in.

3. Making Water Changes

Throughout the months you keep the aquarium running, water will evaporate from the tank, be removed through some of the cleaning processes, and may even need to be removed and replaced (water change) with fresh water. It's important to be prepared to add water to the tank or make water changes.

Tips to be prepared:

- Keep a gallon of water in the fridge that has already had conditioner added to remove chlorine, chloramines, and ammonia
- Keep a 5 gallon bucket of conditioned water by your tank

Follow these guidelines when adding water:

- Only add cold water (as close to the tank temperature as you can get it)
- Only add water that has been conditioned to remove chlorine, chloramines, and ammonia
- Pour water slowly to minimize stirring up the developing trout

Situations that require a partial water change (1/3 to 1/2 of the tank's water) include the following:

- pH levels of water are out of the acceptable range when you test the water
- Ammonia levels of water are out of the acceptable range when you test the water
- Water appears cloudy
- High, abnormal fish mortalities (20 – 30 fish die daily, regularly)

Testing Water Quality Parameters

Even small changes in water chemistry easily affect brook trout. It's important to maintain a healthy tank for the trout. Testing water quality will help you monitor any changes. At a minimum, you should test temperature and pH. Other optional tests that could help you study your tank's water chemistry include ammonia (described below), as well as nitrate and nitrite (not described below).

Temperature

Water temperature affects ammonia and oxygen concentration, as well as trout metabolism. Temperature determines the rate of development. Cold waters slow development while warmer waters increase development rates. A sudden increase or decrease of 3.0^{o}C within a 15-minute period can create major problems for eggs and alevin. When adding water or making water changes, follow the water change guidelines described above to reduce your impact to the trout. Monitoring temperature will help you estimate hatch timing and adjust your tank's settings to ensure your trouts' development coincides with your release date.

Use a standard aquarium thermometer or a digital thermometer to monitor the water temperature. This is referred to as your "tank thermometer".

Recommended temperature range for egg and early alevin stage: 3.0ºC – 4.0ºC
Temperature range for late alevin to fry stage: 4.0ºC –11.0ºC*
Adjust chiller settings to maintain the target temperature

**Note: These temperature adjustments are dependent on your release date. Refer to section* 5.4 Preparing Trout for Trout Releases *for detailed instructions on adjusting your tank's temperature to ensure your trout are ready to release.*

pH
Measuring pH (the hydrogen ion concentration, [H+]) indicates the water's acidity or alkalinity. The pH values range from 1 – 14. Pure, pH-balanced water has a value of 7. Any number less than 7 is acidic. Any number more than 7 is basic or alkaline. Acidic water (low pH) irritates gills, causes excess mucus production, and reduces the gills' ability to exchange oxygen.

Use litmus paper strips or a pH test kit available from aquarium supply stores to monitor pH.
Acceptable pH levels for brook trout: 6.5 – 7.5
Combat pH results outside of the acceptable range with a partial water change (1/3 to 1/2 of all tank water) – see water change guidelines in the section 3. Making Water Changes

Ammonia
Trout continually release ammonia directly into the aquarium through their gills, urine, and solid waste*. Decaying organic matter also adds ammonia to the water. At pH levels above 7, the ammonia increases its concentration. Ammonia is highly toxic to fish. High levels can cause gill damage, anemia, and even death. In nature, plants and plankton reabsorb the ammonia waste, eliminating the problem of high levels. Operating your tank at least three weeks prior to trout arrival allows a healthy level of bacteria to grow in your tank's filter that will help eliminate ammonia.

Monitor ammonia levels with a test kit available from an aquarium supply store.
Acceptable ammonia level for brook trout: 0 - 1
Combat ammonia levels outside of the acceptable range with a partial water change (1/3 to 1/2 of all tank water) – see water change guidelines in the section 3. Making Water Changes

**Note: Because we strongly advise against feeding trout in the TroutKids Program, ammonia levels are easily manageable. The only time you should detect a noticeable difference is when the eggs hatch, releasing ammonia products found in the embryonic fluid into the aquarium.*

2.4 Post-Trout Release: Cleaning and Storing

After the trout release, it is important to clean your aquarium set-up in order to ensure another successful year. If you take a few minutes to make sure everything is clean, your equipment will have a much longer life and set-up next year will be easier. Store equipment in a cool, dry, safe place. We recommend storing TroutKids equipment together and in original packaging when possible.

Here are a few pointers for cleaning various components of your aquarium set-up:

Aquarium
1. Turn off electrical equipment (air pump, chiller, and filter) and then empty the aquarium of water.
2. Disconnect all tubing.
3. Use a 1:10 bleach solution (1 part bleach and 10 parts water) to wipe down the interior and exterior of the aquarium.
4. Thoroughly rinse the aquarium with water and wipe dry with clean cloth, or let air-dry.
5. If you used rocks, soak them in the solution from above, rinse them thoroughly with water, and then dry them by laying them out on a cloth or towel in the sun or ventilated area.

Chiller
1. Use a 1:10 bleach solution to wipe off the chiller coils that were submerged in the aquarium.
2. Your chiller will run more efficiently if you clean the lint and dust from the chiller unit (the "box" not the coils). This can be accomplished using a small vacuum cleaner, dusting cloth, or soft bristle plastic dust brush.

Filter
1. Dispose of the filter cartridge most recently used.
2. Take apart your filter and scrub the plastic parts with a 1:10 bleach solution.
3. Thoroughly rinse all parts with water.
3. Air-dry entire filter apparatus.

Aerator
1. Soak the aerator unit in a 1:10 bleach solution.
2. Thoroughly rinse the aerator with water.
3. Air-dry the aerator.

Airline Tubing
1. Use a 1:10 bleach solution to clean the inside and outside of the tubes. You may use long brushes to clean the inside of the tubing or soak in the bleach solution.
2. Thoroughly rinse the tubing with water.
2. Allow tubing to air dry.

