



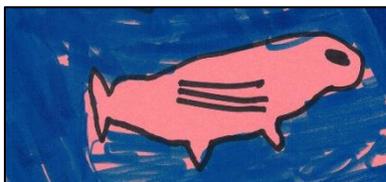
Salmon in the Schools-Tacoma

2021-2022 Teacher Handbook

Tank Manual

Welcome aboard the first Salmon in the Schools (SIS-Tacoma) program! This handbook is your go-to resource for the entire experience.

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PARTICIPATING HATCHERIES

Clark's Creek Hatchery

Diru Creek Hatchery

PARTICIPATING CREEKS AND WATERSHEDS

Swan Creek Watershed

Weekly Zoom Tank Q & A

Meeting ID: 344 082 2174



Funding

SIS-Tacoma is a partnership between Tacoma Public Schools and the Foss Waterway Seaport and Pierce Conservation District. Funding comes from grants secured by the Foss Waterway Seaport, the NW Salmon Enhancement Group (funded by OSPI), and private donations.



KEYS TO SUCCESS

Welcome to the exciting adventure of raising salmon! Pacific salmon are key to healthy rivers and forests in the Pacific Northwest, and the salmon you and your students will rear are part of the big picture of salmon recovery and watershed stewardship.

If this is your first year as an SIS-Tacoma teacher, here are the most important keys to your success:

- **Attend all trainings** throughout the program.
- **Get your whole school involved as pandemic protocols allow** - the principal; science, art, and math specialists; custodial staff; other teachers; parents; and, most important, students! Parent volunteers can help maintain your tank and students should be observing, feeding, and monitoring the salmon.
- **Participate in the teams channel.** This is a great place to ask questions.
- **Read this handbook!!** It will answer most of your questions.
- **Ask for help immediately** if you suspect something is wrong with your equipment, if water-quality takes a nosedive, or if fish seem in distress. We are here to support you!

BE SURE TO LET YOUR PARTNER KNOW RIGHT AWAY IF CONTACT OR OTHER INFORMATION CHANGES.



REARING TIMELINE

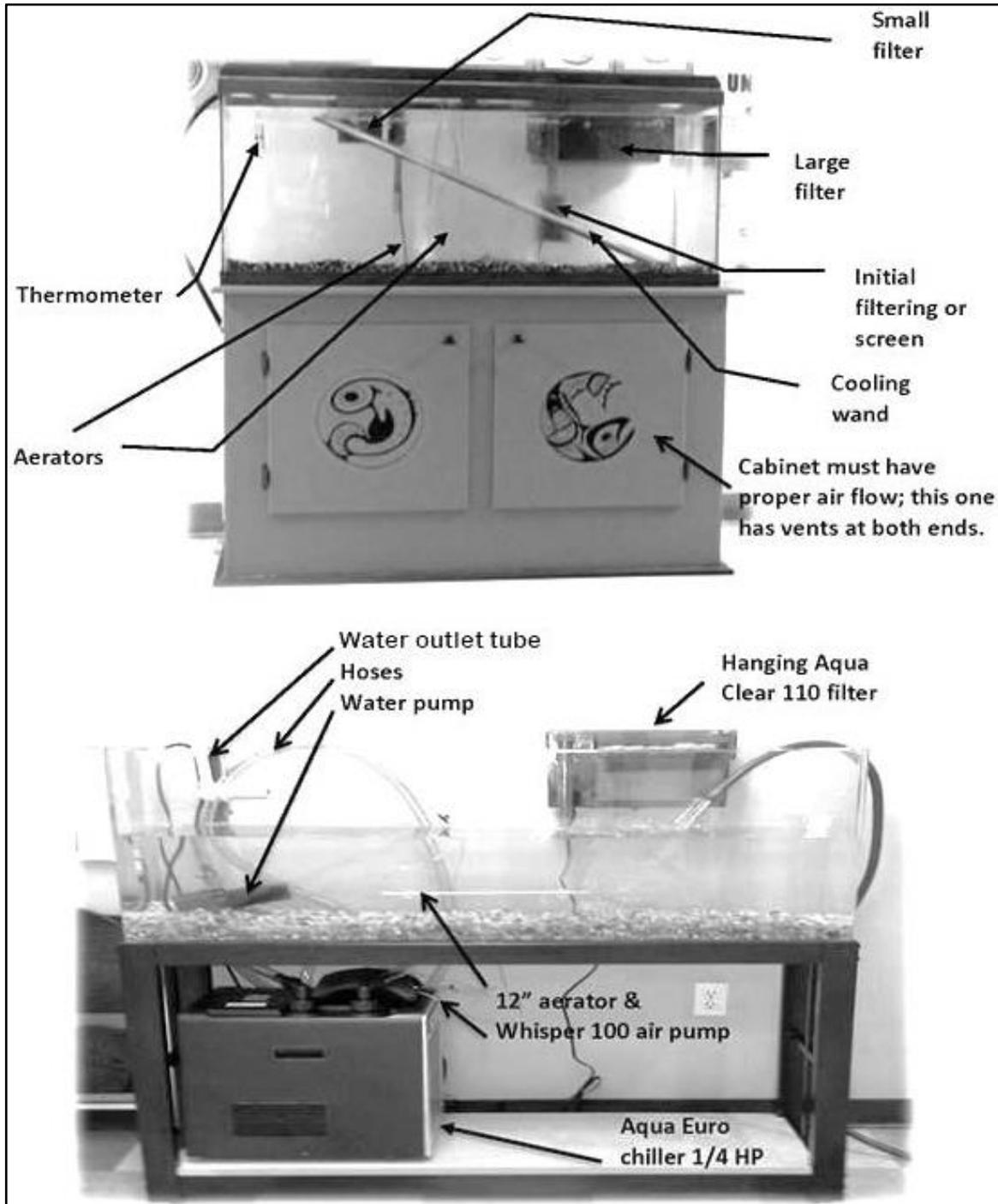
Following is the approximate timeline for rearing coho salmon.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Sign Teacher Contracts, Tanks and supplies finalized									
Participate in SIS workshop 1.									
Set up tank.									
Prepare students.									
Get eggs. Begin observing changes.									
Watch eggs hatch.									
Feed fry.									
Monitor water quality.									
Schedule release.									
Release fry; observe habitat.									
File report. Sign up for next year.									



