Eggs To Fry Program

Hatching Salmon And Trout In The Classroom

Table of Contents

Welcome To The
Oregon Department of Fish and Wildlife's
Egg to Fry Program

Fish egg incubation projects are a popular and valuable classroom education tool. Hatching fish eggs in a classroom setting helps students learn important concepts while developing caring attitudes about Oregon's native fish species and their habitats.

- **This project is <u>not</u> part of a fish stocking program. The goals of your project are to observe and participate in the development process of fish and learn about their life cycles.**

The classroom egg incubation program is coordinated through ODFW's Salmon Trout Enhancement Program (STEP). STEP biologists, and sometimes other ODFW biologists, serve as the primary local contacts for the program. Refer to the STEP Webpage for information on your local STEP: https://www.dfw.state.or.us/fish/STEP/biologists.asp. The STEP Educational Resources webpage also has other helpful resources and videos on the Egg to Fry Program: https://www.dfw.state.or.us/fish/STEP/resources-education.asp

This Egg to Fry Program Manual will help you with:

- √ how to get involved in the Egg to Fry Program
- √ how to set up the incubator (aquarium, chiller, filter)
- √ how to care for the incubator, eggs, and fry
- √ how to predict hatching and release times
- √ how to release the fish
- √ how to troubleshoot
- √ how to record data
- √ how to integrate with state education standards
- √ how to locate related teaching resources

STEP biologists, other ODFW biologists, and volunteers often assist with the Egg to Fry program. They are always available to assist teachers with hatching and caring for the fish. To find your local STEP Biologist, refer to Appendix 1.

Other outdoor field activities, combined with the classroom egg incubation project, provide important long-term educational benefits. Consider angler education and watershed education (aquatic habitat typing, macroinvertebrate studies, water quality monitoring, and watershed mapping) as possibilities. Biological investigations also provide broad opportunities to incorporate chemistry, ecology, math, economics, writing, and social studies into your lessons. For example, encourage students to discuss the social and economic issues revolving around fisheries resources in Oregon today. For more information about ODFW's watershed and angler education programs, contact the Oregon Department of Fish and Wildlife's Angler Education program leader.

Check with your STEP Biologist or project biologist to locate a trained adult or student volunteers interested in helping with your project. Volunteers can help coordinate with your local ODFW contact person, set-up the aquarium, deliver the eggs, provide suitable lessons for students, and help with the release. These volunteers are a valuable resource and a wealth of knowledge. Explore how they can fit into your program.

All K-12 grade levels are welcome in the Egg to Fry Program. The Next Generation Science Standards (NGSS) are best matched with the elements of the Egg to Fry Program for grades 3-5, Middle School, and High School. This manual will help you match the NGSS to different elements in the Egg to Fry Program.

Getting Started with Egg to Fry

Contact the STEP Biologist for your school (Appendix 1). Your local STEP Biologist will send an Egg Request Application for you to fill out and return.

Develop lesson plans to match the Next Generation Science Standards for you students grade level. Egg to Fry can be used to enhance math, writing, science, and art lessons. Your STEP Biologist can offer suggestions for classroom activities. This manual contains helpful links to when the Egg to Fry Program can be used to meet Next Generation Science Standards at many grade levels.

Choose what type classroom egg incubator system best suits your program. The biggest challenge of hosting the fish is keeping the water cold. Room temperature (70 ^{0}F; 21 ^{0}C) will kill the fish so some method of chilling the water is necessary. There are several options for incubator systems but most teachers use a water chiller.

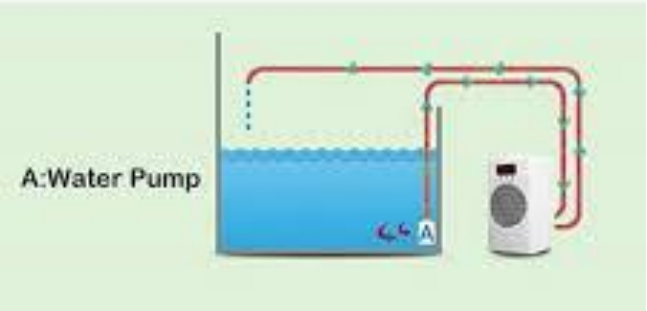
The STEP Education Resources Webpage https://www.dfw.state.or.us/fish/STEP/resources-education.asp has short videos demonstrating 3 systems.

Your STEP Biologist will determine how many salmon/trout eggs you will receive. Many factors determine how many eggs a teacher receives including how many eggs are available from the hatchery, how the eggs are divided and delivered, and the size of the aquarium.