3 Student Role in Tank Maintenance

In order to include students in tank maintenance, teachers should be very familiar with all that is included in the care of the tank. We strongly recommend that teachers thoroughly read the previous section, 2.3 Maintenance, before including students in tank maintenance.

Maintaining the tank and monitoring trout development (described in section 4.1 Monitoring Trout Development) should be a responsibility shared by teachers and their students. While coordinating this program for decades, we have observed a noticeable difference in student engagement and learning with consistent involvement in tank and trout related activities. Students who have been responsible for keeping trout alive for several months feel a deep sense of pride and ownership, leading to stewardship of our local water resources.

3.1 Tank Inspection

Students should conduct the daily Tank Inspections (read more details in the section 2.3 Maintenance). Assign the task to individual students or rotate it among small groups of students. The inspection includes the following, with ways to involve students described in more detail below:

1. Verify equipment is running properly
2. Clean the tank
3. Test water quality parameters you will monitor
4. Record all findings on Tank Inspection Data Sheet

Prior to trout delivery day, instruct students how to conduct an inspection of the tank. A Tank Inspection must be completed on the first day after a weekend and on the last day before a weekend. A daily inspection provides the most learning opportunities for students and the healthiest tank environment. Teachers should fill in if students' schedules do not allow a daily inspection.

Before students conduct the Tank Inspection, review behavior guidelines with your students. We recommend posting the guidelines, below, near the tank. A template tank sign available in the TroutKids Google Drive includes steps of the inspection (stated above) and the code of conduct below:

- Only gloved hands may enter the tank
- Expose trout to natural light for a maximum of 15 minutes
- Use quiet voices and controlled bodies around the brook trout
- If any equipment needs maintenance, inform the teacher
- If any water quality results are out of the acceptable range, inform the teacher

Tank signs, posters, data collection sheets, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

Equipment Checks
Before the trout arrive, review all aquarium equipment with your students and point out features of properly running equipment:

- Chiller coil covered by water
- No ice on chiller coil
- Thermometer within 1.0^{o}C of the chiller temperature setting
- Water flowing from filter
- Filter intake clear of debris
- Aerator bubbling

If the tank equipment does not meet all criteria, students should inform the teacher.

Cleaning the Tank

Removing Dead Trout

Regardless of how well your students conduct inspections and maintain the tank, some brook trout will die. Inform your students of these signs of dead trout:

Egg Stage

- Lack of pink or orange coloration
- Milky white appearance
- Fungus growing on eggs

Alevin/early fry

- Non-moving
- Stiffly curled body
- White yolk sac
- Fungus growing on body

Removal Process

Students, or the teacher, can remove dead eggs, alevin, and fry by using the turkey baster attached to tubing if they have practiced first (see below). Use insulated gloves for this process to avoid bodily contact with the water. Improper turkey baster suctioning technique could harm surrounding trout. Commonly, live trout get mixed in with the dead in this removal process. Be sure to sort out living trout and return them to the tank. You can compost or flush dead trout. You can also dispose of dead trout in a trash can but be sure it's removed frequently to avoid a bad odor.

Students can practice removal techniques by putting items similar in size to trout eggs (beads, frozen peas, etc.) in a bucket of water. They can use the turkey baster and attached tubing to remove some items and transfer them to another container and put "live trout" back in the bucket.

Normal Mortality Numbers

Deaths typically occur in low numbers, gradually. If students are recording high mortality numbers, they should report results to the teacher.

Low, Normal	1 – 15 mortalities daily, on a gradual basis (ex. day one-7, day two-8, day three-2)
High, Abnormal	20 – 30 mortalities daily, repeatedly over several days (ex. day one-30, day two-25, day three-20)

Removing Debris

Students can easily use the net to remove foam that collects on the surface during hatching and, if adept with turkey baster suctioning, can remove egg shells that settle on the bottom using the turkey baster. If there is debris on the filter intake pipe, students should inform the teacher.

Making Water Changes

We recommend teachers take on this responsibility.

Testing Water Quality

Review procedures for water quality testing with students before they begin. Students should practice each test before the trout arrive. Review the acceptable ranges for all water quality parameters being tested; these are available in the section Testing Water Quality. Students should report any results that are out of the brook trout acceptable range to the teacher. At a minimum, students should test the following water quality parameters of the tank:

- water temperature
- pH

Optional tests:

- ammonia
- nitrate
- nitrite

Acceptable ranges:

- Temperature range for egg and early alevin stages is 3.0°C – 4.0°C
- Temperature range for late alevin to fry is 4.0°C –11.0°C*
- Acceptable pH levels for brook trout: 6.5 – 7.5
- Acceptable ammonia level for brook trout: 0 – 1

**Note: These temperature adjustments are dependent on your release date. Refer to section* 5.4 Preparing Trout for Trout Releases *for detailed instructions on adjusting your tank's temperature to ensure your trout are ready to release.*

Tank signs, posters, data collection sheets, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

Record Keeping

Show students how to fill out a Tank Inspection Data Sheet. Feel free to modify our template or create your own. Students who conduct the inspections should share their data with all students in an easily accessible location (leave data sheet on a clipboard by tank, write it on the

white board, share it on a blog, or report in Google Classroom, etc.). Teachers should make regular review part of their curriculum so all students are involved frequently in the program, regardless of if they are conducting inspections.

At a minimum, you and your students should be recording the following information on the Tank Inspection Data Sheet:

- Date
- Names of data collectors
- Equipment maintenance
- Mortalities
- pH
- Water temperature

Additional, optional data to include on the inspection data sheet:

- Water changes or additions
- Other observations

Tank signs, posters, data collection sheets, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

4 Learning About Trout

TroutKids is an incredible learning opportunity with diverse teaching options. At a minimum, we recommend students connect to their trout through monitoring and observing trout development and learning about their life cycle; these activities are detailed in this section of the Guide. Teachers may incorporate additional topics such as trout anatomy and physiology, ecology, human impacts, water quality, watershed protection, and Maine's economy into their curriculum. PWD has lesson kits available to loan that relate to these topics. Information about these and other resources are found in the section 4.4 Teacher Resources.