EQUIPMENT & SUPPLIES

You will find everything except chillers at your local aquarium or pet shop. For details about brands and costs, visit sisseattle.org/equipment/ and click on "List." Full set-ups range from \$1,500 to \$1,900. Yearly maintenance and replacement costs for consumables will be less than \$75. Wand chiller repairs average \$300 per occurrence. SIS-Tacoma may be able to help with these expenses; talk with your area coordinator. The diagrams below show typical setups for a 50-gallon tank on a stand, with wand and inline chillers.



Filter Types



Media Insert Filter



Bio-Wheel Filter



Media Cartridge Filter



Canister Filter



Under Gravel Filter
not recommended

Chiller Types



Wands



Inline



EQUIPMENT

For details about brands and costs, visit sisseattle.org/equipment/ and click on

"List" 50 - 55 gallon glass or acrylic **aquarium**

- A table or **stand** that can hold a weight of 650 pounds, allows ample air flow around the chiller.
- A refrigeration unit, also called a "**chiller**" (NOT found at aquarium or pet shops) sized for at least a 100-gallon tank. In line chillers include the following: JBJ Arctica #DBA-075 1/10 HP (bulkreefsupply.com), Aqua Euro model # AC25A 1/4 HP Apex Titanium Chiller. **These models require an in-tank water pump, hoses, and clamps; make sure you have everything required.**
- Wand chillers: TradeWind ([tradewindchillers.com /drop-in-water-chiller/](http://tradewindchillers.com/drop-in-water-chiller/)), Glacier (glaciercorp.com), and AquaEuro (aquaeuroussa.com)
- A **filtration** system, hanging or canister type, capable of filtering a 100-gallon tank. Options include AquaClear 110; Penn Plax Cascade canister 1000; Fluval 407 canister; Marineland Emperor Pro 450.
- An **air pump system** for ≥ 60 gallons with two hose ports, two check valves, and an 8 ft. air hose
- A **5" fish net** with long handle
- An aquarium **thermometer** (preferably with suction cups)
- **Gravel vacuum** OR a **5 ft. clear siphon hose** for cleaning the tank and replacing water
- Nearby **potable water supply** and an **RV water hose** if possible
- A dedicated **power outlet** and a **power surge strip** with 5 ports
- A battery-operated **air pump/aerator** for your fry release (area coordinators may have loaners)
- Two new 5-gallon **buckets** to use for water exchanges and transporting fry
- *Extra **intake sponges** for pumps and filter intakes
- *Turkey baster or tongs for removing dead eggs or debris
- *A plastic two-quart water pitcher to aid in exchanging water
- *An **aquarium scrubber pad** (appropriate for glass or acrylic tank)
- Cotton towels for water spills