Trying to hatch more fish than your incubator system can handle will lead to water quality issues and related mortalities. Just as in a natural environment, the number of eggs and fry an incubator "habitat" can support, its "carrying capacity," is determined by its size and other critical habitat components.

Preparing for the Fish to Arrive

Assemble and operate the incubator at least a week prior to egg delivery so biofilms can develop and water chemistry and temperature are stabilized. This will also allow time to make sure all the equipment is working and give the STEP Biologist time to assist if the system is not working properly.



Basic aquarium & chiller set up: Water is pumped from the aquarium, through the chiller, and back into the aquarium.

Set the aquarium chiller system up next to a sink if at all possible. Away from windows is also preferable but next to a sink takes precedence. Follow the video and instruction manual for how to set-up the aquarium and chiller. Contact your STEP Biologist if you have questions.

Add about an inch of aquarium grade gravel to the aquarium. Be sure to give the gravel a couple rinses before use. You want to make sure you aren't accidentally introducing any pollutants to your tank habitat. While tempting to use river rock, don't use rocks bigger than pea gravel. Fry will burrow into larger rocks and be hard for the students to see. Plus, if the fry die, they will be hidden and can foul the water. Don't use white gravel as it will camouflage dead eggs.

Place the submersible water pump in the aquarium, with a nylon stocking or other mesh over the intake to prevent eggs and fry from being sucked up. Attach one end of hose to the pump, and the other end to the chiller intake, and secure with hose clamps. Take another section of hose and fasten one end to the chiller outflow, and the other to the U-tube directional return fitting, which is placed on the side of the tank. Again, secure with hose clamps. Never run the pump when it is not submerged, and never run the chiller when the pump is not pushing water through it.

Fill the aquarium to about 2 inches (5 cm) from the top. Always use de-chlorinated water; tap water will kill the fish. If tap water is your only option, be sure to allow the water to sit for <u>at least 24 hours</u> (several days is better) before introducing fish. Inexpensive water treatments that detoxify chlorine and Ammonium, and remove other contaminants are available at pet or aquarium stores. Water treatments are also used when changing the water after the eggs hatch.

Install the side mount water filter. This type of filter is notorious for being difficult to get the water flowing. Fill the filter chamber with water, start the filter, then continue to pour water in the filter chamber until the filter pump "catches" and the water start to cascade from the filter.

Set the chiller for water temperature between 45 ^{0}F and 55 ^{0}F (7 ^{0}C to 13 ^{0}C). Unless the water temperature warms above 65 ^{0}F (18 ^{0}C), temperatures outside this range are not lethal. However, temperatures above 55 ^{0}F (13 ^{0}C) can lead to more water quality issues. Also, colder water will cause condensation on the aquarium surface. This condensation can drip off the aquarium and pool making it seem the aquarium is leaking, and make it hard for students to see the fish. Place a folded towel next to the bottom of the long sides of the aquarium; a small fan set on the aquarium will also reduce the condensation. This is also a great opportunity to teach students about humidity and temperature.

While light (natural and classroom lights) is not toxic to the fish, they don't like it when they first hatch. Cover three sides and the top of the aquarium with opaque material. This will minimize the light but still allow the students to see the fish.

Water circulation oxygenates the water. The water pump, as well as the cascading water from the side mount filter both oxygenate the water. If the pump and filter are working properly, there will be sufficient oxygen. However, aerators are inexpensive and adding one will ensure the fish have oxygen if the pump or chiller fail. The fish can survive warm water longer if they have sufficient oxygen.

A volunteer or STEP Biologist will deliver the eggs. Most volunteers will take a few minutes to talk to the students, but remember they may have many deliveries to complete. If you are interested in a longer presentation, reach out to your STEP Biologist. The eggs are not transported in water as they can absorb oxygen from the air for short periods of time, as long as they remain cold and moist.

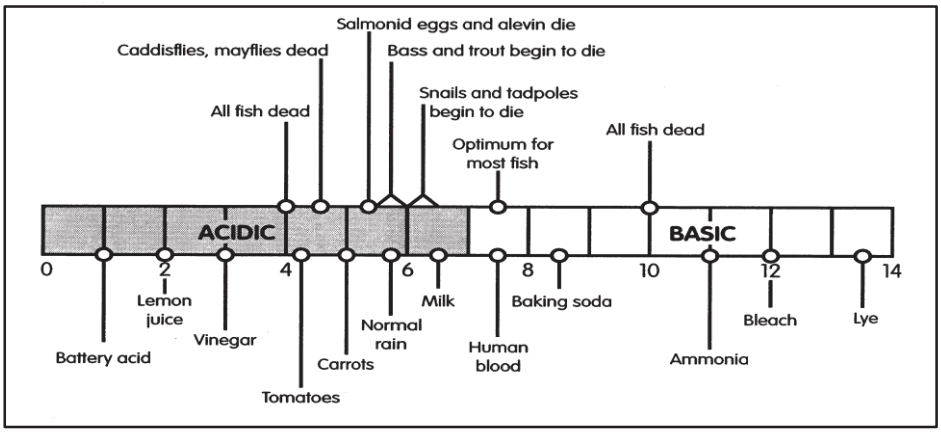
Care and Maintenance of the Incubator System and Fish