4.1 Monitoring Trout Development

In order to be sure your trout reach the releasable fry stage by the release date AND to avoid feeding your trout, trout development must be monitored. This is a crucial part of the program without which your trout will not be ready for release. By closely monitoring trout development, students and teachers can also predict when new life cycle stages will be reached (read more in the section 4.3 Brook Trout Life Cycle – What to Expect in Your Tank). Monitoring development connects life cycle, adaptations, math, responsibility, and is an authentic learning experience. We recommend incorporating the process (described below) into the daily Tank Inspection.

Total Thermal Units

Trout development is controlled by temperature. You will track development using "Thermal Units" (TU), a unit of measurement related to your tank temperature. A single degree Celsius is equivalent to one thermal unit. Therefore, the temperature of the tank in a single day is equivalent to the "Daily Thermal Units" (DTU). Development is cumulative and expressed as their "Total Thermal Units" (TTU).

When your eggs are delivered, you will receive the TTU of your trout. This number was calculated by Maine Department of Inland Fisheries & Wildlife (MDIFW) using the same method you will use. From the day you receive your eggs, you will add your DTU to the TTU provided and record progress on a data collection sheet. You may use our templates or create your own.

<u>Predictable Developmental Stages</u>

Trout reach the following stages at the total thermal units (TTU) below:

300 TTU	Strongly eyed (stage near delivery day!)
425 TTU	Nearly all hatched
750 TTU	Releasable fry (when trout are ready for release!)

<u>Calculating Total Thermal Units (TTU)</u>

1. On the Trout Development Data Sheet, record the water temperature in degrees Celsius.
2. For every 1.0°C, record 1.0 Thermal Unit (TU) as your Daily Thermal Units (DTU).
   Example. 3.2°C = 3.2 DTU
3. Add the current day's DTU to the previous day's TTU for the current day's TTU.

Trout Development Data Sheet

Thermal Units

For every 1.0°C, record 1.0 TU as your DTU.
Example. 3.2°C = 3.2 DTU

Date	Recorders	Temp. °C	Daily Thermal Units (DTU)	Total Thermal Units (TTU)	Notes
1/13	MDIF&W			298.0	Delivery Day!
1/14	Sam, Izzy	3.2	3.2	301.2	Strongly eyed, bright orange
1/15	Sam, Izzy	4.0	4.0	305.2	Strongly eyed still

Sample of recording data on Trout Development Data Sheet

Tank signs, posters, data collection sheets, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

4.2 Observing Trout

Trout can be transferred from the tank into a clean, clear container (beaker, cup, petri dish) filled with tank water for student observations. In order for students to notice the developmental changes, we recommend conducting observations once or twice a week. Teachers should incorporate regular trout observation into their curriculum for all students.

Follow these guidelines when observing trout outside of the tank:

- Use the turkey baster with attached tubing to gently suction a few to observe
- Transfer trout into a clean, clear container with tank water
- Place container on a white surface for best observation conditions
- Be quiet and gentle around the observed trout
- Return the observed trout to the tank within 15 minutes

Students can keep a journal of development, take and post photos, or complete other projects related to brook trout development from eyed egg to alevin to fry. They can look for, write about, and/or sketch the trout throughout development looking for anatomical changes and adaptations described in the next section.

4.3 Brook Trout Life Cycle – What to Expect in Your Tank

Your students will be caring for brook trout during the earlier stages of their life cycle. Learning about their entire life cycle is an important part of the TroutKids Program and classroom tank experience. Brook trout are a sensitive species that require cold, healthy, oxygen-rich water to survive. Focusing on these necessities in their life cycle links brook trout to human impacts and local resources.

Brook trout begin their lives in cold, freshwater streams. As they mature, they migrate downstream and live in rivers, ponds, lakes, and even marine habitats. Water temperatures drive the development of brook trout; colder temperatures slow their development while warmer water increases growth rates. Trout dwelling in colder waterbodies develop slower and are smaller than trout in warmer, larger waterbodies that develop faster and reach greater sizes. Adult fish move upstream to reproduce by spawning, beginning the life cycle for the next generation of brook trout.

Spawning Adults

Spawning in Maine peaks during late November. The shortened days and colder fall temperatures act as a signal for mature adults, typically two years old, to seek out suitable spawning habitat upstream. Important features of spawning grounds includes a gravel bottom

and groundwater seepage. Trout commonly select streams or shallow rivers where the eggs will be unaffected by freezing water due to the flow of groundwater. Some brook trout may remain in lakes if gravel and groundwater seepage is present.

Spawning males develop a hooked jaw, known as a kype, and a more vividly red stomach compared to the females. Males defend a female for the chance to fertilize eggs she deposits. The female constructs a redd, a nest-like depression, by fanning the gravel with her caudal (tail) fin. She lays some of her eggs in this redd and nearby adults, and sometimes juvenile males, fertilize the eggs with a cloud of milt. Then, the female moves upstream to create another redd and deposit more eggs. The gravel from one spawning settles downstream covering the previously laid eggs. Females continue this process until they deposit all their eggs. Females lay between 500 and 5,000 pea-sized eggs. The number of eggs produced increases as the size of the female increases.

Because many spawning habitats freeze at the surface of the water and can be covered in snow, fewer predators pose a risk to the developing eggs. Adult brook trout play no role in caring for the eggs or offspring.

<u>What to Expect in Your Tank:</u>

- Tanks mimic the specialized habitat of sensitive brook trout – dark and quiet with cold, clear, oxygen-rich water.
- Tank insulation acts like the ice and snow that would block out sunlight and noise.
- The chiller maintains cold water temperatures that would occur during the winter.
- The filter removes impurities replacing functions of the surrounding forest and stream current.
- The water flowing from the filter and the oxygen added by the aerator create an oxygen-rich environment.
- Spawning brook trout use gravel to construct a redd, within which the defenseless eggs and alevin are protected. The tank has no predators. Some teachers decide to put rocks/gravel at the bottom of their tanks to mimic a natural stream habitat but we recommend a bare-bottom tank because it requires less maintenance.