SUPPLIES - CONSUMABLES

- 10 lbs. of clean, natural-colored **aquarium gravel** and 12 fist-sized **river rocks** to provide places for alevin to hide. Change out gravel every three years or more frequently if pH is difficult to maintain.
- API's **Freshwater Master Test Kit** for monitoring water chemistry; check expiration dates annually. Test strips are unreliable; don't waste your money.
- **Tap-water conditioner** (such as *AquaSafe*, *Stress Coat*, *Nite-Out II*, or *Prime*) to help keep tank balanced and remove chlorine and metals
- Enough **filter media and other filter supplies** (depending on the type of filtration system you have) to be able to change out once a month. Make sure you have sponge or other screen material on the intake tube to prevent fish from being sucked into the filter basket.
- *A **mineral block** to maintain proper pH and water hardness
- ***Flake-style fish food** (such as *Tetra-Min Tropical Flake*, *Omega One Freshwater Flake*, or *Sera Vipan*) from an aquarium store as a step-up food. All these brands are about 45% protein and 6-10% fat. First meals will be from food provided by the hatchery with your eggs
- ***Frozen/freeze-dried bloodworms** as a step-up food (enough for 2-3 weeks prior to release)

*Optional



TANK PREPARATION

We **STRONGLY** advise that you enlist one or more "**tank angels**" to help throughout your salmon project, from tank preparation through release. These volunteers can do water changes, help students monitor tank conditions, and generally give a hand so that you can teach, manage this project, *and* keep pace in your classroom. Find a sample volunteer recruitment flyer in Appendix G. If you have difficulty recruiting a volunteer, contact your area coordinator for ideas or referrals.

Preparing your tank a few weeks prior to when you will receive eggs will enable you to work out any kinks in the system before baby salmon are at risk - to check equipment, get the water to the proper temperature, and begin establishing the biological filter (see note on p. 10. Once you confirm that all systems are working, you may turn off everything except the air pump and filter system. Turn on your chiller 2-3 days before eggs go in.

Follow these steps to get your tank ready for eggs:

TANK STAND: Position your stand in a hallway or other common space where you, your students, and your tank volunteer have ready access.

TANK: Rinse the tank in water only (no soap or chemicals), gently scrub with baking soda or a strong salt solution, and rinse again thoroughly. (You may have done this step in the spring.)

GRAVEL OR ROCKS: If you choose gravel, use approx. 10-15 lbs. of rinsed, natural pebble-sized gravel (never colored gravel, dirty gravel, or very old gravel). If you choose rocks, use three piles of 3 or 4 clean fist-sized rocks. Rinse gravel/rocks well in water to remove dust and algae. Gently spread gravel to at least an inch deep. If you choose to add aquarium wood or plants, keep to a Northwest theme; you aren't rearing tropical fish!

TEMPERATURE: Install a suction-cup thermometer inside the tank as a backup to the readout on your chiller and so students can gain experience using a thermometer to monitor temperature.

WATER: Fill the tank with cold tap water. To avoid unwanted chemicals, do not use an old garden hose, a metal bucket, or a bucket that has ever contained a cleaning product or other chemicals. (A white RV hose for potable water is OK.) Fill to at least 3 inches from the top and use a Sharpie or weather-proofing tape to mark the fill line. Be sure you fill high enough for your type of filter to work. We strongly recommend the use of water conditioners to remove the toxicity of heavy metals and chlorine whenever you add water. **Letting water sit to off gas does not remove heavy metals.**

CHILLER: Blow all the dust off condenser fins, screens, and motors. **Failure to remove dust may cause your chiller to overheat, resulting in costly repairs.** See the following cleaning instructions.

→ **IMPORTANT:** After moving any chiller into place, always allow it to sit for a minimum of 30 minutes before powering up so internal fluids can reset.

If you have a wand chiller: Insert the silver portion of the wand along the inside back of the tank and rest the tip on a fist-sized rock. Keep the copper connection piece out of the water as leaching copper will kill your fish. Insert the small, gray-wired temperature sensor into the tank until it reaches the bottom. Secure this wire to the tank with weather-proofing tape. Set the thermostat to 48° F, with a 2° differential (the range the thermostat will use to turn refrigeration on and off; see Appendix E)

→ **Note:** If ice forms on the chilling wand, check that the thermostat wire is in the water! Increase circulation around the wand by moving filter/circulation systems closer to it.