Always check the aquarium daily when school is in session. Be sure to remove dead eggs (turn from translucent pink/orange to chalky white). Alevin will turn grey and stop moving. It is imperative to remove the dead eggs and alevin as they can grow fungus and infect the other fish. The dead fish will also decompose and foul the water. The best way to remove dead eggs and alevin is a turkey baster. While the fish will be okay over a weekend, someone should check the system and fish for longer breaks.

Record egg or fry losses and water temperature for tracking Temperature Units. Your STEP Biologist can supply an Egg to Fry Daily Progress Form or you can develop your own with your students. Keeping daily record of the water temperature, dead eggs and fry, when the fish hatched, and making notes on their progress toward release are important for planning water changes, fry release and for end of season reporting. It is also a great way to teach the students about data and record keeping.

Have a thermometer to measure water temperature rather than just relying on the temperature reading on the chiller. This teaches the students how to take and record data, and, not to rely on the equipment which can be incorrect. For example, if the pump stops working, the water chiller will still show the set temperature but the aquarium water will be warming to room temperature.

One way to monitor water quality is with pH. Test kits are inexpensive, easy to use, and add to the student's data collecting experience as well as teaching basic chemistry. Monitoring the pH can also expose water quality issues before they become toxic. Water that is either too acidic or basic can be toxic to the fish. For example, pH above 8 could be a sign Ammonium is starting to build up in the water. If pH is too low (less than 6.5) add 1 tablespoon of baking soda every few minutes until the pH is 7.5. If the pH is too high, watch for other signs of Ammonium buildup such as foamy water. Small amounts of white vinegar can be added to lower pH.



When the fry first hatch, their yolk sac is delicate and easily damaged. If startled, the fry will instinctively try to burrow into the gravel. This can cause coagulated yolk sac, an often fatal condition. Keep the abrupt noises to a minimum at this stage, and shield them from bright light.

How to Change the Water After Eggs Hatch

When all the eggs have hatched, change out half the aquarium water with fresh treated chilled water. Since the fry have just hatched, do this with as little disruption to the fish as possible.

The buildup of ammonium to toxic levels is the number one reason for fish mortalities. When the fish eggs hatch, egg fluid and shells are trapped in the aquarium. The fluid and shells contain proteins that break down into Nitrogen that then forms into Ammonium. After the eggs hatch, it is ***imperative*** to change out half of the water in the aquarium, remove the eggs shell ("fish out with a net, clean intake of pump and filter), and rinse out the bio-filter cartridge in the filter.

As soon as your predicted hatch date approaches, prepare to change out the water. Fill a couple 5 gallon buckets and add water treatment. Chill the water by setting the buckets outside over night or adding ice; remember, ice can have chlorine so be sure to use water treatment. Match the water temperature in the buckets to the water in the aquarium within 5 ^{0}F (3 ^{0}C). If the aquarium is not next to a sink, you will need an empty bucket to drain the aquarium into. Have a couple of towels handy for spills.

Start by turning off the pump, chiller, and filter. If the system is set up by a sink, remove the chiller output hose, turn the pump back on, and drain about half the water into the sink. If the system is not by a sink, drain the water into a bucket, emptying as necessary. Drain the aquarium until about half full. Unplug the filter, remove from side of aquarium, pour out water into the sink or bucket, remove the bio-filter cartridge from the filter and rinse. Use a fine mesh net to "fish" out the egg shells; they look like contact lens floating in the water. Carefully replace the water with a pitcher so as not to disturb the sac fry. Once the aquarium is refilled, replace the bio-filter cartridge and return the filter to the side of the aquarium. Fill the filter chamber with water, start the filter, then continue to pour water in the filter chamber until the filter pump "catches" and the water starts to cascade from the filter. Turn the pump and chiller back on.

How to Predict a Hatching and Release Date

By keeping daily temperature records, you can monitor the fish to predict approximate hatching dates and when the fish will be ready for release. Warmer water matures the fish faster; just 2 0F a day matures the fish 6 days faster to release.