Eyed Eggs

Eggs remain just below the gravel of the redd throughout the winter months. Groundwater seepage provides the eggs with a constant flow of cold, oxygenated water, preventing freezing and delivering necessary oxygen to the trout, which they absorb across the egg shell. Trout reach the eyed egg stage once the dark eyes and spine of the developing trout within become visible through the egg. This stage typically occurs around December or January. Movements of the tiny trout inside can be seen and eggs will often roll around in the gravel.

<u>What to Expect in Your Tank:</u>

- Eggs are delivered to TroutKids schools at this stage of development. Eggs can be weakly eyed to strongly eyed which is distinguished by the brightness of the orange egg and the

prominence of the dark eyes. Darker eyes and brighter orange indicate a more strongly eyed egg.

- The egg shell is transparent! Encourage students to observe the eggs for a few minutes to witness trout movement within. If you have a microscope to use, students could even see blood movement through the egg.
- Eggs are the size of a pea when females deposit them in the redd. They grow larger as they develop and you can easily measure their growth.
- Trout should be strongly eyed around 300 Total Thermal Units (TTU) - read more about this in the section 4.1 Monitoring Trout Development

Alevin (pronounced al-eh-vin)
In late winter, trout hatch from their egg at the point when they can no longer get enough oxygen through the egg shell. Newly hatched trout, known as alevin and also referred to as sac fry, initially lack fins and a mouth. The average length of a newly hatched alevin is half an inch. The round yolk sac protruding from their underside provides their required nutrients. The absorbed nutrients aid in growth and the development of fins and a mouth. Trout squirm and wiggle but remain in the protective gravel of the redd until nearly all of the yolk sac's nutrients are absorbed.

<u>What to Expect in Your Tank:</u>

- Historically, trout have begun hatching anywhere from 340.0 TTU to 450.0 TTU; this can vary from year to year.
- It may take two to three weeks for all of the alevin to hatch. This provides plenty of opportunity to observe the unique methods of hatching: head first, tail first, yolk sac first!
- Trout are generally nearly all hatched around 425 Total Thermal Units (TTU) – read more about this in the previous section, 4.1 Monitoring Trout Development.
- In a natural stream habitat, the current would flush egg shells, and the enzyme released from the egg during hatching, downstream. Your tank's filter does not have the ability to keep up with the hundreds of hatching trout so daily cleaning is extremely important to maintain water quality when trout are hatching.
- Your tank may not have gravel or rocks for trout to squirm and remain hidden in, but you will notice that the alevin huddle together and do so near the edges of the tank as if instinctively they know to hide near an object.
- Almost every tank reports a two-headed trout so be on the lookout for one in yours. This is a common genetic mutation seen even in wild populations of brook trout. We may see more in the TroutKids Program than in the wild. Although MDIFW attempts to maintain genetic diversity in their system by not breeding immediate family members, a higher incidence of mutations exists in most aquaculture situations due to some level of inbreeding.
- When students frequently observe alevin, they can notice subtle changes as more and more nutrients are absorbed from the yolk sac, including:
    - Fins developing

    - Mouth developing
    - Size and shape of the yolk sac
    - Length of alevin
- During this stage, and depending on your trout release date, you will begin increasing the tank temperature. Read more about this process in the section 5.4 Preparing Trout for Trout Releases.
- When the yolk sac is almost completely absorbed and fins are well developed, the trout will begin swimming up searching for food that would be flowing or swimming in the water. Some refer to this phase of the alevin stage as swim-up fry.
- Once some of your alevin begin swimming, we recommend covering the filter intake with cheesecloth secured by a rubber band to prevent trout from being sucked into the filter.

Fry

When brook trout leave the gravel redd in the spring, they have reached the fry stage of development. At this point, they have absorbed all nutrients from the yolk sac and will need to find food in their aquatic habitat. Fry measure about one inch in length. Their size makes them vulnerable to predation by other wildlife and nearby adult brook trout. Fry seek shelter from predators and other territorial trout fry in calm, shallow areas of stream edges underneath stones, rocks, and vegetation. The diet of trout fry includes microscopic life and tiny crustaceans and larval insects.

<u>What to Expect in Your Tank:</u>

- In a natural stream habitat, fry emerge from the redd in spring. Similarly, your trout will leave the protection of the tank in May. It's important to progressively remove the insulation so they become accustomed to more sunlight. Read more about this process in the section 5.4 Preparing Trout for Trout Releases.
- You will release your brook trout at this stage of development! The closer to the transition from alevin to fry the better.
- Even though many of your trout will be swimming in search of food, we strongly advise against feeding trout. Feeding them will create a lot of solid waste that requires a more intense filtering system than we recommend. You may lose a fry or two as you wait for your trout release, but it is preferable to lose a few trout over creating waste in the tank.
- Trout are developmentally ready to survive outside the protection of the redd, swim against gentle currents, and find their own food when they've reached 750 TTU. Read more about this in the previous section, 4.1 Monitoring Trout Development.

Parr

As trout grow to the parr stage, also known as the fingerling stage, they develop dark vertical bars on their sides known as parr markings. These markings persist through the juvenile stage and provide camouflage. Trout at this stage are still small, growing one to three inches in length. Parr require similar habitat for shelter as trout in the fry stage but can cope with slightly deeper and faster water as they grow. Parr engage in more instream movements, often

downstream, to find suitable food, territory, and water quality. They feed on small crustaceans and larval insects.