If you have an inline chiller: Place your chiller in a ventilated place away any heat source and make sure that the front and rear of the chiller have at least 1-foot clearance for air flow. It must have adequate air flow to function correctly. Do not place your chiller inside a fully enclosed tank stand!

Pre-rinse used hoses with hot water to remove any build-up. Clean the intake foam screen on your pump with water and reinstall. **You will need to clean this intake pump sponge weekly** (see p. 10).

Attaching chiller hoses:

1. Dry measure lengths of hose before cutting anything; the inflow hose will be longer than the outflow.
2. Attach the outflow hose to the chiller fitting and clamp it (softening with hot water helps hoses fit easier).
3. Attach the outflow diverter on the other end and hang the clamped hose over the back of the tank.
4. Connect the intake hose to the water pump (this pump will be in the bottom of the tank). Leave enough hose to be able to pull pump out of the water to service it.
5. Connect the other end to the chiller fitting, using a hose clamp. Put the water pump in the bottom of the tank.
6. Plug in just the water pump and check all fittings for leaks. Run the pump for a few minutes.
7. Plug in the chiller and set the digital reading to 48 degrees.

Call your partner or use the internet to learn more about your chiller.

CONNECTING HOSE TO NEW JBJ CHILLER

1.) method of connecting hose to **chiller**.

- ① Unscrew hose nut and remove rubber gasket.
- ② Pull out cork stopper (not needed to run **chiller**)-Discard.
- ③ Insert hose elbow into hose nut.
- ④ Insert hose elbow into rubber tighten.
- ⑤ Screw onto **chiller** and hand tighten.
- ⑥ Connect rubber tubing over threaded portion of hose elbow.
- ⑦ Fasten hose clamp to secure hold.

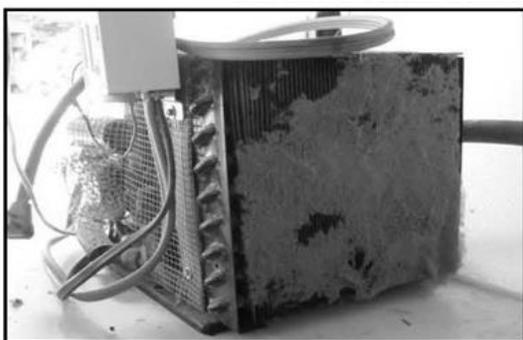
2.) Checking equipment connection.

⚠ These units have been performance tested and may contain moisture in the heat exchange chamber.

⚠ Remove and discard cork stopper before connecting pipe/hose to the chiller.

Checking connections between parts	
Hose Elbow	
Large 3/4"	2PCS
Medium 5/8"	2PCS
Small 1/2"	2PCS

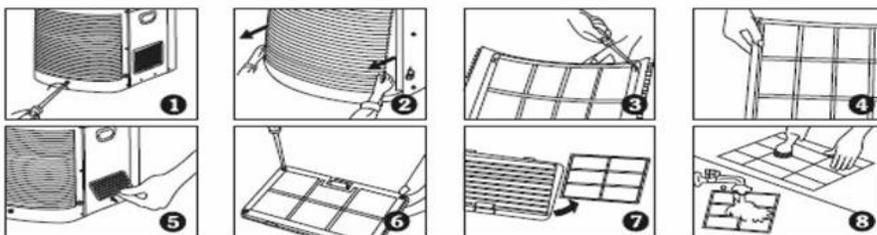
➔ **NOTE:** Always turn off power to your chiller and filters before doing water changes.



A good way to avoid refrigeration problems is to keep the condenser (the motor, filters, etc.) free of dust and have plenty of air circulation around it. Giving it a thorough cleaning with pressurized gas once or twice a year will go a long way toward keeping it good working order. This photo shows a very dirty chiller condenser. ☹

How To Clean the AquaEuro 1/4 HP Chiller's Filters

1. Loosen front cover screw and turn counter-clockwise (Fig. 1).
2. Gently pull out front hood cover (Fig. 2).
3. Loosen filter screws and remove filter (Figs. 3-4).
4. Lift and remove side draft hood (Fig. 5).
5. Loosen screw of side draft hood and remove the filter (Figs. 6-7).
6. Remove dust with brush or vacuum cleaner or rinse filter well with water and completely dry it before reinstalling (Fig. 8).
7. Reinstall all parts by counter steps.