Incubation time is measured in temperature units (TUs). A temperature unit in Fahrenheit is 1° F above 32° F for 24 hours. In Celsius, 1 ^{0}C equals 1 TU. See page 14 for more information on calculating TUs and this link for a TU calculator: https://www.dfw.state.or.us/fish/STEP/docs/TU_calculator_4-2013_protected.xls

First and foremost, remember TUs are a human invention and fish don't pay any attention to us. We use TUs to **estimate** when the salmon or trout will hatch and be ready for release. The fish do as they darn well

please. Also, not all fish will hatch at one time or all be ready for release at the same time. When monitoring the fish for a release date, watch for signs they are maturing such as how much yolk sac is absorbed and their swimming behavior. Consult with your STEP Biologist if you are unsure.

The eggs will have accumulated TUs when they arrive; use these as your starting TUs. Add each day's temperature units to the total accumulated from the preceding days.

Development Rates in Fahrenheit Temperature Units

Species/Stocks	To Eyed Stage	To Hatch	To Fry Stage (Button-Up)
Spring Chinook	536 - 650	850 - 900	1500 - 1600
Fall Chinook	650 - 704	850 - 983	1590 - 1700
Steelhead	400 - 480	550 - 700	997 - 1120
Rainbow Trout	305 - 315	500 - 600	900 - 1100

Example in Fahrenheit:

- TUs when salmon eggs arrive to your classroom = 600
- Water Temperature = 52 F
- Daily TUs = 20

TUs for Day One = 620
TUs for Day Two = 640 and so on

Development Rates in Celsius Temperature Units

Species/Stocks	To Eyed Stage	To Hatch	To Fry Stage (Button-Up)
Chinook	280	480 - 540	900 - 1000
Steelhead	250 - 270	360	600
Rainbow Trout	210 - 240	300 - 320	500 - 580

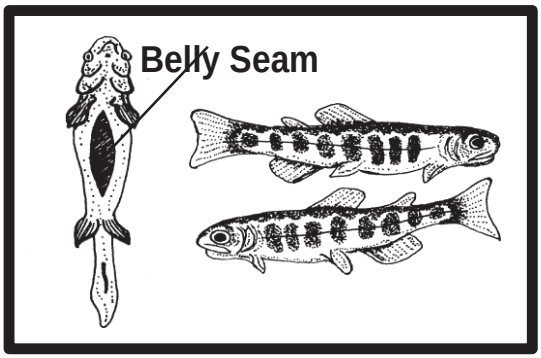
Example in Celsius:

- TUs when salmon eggs arrive to your classroom = 300
- Water Temperature = 10
- Daily TUs = 10

TUs for Day One = 310
TUs for Day Two = 320 and so on

Are Fry Ready for Release?

Place one or two fish in a small clear jar to closely observe the seam width. When the belly seam is about one millimeter in width, a small amount of yolk is still present within the body cavity. This amount can sustain the fry for a short time. When the yolk is no longer visible from the side view and the seam is one millimeter or less in width, the fish are then ready for release. Do not feed the fry before release. If unsure, consult with your STEP Biologist.



Students are often reluctant to release the fry. The fish are endearing and the students become attached to them. Teachers frequently ask if they can feed the fry to keep them a little longer.

The Egg to Fry Program requires the fish be released as unfed fry for a couple of reasons. One is because of how the Egg to Fry Program is administered; the program is for educational purposes and not hatchery production. Feeding the fry represents a new stage of hatchery production. STEP is allowed to use the hatchery fish as long as they are not kept past the unfed fry stage.

A more important reason to not feed the fry is how it will affect the water quality in the aquarium. Uneaten fish food and fish poop add protein to the aquarium water. Just as the egg shells, this protein will break down to Nitrogen and reform into ammonium. The filter on the Egg to Fry aquarium system is not designed to detoxify this level of ammonium. Also, getting fish on feed is a difficult process and time of high mortality.

How to Release the Fry

When the yolk sacs on the sac fry are noticeably smaller, usually about two weeks before release, set a release date. (Release dates can be manipulated as described in Appendix 2). Review the release site information on the Transportation Permit; only release the fry in an approved location. Plan a visit to the site to address safety concerns and logistics before taking students to the release location.

These fry are showing signs they will be ready for release soon.

Allow at least an hour to transfer the fry from the aquarium to the transport cooler.

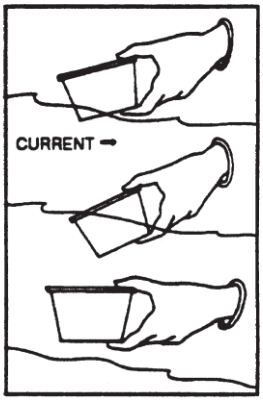
When most of the fry are actively swimming, prepare to release the fish. Fish are best transported in an 18 quart picnic cooler. Just as you did when changing half the water, use the chiller output hose to pump water from the aquarium into the cooler. Fill the cooler with a few gallons of water then continue to remove water from the aquarium until there is a few inches left. Fry are fast and hard to catch. Lowering the water level in the aquarium will make it earlier to catch the fry and reduce their stress.