Juvenile
By the end of their first summer, trout reach the juvenile stage and grow to an average length of three to four inches. Juveniles retain parr markings while subtle yellow, wavy, wormy lines, known as vermiculations, and colorful spots develop on their sides. Juveniles swim up and downstream frequently. Food availability, water temperatures, oxygen levels, and competition influence their movements up and downstream. Trout remain in the juvenile stage until they are mature enough to reproduce. This timing varies and is dependent upon habitat conditions.

Adult
Mature adult brook trout, typically aged one to three years, often grow to about a foot in length, but can vary from 7.5 to 17.5 inches. Adults display the beautiful coloration distinct to brook trout. The fins on the dorsal side of the trout have obvious vermiculations on their surfaces. The sides have iridescent blue spots, large yellow spots, and some small red spots encircled by blue. The white front edge of each of the lower fins is contrasted by a black stripe edging into the reddish colored fin. At this stage, their diet consists of nearly any aquatic or terrestrial invertebrate or vertebrate that will fit into their mouth, but primarily includes insects and, to a lesser degree, fish. Adult trout can move into larger rivers, ponds, lakes, and even the ocean.

4.4 Teacher Resources

PWD Resources
Please contact the Education Department (sebagolake@pwd.org) to learn more about the PWD resources described below.

Teacher Consultation
PWD education staff is available to help teachers implement the TroutKids Program, and can provide consultations to teachers. Support often includes helping new teachers set up tanks for the first time, providing an overview of the program, budgeting information and equipment lists, and assisting with the design of trout release field trips.

Grants
Education grants are available from PWD. Funds may be used for supplies, curricula, field trip transportation, and other resources related to TroutKids or other water-related education. Individuals can receive a maximum of $200 while a collaborative group of three or more educators can receive up to $500. Learn more/apply: https://www.pwd.org/water-education-grants

Drop-in Lessons
PWD education staff visit schools to provide hands-on activities related to various topics, including water pollution, stewardship, watersheds, water quality, brook trout life cycle and

survival requirements, and more. Requests must be received a minimum of six weeks in advance and availability is limited.

Loanable Resources
PWD loans educational resources to support students' learning about water. We offer complete lesson kits with lesson plans, field equipment, sampling supplies, models, and more. Requests must be received two weeks ahead of time and may be borrowed for up to two weeks; availability may be limited. Learn more: https://www.pwd.org/loanable-water-education-resources

Discovering Water
Discovering Water, a book about water written for a middle school audience, was a collaborative effort between Windham High School students and staff, PWD, and other local schools. A full chapter is focused on brook trout. Learn more/accessibility info: https://www.pwd.org/educator-resources

Local Partners
PWD may provide contact information for partner organizations able to assist with your trout release or other related learning. Local organizations may include land trusts, water quality monitoring groups, municipal staff that work with stormwater compliance, staff from statewide natural resource related agencies (ex. Maine Dept. of Environmental Protection, MDIFW, etc.), and high schools or colleges (Earth Science, Aquatic Ecology, or Biology students, etc.). Many of these organizations provide public education about water resources.

Access to Trout Release Google Resources
Trout release data sheets, sample schedules, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

Maine Department of Inland Fisheries and Wildlife

Hatchery Support
MDIFW hatchery staff may be able to work with schools to provide tours of hatcheries, fish stocking events at local waterways, and classroom presentations. Availability depends on facility structures and staffing levels, which vary at each hatchery. Local, state-owned hatcheries and their supervisors (list created in 2019) are listed below. Visit the MDIFW website for more information: http://www.maine.gov/ifw/about/contact/department-directory.html#fishhatcheries

Casco Hatchery
Steve Tremblay, Supervisor
Stephen.Tremblay@maine.gov
207-627-4358

Dry Mills Hatchery (Gray)
Greg Bell, Supervisor
Greg.Bell@maine.gov
207-657-4962

New Gloucester Hatchery
Tim Knedler, Supervisor
Tim.Knedler@maine.gov
207-657-3423

Teacher References

Bonney, Forrest, 2007. Squaretails: Biology and Management of Maine's Brook Trout. Maine Department of Inland Fisheries and Wildlife. Augusta, Maine. 165 pp
https://www.amazon.com/Squaretails-Biology-Management-Maines-Brook/dp/0979436303

Bonney, Forrest, 2006. Maine Brook Trout: Biology, Conservation, and Management. Maine Department of Inland Fisheries and Wildlife. Augusta, Maine. 153 pp
https://www.amazon.com/Maine-Brook-Trout-Conservation-Management/dp/B003AP6QM8/ref=sr_1_2?qid=1580997978&refinements=p_27%3AForrest+Bonney&s=books&sr=1-2&text=Forrest+Bonney

Maine Department IF&W: https://www.maine.gov/ifw/docs/Biology_and_Management.pdf

Related Curriculum

Trout Unlimited Trout in the Classroom lesson plan ideas:
http://www.troutintheclassroom.org/teachers/lesson-plans
Note: Many Trout in the Classroom programs differ from PWD's TroutKids program. In particular, the tank set up for TrouKids differs, so do not use their tank set up resources. The link above is for relevant lesson plans.

Aquatic Wild Aquatic: https://www.fishwildlife.org/afwa-inspires/project-wild/aquatic-wild

Healthy Water, Healthy People: https://store.projectwet.org/water-quality-educators-guide.html

Project WET: https://www.projectwet.org/
Must attend a Project WET workshop to receive curriculum; Maine Project WET Coordinator is Cami Wilbert, cami@watershedfriends.com

5 Trout Releases

Trout are ready to be released into their new homes in May. Students may participate in outdoor field trips called “trout releases” where trout fry are released into local streams and rivers. PWD obtains permits to release trout into these water bodies from the Maine Department of Inland Fisheries & Wildlife (MDIFW). Trout releases can follow many formats, offering students an opportunity to extend learning about brook trout and their survival requirements.

This section covers release site conditions, the format of a PWD coordinated trout release, suggestions for teachers who are designing their own trout release, and preparations for students, trout, and teachers that will yield successful trout releases.