Keep the fry cool (below 60 ^{0}F or 15 ^{0}C) during transport and avoid any rough handling. If needed, ice cubes or ice packs can be floated in the container.

When you arrive at the release site, check the water temperature in the river and compare it to the water temperature in the transport cooler. If there is more than a 5 ^{0}F (3 ^{0}C) difference, add a couple gallons of river water in the transport cooler. Do this until the water is within 5 ^{0}F (3 ^{0}C). This will also acclimate the fry to the chemistry of the river water. Wait a few minutes and begin releasing the fry. If using a bucket or other non-insulated container, another option is to place the bucket in the stream water and allow temperature to equalize.

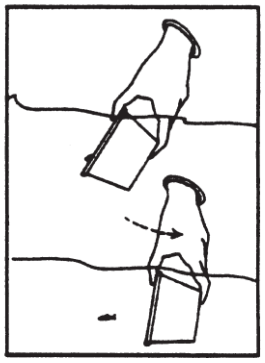
Avoid releasing the fry in deep pools or other spots where large fish may wait to prey upon them. Shallow water without strong currents is best. Areas with too much wave action may wash fry onto the shore. Try to release the fry in an area with plenty of cover so they can hide.

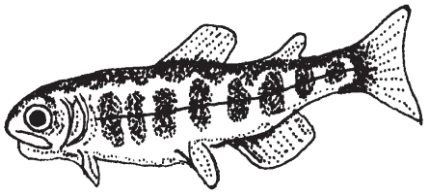
Take the transport cooler to the river's edge. Fill a small container half full of water in the transport cooler and add a few fry. Give the container to a student to take to the river. Place the container in the water, and tip the container to allow some water to flow into it.



Wait a few moments, then submerge the container and allow some of the fry to swim out. Continue until all fry are released. Encourage students to watch where the fish go and what they do, then write about their experience (poems, stories, journal entries). They will notice that the fish are very camouflaged and well-suited to their new environment.

Students often express concern about fry survive once released. Use this as an opportunity to discuss potential threats to fry survival in a natural habitat. Help students understand the percentage of fry that survive to adult fish is determined by many factors. These include predation (by birds, other fish, and many other animals), pollution, unfavorable water temperatures, food availability, cover, living space, inadequate or excessive stream flows, excessive siltation, obstacles to migration, ocean environmental conditions, and competition with other fish.





Cleaning and Storing the Equipment

Empty the aquarium and remove the gravel. Rinse the aquarium, bio-filter cartridge, and gravel with tap water and air dry. Rinse the gravel thoroughly until the water pours out clean. Pull off the cap of the pump intake and clean off the filter inside. Do not bleach or use detergent unless there was a mass casualty event and there is a lot of dead fish. In this case, wash equipment with a mild bleach solution (1/4 cup bleach in one gallon water) and rinse very thoroughly with tap water.

Tip the chiller upside down to remove all water from the chiller. Although the instruction manual states not to do this, it is okay for a few moments. You may want to circulate some clean water through the pump and chiller as well. Fill a bucket with clean water, place the pump and chiller return in the bucket, and run the pump for a few minutes. Follow the instruction manual directions to pull off the front cover and clean the front cover filter and clean out any dust bunnies inside the unit.

After all equipment is thoroughly dry, reassemble for storage. Make sure everything is together for the next time you host the fish.

Reporting to the STEP Biologist

Recording data from the Egg to Fry Program is mandatory. Please report your information to the STEP Biologist so they can enter it into ODFW's hatchery management system database.

After the fry are released, send the STEP Biologist the following information:

- **number of dead eggs**
- **number of dead fry**
- **number of fry released**
- **where the fry were released**

Your local STEP Biologist will let you know how they want you to report data.

Leaving the Egg to Fry Program

If you are using equipment on loan from STEP and are moving to another school and want to continue in the program, ask the STEP Biologist if you can take the equipment with you. If not, or if you are retiring (congratulations and thank you for your years of service as a teacher), ask other teachers at the school if they would like to host the fish next season. If yes, have them contact the STEP Biologist. If not, contact the STEP Biologist so they can pick up the equipment.

Troubleshooting

It can be distressing to students, and teachers, when fish die. If fish have what they need, they do really well. But if the water gets to warm (over 60 F), ammonium levels get too high, or oxygen gets to low, the fish will die. Paying close attention to the fish and monitoring the aquarium chiller system, water temperature and water quality will minimize the risks. However, you can do everything right and still lose some fish. A few dead eggs or fry is not cause for concern. However, if more that 10% die, there could be something wrong with the water quality or the aquarium, chiller, or filter system

Most often mortalities are the result of water quality issues or aquarium/chiller/ filter system failures. Always check the fish every school day to make sure the water is chilled and filter is running. Remove dead eggs and fry every day. Check on the fish if school is out more than 3 days. If problems persist, call your STEP Biologist.

The buildup of ammonium to toxic levels is common reason for fish mortalities. When the fish eggs hatch, egg fluid and shells are trapped in the aquarium. The fluid and shells contain proteins that break down into Nitrogen that then forms into ammonium. After the eggs hatch, it is ***imperative*** to change out half of the water in the aquarium, remove the egg shells ("fish" out with a net, clean intake of pump and filter), and rinse out the bio-filter cartridge in the filter.

Fish

Problem	Cause	Solution
Dead eggs Appear chalky white and/or fuzzy	Water too warm, oxygen too low, injury to egg before delivery.	Remove dead eggs every day. Check water temperature. Make sure the pump is circulating the water and filter is working.
Eggs partially hatched; Deformities	Unknown. This happens occasionally (under 10%).	Remove partially hatched fry. If over 10%, check aquarium/chiller/ filter check system and water temperature.
Dead fry Appear white or grey, no longer moving	High ammonium levels, water too warm, aquarium/chiller/ filter system not working.	Remove dead fry every day. If foam develops on top of aquarium, change half the water. Check aquarium/chiller/ filter check system and water temperature.
Fuzzy eggs or fry	Fungus	Remove dead eggs and fry including pink eggs stuck to fuzzy egg as they are infected too. If not removed, infected eggs and fry will spread fungus to other fish and kill them.
Yellow chunks in yolk sac	Coagulated yolk sac; A condition resulting from injuries to yolk sac when first hatched.	Prevention is only solution; minimize loud noises, bright light and abrupt changes to reduce fish attempts to burrow in gravel.
Fish swimming at surface, gasping for air	Low dissolved oxygen; most likely cause aquarium/chiller/ filter system not working.	Check water pump and filter. Dissolved oxygen levels should be sufficient if pump and filter are functioning properly. An aerator will ensure oxygen levels are maintained at sufficient levels.

Aquarium System

Problem	Cause	Solution
Cloudy water; Foam at top of water; Aquarium water smells bad	Various but usually indicates ammonium in water. Water test kits for ammonium are available at aquarium stores. Most common after eggs hatch or if dead eggs or fry are not removed daily.	Make sure the filter is working and rinse bio-filter cartridge. Change out half water. Repeat water change if needed. Add a water treatment that detoxifies ammonium. Remove dead eggs and fry daily.
Water temperature too warm.	Chiller unit not working; ice bottles melted too fast; room temperature thermostat set too high or broken.	Bring water temperature down slowly over several hours. Rapid decrease in temperature can be more harmful than too warm water. If using a chiller, always have ice bottles in freezer in case unit stops working. Check chiller power (accidently unplugged or power strip turned off). Some chillers have fuses that may need replacement. Call STEP Biologist or chiller manufacturer for more information.

Temperature Units (TUs)

Salmon and trout eggs mature based on water temperature. Salmon/trout maturity is measured in Temperature Units (TUs). TUs begin accumulating from fertilization. In Fahrenheit, one TU is accumulated for each degree over 32 ^{0}F. For Celsius, 1 ^{0}C equals 1 TU. The warmer the water temperature, the faster the fish will mature; just 2 ^{0}F a day matures the fish 6 days faster to release.

Keep in mind, TUs are a human invention and fish don't pay any attention to us. We use TUs to **estimate** when the salmon or trout will hatch and be ready for release. Not all fish will hatch at one time or all be ready for release at the same time. When monitoring the fish for a release date, watch for signs they are maturing such as how much yolk sac is absorbed and how active are the fry. You can find a TU calculator at this link:
https://www.dfw.state.or.us/fish/STEP/docs/TU_calculator_4-2013_protected.xls

Calculating Hatch/Release Dates
Beginning on the day the eggs are fertilized, the temperature units are added every day. When your eggs arrive, they will have already accumulated TUs so you will need this number to start your record.