5.1 Release Sites and Permits

Release Permits
MDIFW permits the release of brook trout into certain water bodies where water quality and habitat are suitable, and where stocked populations will not interfere with native, wild populations. In general, rivers with wild populations are more common in northern locations and releasing stocked fish, including those in the TroutKids Program, is not permitted.

PWD will secure release permits from MDIFW for schools participating in the TroutKids Program, and communicate with schools about release site selection and permit approval. This process begins in November when PWD requests release site preferences from teachers, and then emails the information to MDIFW. Once approved, PWD will email MDIFW permits to all participating teachers. All teachers must receive this approval to release their trout into any receiving water body.

Release Sites
In 2019, MDIFW indicated the water bodies below, in the Greater Portland area, would be suitable for releasing brook trout fry and would receive release permits:

Town	Water body
Gorham	North Branch, Little River
Gorham	Presumpscot River, Gambo & Dundee areas
Gray	Collyer Brook
Falmouth	West Branch, Piscataquis River
Raymond	Rolfe Brook, lower end
Scarborough	Nonesuch River
South Portland	Trout Brook
South Portland	Red Brook, lower mile
Westbrook	Mill Brook
Windham	Pleasant River

Other water bodies may receive permits as well. Contact the Environmental Education Department (sebagolake@pwd.org) to inquire about a different site.

Although the above water bodies would be permitted through MDIFW, not all rivers have spots suitable to bring students on a field trip. In 2019, PWD created a map of potential trout release sites using the following criteria:

- Safety: no major road crossings and student access areas are away from busy roads
- Area for bus access and turnaround
- Flat and accessible spots in woods for learning stations to be set up, suitable distance between areas to enable successful learning (noise/distractions), and students able to walk easily between spots during station rotations
- Trail available for streamside assessment hike, with different features to evaluate
- River accessible and safe for trout release in multiple locations

Please note all sites should be visited ahead of time to determine suitability for students with limited mobility

The map is available here:
https://drive.google.com/open?id=1bbTVGYNS_fzOvFWEcvIKEoJ1mqT-5XD_&usp=sharing
A users' guide for the map will be available soon.

5.2 Releases Coordinated by PWD

A select number of schools will participate in trout release field trips coordinated by PWD. Schools will receive notification of participation in the fall. Field trip coordination efforts begin in March, when teachers will be asked to provide information about availability, trip timing, student numbers, and other details. Release dates will be confirmed by April, with trout releases scheduled throughout the month of May.

Format
At the PWD release, three groups of students rotate through three different stations, with each station lasting approximately 25 minutes. Students conduct tests and evaluate waterbody and watershed characteristics to determine if the release site is suitable for their trout. Stations are staffed by scientists, educators, conservation professionals, and volunteers from PWD, state and local governmental organizations, environmental nonprofits, and local communities.

Trout release data sheets, sample schedules, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

The three stations include:

- Water quality testing: chemical & physical – conduct pH, temperature, conductivity, dissolved oxygen, and turbidity tests and compare results to trout requirements
- Water quality testing: bioassessment – identify and quantify macroinvertebrates from the water body and determine water quality based on data
- Streamside assessment hike – evaluate land and river characteristics that contribute to water quality

During the last rotation, students evaluate all data to determine whether the water body will support their brook trout. If they decide conditions are favorable, each student releases at least one of the classroom trout into the stream or brook.

PWD Trout Release Requirements

- Teachers must teach students two PWD lessons within three weeks of their trout release: "Benthic Bugs & Bioassessment" and "Swim for Your Life"
- Trout have reached "Releasable Fry" stage of development on release day
- Maximum number of 50 students per release
- Minimum of two hours for instruction at the site (excluding travel/snack/lunch time)
- Transportation provided by the school
- Minimum of three trained school staff attend release (recommend at least three additional chaperones, either from school or parent/guardian chaperones, for a total of six)

5.3 Releases Organized by Teachers

Schools that do not participate in a PWD-coordinated trout release can conduct their own meaningful experience. Trout release formats and classroom learning vary depending on teachers' abilities, interests, resources, and needs.

PWD Support

PWD education staff (sebagolake@pwd.org) is available to support all participating teachers with trout release planning. Support may include teacher consultations, loanable water quality monitoring and bioassessment gear, loanable lesson kits, contact information for partner organizations, grant funds for equipment and field trip transportation, and more. Read more about these services in section 4.4 Teacher Resources PWD Resources.

Trout release data sheets, sample schedules, and other resources can be found in the TroutKids Google Drive folder: https://drive.google.com/open?id=1bsdEtbf_-6XT9SLPRFw8y_CcN8UAHa9A

Release Format Options
Teachers can decide how to assess data before releasing trout, and how they'd like to collect it. Release experiences can range widely, from all student learning occurring in the classroom and the teacher independently releasing trout to planning a release similar to that coordinated by PWD; many options exist!

This section provides examples of different models, all of which are based on collecting the same type of data students obtain at a PWD release. At these field trips, students evaluate the water quality and streamside characteristics of the receiving water body through three stations, which include:

- Water quality testing: chemical & physical – conduct pH, temperature, conductivity, dissolved oxygen, and turbidity tests and compare results to trout requirements
- Water quality testing: bioassessment – identify and quantify macroinvertebrates from the water body and determine water quality based on data
- Streamside assessment hike – evaluate land and river characteristics that contribute to water quality

During the last rotation, students evaluate all data to determine whether the water body will support their brook trout. If they decide conditions are favorable, each student releases at least one of the classroom trout into the stream or brook.

Below are examples that have been successful at area schools. Teachers may choose to follow one of these, combine models, or make up their own format! Please tell the Education Department (sebagolake@pwd.org) what you did and how it worked so they may share new formats with participating teachers!

<u>Model 1: Teacher Releases Trout</u>
One model involves the teacher releasing trout without students attending the release at all. If the release site has been approved by MDIFW, it is suitable for the trout. Teachers may choose to select this option if a field trip is not feasible. Classroom learning experiences with just the trout tank is an incredibly valuable experience in and of itself.