Development Rates In Temperature Units in Fahrenheit

Species/Stocks	To Eyed Stage	To Hatch	Release
Spring Chinook	536 - 650	850 - 900	1500 - 1600
Fall Chinook	650 - 704	850 - 983	1590 - 1700
Steelhead	400 - 480	550 - 700	997 - 1120
Rainbow Trout	305 - 315	500 - 600	900 - 1100

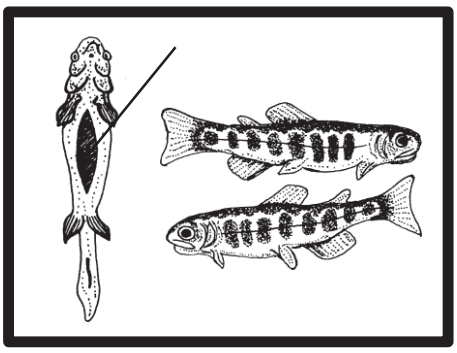
To calculate TUs, you will need the accumulated TUs and the daily water temperature. If water temperature is 52 ^{0}F, 20 TUs will accumulate each day. (water temperature ^{0}F minus 32 = TU).

Starting TUs = 540 TUs – this is the number of TUs your fish will have accumulated when they arrive.
Day one + 20 TUs
560 TUs
Day two + 20 TUs
580 TUs Continue adding the TUs each day.

Example:
The salmon eggs arrive on October 15 with 540 TUs accumulated. The water temperature is 52 ^{0}F.

To hatch:
850 TUs – 540 TUs = 310 TUs
310 / 20 = 15.5 days
October 15 + 15.5 days = October 30 - 31

To Release:
1600 TUs – 540 TUs = 1060 TUs to release
1060 TUs / 20 TUs day = 53 days
October 15 + 53 days = December 8.



Fry ready for release

Converting TUs to Celsius

When the salmon/trout eggs arrive they will have accumulated TUs. This figure will be TUs in Fahrenheit. To track the fish in Celsius, you will need to convert the TUs in ^{0}F in TUs in ^{0}C. to do this, multiply the TUs in ^{0}F by 0.6.
For Example:
Starting TUs in ^{0}F = 550
x 0.6
Starting TUs in ^{0}C = 330
The accumulated TUs to hatch and release are different in Celsius as well.

To calculate TUs, you will need the accumulated TUs and the daily water temperature. If water temperature is 10 ^{0}C, 10 TUs will accumulate each day. (water temperature 1 ^{0}C equals 1 TU = TU).

Starting TUs = 330 TUs – this is the number of TUs your fish will have accumulated when they arrive.
Day one + 10 TUs
340 TUs
Day two + 10 TUs
350 TUs Continue adding the TUs each day.

Example:
The salmon eggs arrive on October 15 with 300 TUs accumulated. The water temperature is 10 ^{0}F.

Development Rates In Temperature Units in Celsius

Species/Stocks	To Eyed Stage	To Hatch	Release
Chinook	280	480 - 540	900 - 1000
Steelhead	250 - 270	360	600
Rainbow Trout	210 - 240	300 - 320	500 - 580

Example:
The salmon eggs arrive on October 15 with 300 TUs accumulated. The water temperature is 10 ^{0}F.

To hatch:
480 TUs – 300 TUs = 180 TUs
180 / 10 = 18 days
October 15 + 18 days = November 2

To Release:
900 TUs – 300 TUs = 600 TUs to release
600 TUs / 10 TUs day = 60 days
October 15 + 60 days = December 14.

*Note the release dates for TUs in ^{0}F and TUs in ^{0}C are different. This is because 10 ^{0}C equals 50 ^{0}F; just 2 ^{0}F a day matures the fish 6 days faster to release.

Egg to Fry Program
Frequently Asked Questions

What temperature is best for the fish?

Water temperature between 45 ^{0}F and 55 ^{0}F are best for the salmon and trout. Unless the water temperature warms above 65 ^{0}F, temperatures outside this range are not lethal. However, temperatures above 55 ^{0}F can lead to more water quality issues. Also, colder water will cause condensation on the aquarium surface. This condensation can drip off the aquarium and pool, making it seem the aquarium is leaking. Place a folded towel next to the bottom of the long sides of the aquarium; a small fan set on the aquarium will also reduce the condensation.

How many eggs should I get for my aquarium?

A 10-gallon aquarium with a side mount filter will easily raise 100 eggs to the unfed fry stage. If more eggs are incubated, use a correspondingly larger aquarium.

Do I need an aerator?

Water circulation Oxygenates the water. The water pump, as well as the cascading water from the side mount filter both work to Oxygenate the water. If the pump and filter are working properly, there will be sufficient Oxygen. However, aerators are inexpensive and adding one can ensure the fish have Oxygen if the pump or chiller fail. The fish can survive warm water longer if they have sufficient Oxygen.

How are the egg placed in the aquarium?

Most of the time, a volunteer or STEP Biologist will deliver the salmon/trout eggs and place them in the aquarium. However, should you need to place the eggs, carefully drop the eggs in to aquarium so they gently land on the gravel. Don't worry if some land by themselves; the eggs will roll around on their own to find each other. Place the eggs on the opposite side of the aquarium from the pump.

Should I cover my aquarium?

While in the egg and sac fry stage, salmon/trout like to be in the dark and together. While light (natural and classroom lights) is not toxic to the fish, they don't like until they start swimming. Covering three sides and the top of the aquarium with dark opaque material will minimize the light but also allow the students to see the fish.

Also, when the fry first hatch, their yolk sac is delicate and easily damaged. If startled, the fry will instinctively try to burrow into the gravel. This can cause coagulated yolk sac, an often fatal condition. Covering three sides and top of the aquarium will help reduce the fish startling.

Should the water be filtered?

Yes. This is imperative. A side mount filter with a bio-filter cartridge removes some of the waste products and impurities from the aquarium. The water cascading from the filter will also Oxygenate the water.

How is the water cooled?

A low-cost option is to use bottles of ice to cool the water. Although more labor intensive than other options, it can be very effective. While teachers used this method for many years, and still

can, it requires changing ice bottles on a daily basis. While extra ice bottles can get the fish through a two day weekend, someone must change bottles out for longer breaks.

Water chillers are readily available and, with pump and tubing, cost around $400.00 (2020 price). While having a water chiller eliminates the need to change ice bottles, the fish and water quality still need to be monitoring. During the school week, the aquarium water must be inspected for signs of Ammonium build up (foam, bad smell, pH increase) and dead eggs and fry removed on a daily basis. For school breaks longer than a regular weekend, someone should check the system every few days to monitor the water quality and remove dead eggs or fry.

What if many or all of the eggs or fry die?

Accidents happen in the classroom. Someone may unplug the system or the Ammonium may reach toxic levels. If a many or all of your eggs or fry die, use it as a teaching moment to remind students that fish are sensitive to environmental conditions and it is difficult to raise them in an artificial environment.

Contact you STEP Biologist if you experience a mass casualty event. You will not be expelled from the program. It may be possible to save the remaining fish, or at the very least, identify the problem for the next time.

STEP Coordinator
Salem Headquarters
4034 Fairview Industrial Dr. SE
Salem, OR 97302-1142
(503) 947-6232

For direct contact information on the current STEP Biologists and their districts, check the STEP webpage at:
https://www.dfw.state.or.us/fish/STEP/biologists.asp

STEP District	Egg Delivery Dates Fish Species
North Willamette 17330 SE Evelyn Street Clackamas OR 97015 971 673 6000	Mid October to early November - spring Chinook salmon Late January - rainbow trout
Mid – Willamette 7118 NE Vandenberg Ave Corvallis OR 97330 541 757 4186	Mid to Late October – spring Chinook salmon Late January - rainbow trout
South Willamette 3150 E Main Street Springfield OR 97478 541 726 3515	Early to Mid-October – spring Chinook salmon
North Coast 4907 Third Street Tillamook, OR 97141 503 842 2741	Mid-October to November – spring Chinook salmon Early January – fall Chinook salmon February/March – steelhead, rainbow trout
Mid Coast 810 SW Alder Street Suite C Newport, OR 97365 541 265 8306	February – steelhead April - steelhead
Umpqua 4192 N Umpqua Hwy Roseburg, OR 97470 541 440 3353	Late April/early May - steelhead
Lower Rogue PO Box 642 Gold Beach, OR 97444 541 247 7605	Early April - steelhead
Upper Rogue 1495 E Gregory Road Central Point, OR 97502 541 826 8774	Mid to late October – spring Chinook salmon
Eastern Oregon 61374 Parrell Road Bend, OR 97702 541 633 1113	Eastern ,Klamath, Lakeview, Central Oregon: January – rainbow trout Prineville, Bend: March – rainbow trout NE Oregon: April – steelhead

Tank Equipment Checklist

Required:

- 10-20 gallon aquarium tank
- Tank lid (buy to fit tank or use makeshift cover)
- Aquarium water chiller unit (or frozen bottles)
    - Flexible hose for pump and water return lines to chiller
    - U-tube directional return fitting
    - Hose clamps
- Submersible water pump with filtered intake
    - Nylon stocking or other mesh to cover pump intake
- Water filter (side mounting waterfall style is best)
- Gravel
- Suction cup thermometer
- Fish net
- Turkey baster
- Bucket(s)
- Pitcher
- Power strip
- Sturdy table or countertop
- Water treatment to de-chlorinate and detoxify ammonium

Optional:

- Water quality testing equipment (pH, dissolved oxygen, ammonia)
- Aerator/bubbler
- Opaque material (cardboard etc.) to cover tank sides
- Insulation material (foam) may be helpful if using frozen bottles
- Backup frozen water bottles (recommended)
- Towels