Teachers may choose to supplement this experience by assessing the water quality of the release site on their own when they release the trout and sharing data with students. Or they may bring water and macroinvertebrates collected from the water body into the classroom for students to assess. See below for more information about these experiences.

<u>Model 2: Classroom Assessment</u>
Teachers may collect water and/or macroinvertebrate samples from their release site for students to test and analyze in the classroom – effectively bringing the outdoors inside. Classroom investigations may be spread over several days, potentially creating a deeper learning experience than a two hour field trip could provide.

Teachers can assess both macroinvertebrates and the chemical/physical water parameters or just one in the classroom. Students can then collect the remaining data at the release site before reviewing all data and releasing their trout. This makes field trip coordination easier – teachers will likely need less time, equipment, chaperones, and instructors.

This model was successfully used in 2019 in two different ways:

Format 1:
Classroom: Water quality: physical and chemical parameters
Outdoors: Water quality: bioassessment, streamside assessment hike, trout release
Support: PWD grant to purchase equipment, field trip support from a local land trust

Format 2:
Classroom: Water quality: physical and chemical parameters & bioassessment
Outdoors: Streamside assessment hike, trout release
Support: Loaned PWD equipment, in-class and field trip support from additional school staff and town's Environmental and Sustainability Coordinator

If teachers are unable to bring students to the release site at all, if they can only bring them for the trout release itself, or if they'd like to dive more deeply into the content, they could also assess streamside characteristics in the classroom. Students could use aerial mapping tools (e.g. Google maps) and photos or video taken by the teacher to assess pollution sources, nearby land uses, vegetation cover, etc.

Notes:
When collecting water samples, teachers must take the temperature and dissolved oxygen measurements onsite as these are only accurate when taken in the water body; data is then shared with students.

Macroinvertebrates should be collected the morning of the bioassessment and returned as soon as possible to increase rates of survival. If using all day for several classes, return samples and obtain more for the afternoon or consider ways to keep water cool and oxygenated throughout the day.

<u>Model 3: Outdoor Assessment</u>
Another model involves a trout release experience like those coordinated by PWD where all investigations and the release occur outdoors, at the release site, and with student involvement. Students should learn content specifically related to their trout release activities in the classroom beforehand (read more in section 5.5 Preparing Students for Trout Releases). PWD may be able to provide support in assisting teachers with coordination.

5.4 Preparing Trout for Trout Releases

Trout are ready for release day when they've reached the correct stage of development (read more about tracking trout development in section 4.1 Monitoring Trout Development), the tank's temperature is close to the release site's water temperature, and when they can handle full exposure to sunlight. Additionally, there are some day-of preparations that make the transition from tank to nature go smoothly. Read more about each of these preparations in the sections below.

Releasable Fry
Your trout are releasable once they reach the fry stage, around 750.0 Total Thermal Units (TTU). At this stage of development, the nutrients in the yolk sac will be nearly completely absorbed enabling them to swim and hunt for food, and camouflaging patterns will be visible on their bodies. ***It is extremely important your trout are as near to this stage of development (750 TTU) as possible at the time of their release.***

Underdeveloped trout will have no chance of survival in a natural habitat. If trout still have protruding yolk sacs, they will be unstable and/or unable to swim. This will make them vulnerable to predation and more likely to be swept downstream in a current.

Overdeveloped trout will create an unpleasant situation for you and your students. If all of your trout are swimming and lack no evidence of a yolk sac, they are in need of food. We strongly advise against feeding your trout. Feeding them will create a lot of solid waste that requires a more intense filtering system than we have recommended. If you feed them, many trout will die because water quality will rapidly decline. If you don't feed them, many trout will die because of starvation. Both situations will be stressful for the trout, teachers, and students but can be avoided by closely monitoring and adjusting your tank's water temperature.

Tank Temperature
On the day before your trout release, your tank's temperature should be at 11°C. Your tank's temperature should remain between 3°C and 4°C while trout are in the egg and early alevin stage. Beyond these stages, the tank temperature should be between 4°C and 11°C, ***with increases occurring only after determining your release date***. These temperature recommendations achieve two things:
1. Trout development will not occur too quickly resulting in overdeveloped trout by your release date.
2. When trout transition from your tank into their release site, water temperature differences are not dramatic enough to stress the trout.

In May, many release sites have water temperatures ranging from 7°C and 13°C. Colder temperatures are typical in early May, while warmer temperatures occur later in May, with most sites experiencing temperatures above 10°C. By setting your tank at 11°C by the day before your release date, it is easier to acclimate trout to differing temperatures by mixing release site and tank water prior to releasing the trout.

Calculating Releasable Fry and Tank Temperature
By closely monitoring trout development and creating a schedule in advance for adjusting the water temperature leading up to the release date, you can avoid feeding the trout and ensure trout reach the "releasable fry" stage of development.

Once you know your release date, work with your students or create an assignment for them to come up with a development calendar of water temperature adjustments that will help you reach your development goal and target tank temperature. This is a great math exercise with meaningful, science-related results!

Tips for success:

- Work backwards from your goals of 750.0 TTU and 11.0°C
- Set your goal date to be one or two days before your release date
- Make gradual temperature changes of no more than 1.0°C -2.0°C daily. To avoid making temperature changes greater than 1.0°C -2.0°C, begin creating this calendar in early April
- Adjusting the temperature every other day is more gradual and ideal; daily is acceptable if absolutely necessary

Remove Tank Insulation
The tank insulation helps your chiller be more effective but also acts like ice and snow that would cover a natural brook trout habitat during the winter months. Too much exposure to the sun's UV rays can harm brook trout in the egg and early alevin stages. In nature, when trout emerge from their gravel redds as fry during early spring, they can handle the UV rays.

Two weeks before your release date, begin gradually removing your tank's insulation a piece at a time, day after day to expose the trout to indirect sunlight.

Release Day Preparations for Trout

- Transfer your trout into transport coolers as close to the release time as possible for adequate oxygen and temperature
- Suggestion: Take some water out of the top of your tank to more easily collect fry; use a small fish net to collect
- Place tank water and trout into three different transport coolers; top with double bagged, tightly sealed Ziplock baggies full of ice and then tightly seal the cooler (the three cooler requirement is for PWD-coordinate trout releases)

Releasing Trout
PWD staff find it helpful to "stage" trout in cups so they are set when students have completed their three stations and are ready to release the trout. Someone can do this when students are working at their stations by finding a flat, shady spot off the beaten path near each station to get the fry into cups. It's best to start this process during the second rotation to keep trout as cold as possible, and stage three areas near each of three stations. That way, when students

have completed their assessment and determined they should release the trout during their final rotation, they can next form a line and receive a cup of trout while they wait for their turn to release.

Below is a suggested process:

- Use a bucket to collect water from the release water body
- Fold a towel and lay it on the ground for kneeling
- Place all cups needed at that station on the ground close by in a sturdy spot
- Fill cups about half way with river water; this will allow trout to acclimate to the new water's temperature and characteristics as it mixes with tank water
- Open cooler, remove ice from baggies (do not mix with tank water) and set baggies aside
- Pour off some of the tank water at top of cooler
- Pour fry into cups; some may come out in big clumps, especially as you reach the bottom of the cooler
- Transfer fry from cup to cup to achieve an approximately even number of trout per cup

When students are ready to release, find a spot where they can access the river safely. Students stand in line a distance away from the release spot and all receive a cup of trout! One by one, they make their way to the river where a chaperone waits. The next student proceeds after the one before returns to the line. Students crouch down low and place the cup in the water so the trout can swim into their new homes! The first student can collect the cups. This one-by-one process ensures safety and also gives students more time to observe their trout and say goodbye.

5.5 Preparing Students for Trout Releases

Classroom Lessons Related to Release Topics

Students should learn content specifically related to their trout release activities in the classroom ahead of time. Students maximize their trout release experience if they have received related lessons beforehand.

Teachers who will receive PWD-coordinated trout releases must commit to teaching two PWD lessons within three weeks of their trout release: "Benthic Bugs & Bioassessment" and "Swim for Your Life." PWD will provide lesson plans and supplies, and teachers need to make arrangements to borrow and transport materials. Teachers coordinating their own trout release may also request these resources. In the same three week timeframe, we also recommend covering content related to chemical and physical water quality tests as well as streamside assessments and land use characteristics that impact water quality. These lessons will prepare students for related activities at the trout release and will greatly enhance learning and the students' field trip experience.

To make arrangements to borrow PWD lessons, contact the Environmental Education Department (sebagolake@pwd.org).

Requirements for loaning resources:

- Request for lesson kit made two weeks prior to date needed
- Lesson kit loanable for up to two weeks
- Teacher responsible for pick-up and drop-off of lesson kit at Sebago Lake Protection Office, Standish
- Materials returned in same condition as loaned

Release Day Preparations for Students

- Inform students of their field trip group, leader, and chaperones
- Let students know bathrooms will not be available during the trip
- Students should place nametags on their outer layer of clothing before arrival; use nametags or tape with strong adhesives as they often fall off slippery coat fabric
- If desired, students should apply bug spray BEFORE leaving school and wash hands thoroughly afterwards to be safe for working with macroinvertebrates and trout
- Everyone should wear close-toed footwear (rain/winter boots, hiking boots, or sneakers) and pants, dress warmly in layers, and tuck socks into pants for tick prevention

  Students often do not dress appropriately for these outdoor trips. Being comfortable enables students to concentrate, learn, and enjoy the overall experience.

5.6 Preparing Yourself for Trout Releases

If your school is attending a PWD coordinated trout release, the following requirements will help prepare your trout and students for a successful day. These procedures, or a variation, may be helpful for teachers who are conducting their own releases as well.

Months to Weeks Before the Trout Release

- Teach students two PWD lessons within three weeks of their trout release: “Benthic Bugs & Bioassessment” and “Swim for Your Life”
- Conduct calculations, raise tank temperature accordingly, and remove insulation to ensure trout will reach “Releasable Fry” stage of development on release day
- Arrange transportation
- Secure a minimum of three trained school staff and other chaperones and communicate details
- Obtain student field trip permission forms
- Obtain list of students who may not have photos taken

The Week Before the Trout Release

- Assign students, chaperones, and teachers into three effective working groups so they can assemble quickly after a brief introduction at the trip; communicate assignment to students
- Communicate clothing, bathroom, and bug spray expectation to students (see section 5.5 Preparing Students for Trout Releases)
- Exchange cell phone numbers of field trip coordinator, school staff, and chaperones in case of any last minute changes (inclement weather, getting lost, running late, etc.)
- Prepare student nametags with strong adhesive or tape as they often fall off slippery coat fabric
- Communicate schedule and plan with school staff and chaperones
- Finalize teaching of PWD lessons or reinforce content
- Ensure trout development is on track
- Gather safety supplies and lists required by the school

The Morning of the Trout Release

- Place tank water and trout into three different transport coolers; top with double bagged, tightly sealed Ziplock baggies full of ice and tightly seal the coolers
- Have students place nametags on their outer layer of clothing before arrival
- If desired, students should apply bug spray BEFORE leaving school and wash hands thoroughly afterwards so they are safe for macroinvertebrates and trout
- Bring PWD lesson kits to return the “Benthic Bugs” and “Swim for your Life” lessons
- Bring any safety supplies and lists required by the school

After the Trout Release

You and your students did it! It’s time to wrap up and prepare for next year.

- Clean and store your tank and equipment; tips provided in 2.4 Post-Trout Release: Cleaning and Storing
- Students can evaluate data (including review of data collected by students in previous years) and their experience through continued lessons and self-reflection