AIR: At a minimum, have a 60-gallon air pump with two hose ports. Install check valves on pump side of hosing to prevent back-flow. Install air stones on the tank ends of the hoses and place them near the chiller wand or the bottom of the tank. Use a rock or gravel to keep them on the bottom of the tank.

WATER FILTER: Install either hang-on-the-back or external canister filter systems. At a minimum, your bio-filtration system needs to be capable of filtering a 100-gallon tank. You may use one or two filter systems. Wrap netting over the filter intake or attach a foam rubber "fish sponge" to prevent alevin from being sucked in. Always start the new season with fresh filter materials. Remove plastic packaging, always rinse new filter materials thoroughly, and read manufacturer recommendations online. Before plugging in, prime the filter by pouring tank water into it until it starts to flow back into the tank. Canister filters have a priming button that you push.

SPONGE FILTERS: Optimize your tank by using coarse sponge filters installed on filter intakes and used with air hoses. Sponge filters are inexpensive and provide space for beneficial bacteria to grow. They also help balance bacteria colonies when changing out filter media.

STARTING THE AQUARIUM CYCLE: We recommend that you add nitrifying bacteria (such as *Nite-Out*, *Quick Start*, or *RediStart*) to kick start the growth of beneficial bacteria. Also, when changing filter cartridges, replace only one side at a time, wait one week, and replace the other side to allow bacteria to recolonize faster. For fall start-up, use all new filter cartridges.

POWER-UP: Check to make sure everything is working properly. Tap water may take **48 hours** to cool to 48 degrees. "Cycling" an aquarium to build up nitrifying bacteria on gravel/rocks and filters takes four to six weeks. **Recheck everything after two days; if your tank is not at/near 48 degrees, call your area coordinator.** If everything is working property, you may turn off the chiller until three days before your eggs arrive. Leave the air pump and water filter on to keep water circulating.

BACKGROUND ON BIOLOGICAL FILTRATION

A biological filter is a population of beneficial bacteria that eat available waste products in the aquarium. Some bacteria consume salmon eggshells, uneaten food, and fish waste and produce ammonia (which can be very harmful with a high pH). Others (*Nitrosomonas*) consume ammonia and give off nitrite. Still others (*Nitrobacter* and *Nitrospira*) consume nitrite and produce nitrate (a harmless fertilizer unless levels get very high).

A well-established biological filter keeps tank chemistry under control. However, if a lot of protein is available and the filter isn't fully operational, you may see spikes. For example, if little nitrite is in the tank, bacteria may be able to process the proteins and ammonia, but the population of nitrite-consuming bacteria may be inadequate. Until that population increases enough to consume all that is being produced, you may have a spike in nitrite levels. The same is true with ammonia. (For more, see fishlab.com/biological-filtration.)



TANK MAINTENANCE & TROUBLESHOOTING

You can sometimes solve both mechanical and water-quality issues on your own with a little investigation and troubleshooting. The important thing is to keep up with maintenance and catch problems early. If you have a concern, check the applicable section below to try to solve the problem yourself. If you conclude that you need help, call or email your area coordinator. Don't wait until the end of the day! If you end up needing a chiller repair, SIS-SEATTLE can help with a loaner. Most schools will need to budget for their own chiller repairs (approx. \$300 per repair).



CHILLER

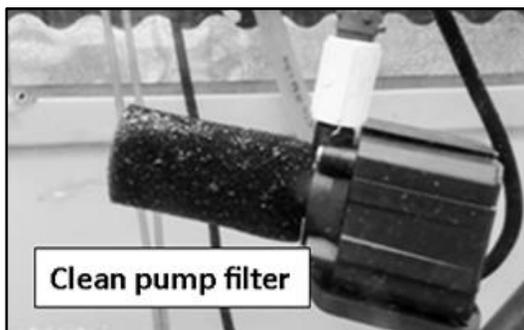
A malfunctioning chiller is the most common mechanical problem. Check water temperature daily as your fish can die in as little as 24 hours in water that a sick chiller cannot keep cold enough.

If the temperature rises into the danger zone (above 55° F):

Wand chiller: Make sure the power is on and that the gray temperature sensor is in the water (not on the floor!).

1. Try unplugging and restarting the chiller to see if it resets itself and resumes cooling.
2. Take the wand out of the water; if the chiller is working properly, the entire wand should start to develop a layer of frost.

Inline chiller: If you see no digital display, the fuse may have popped; **call your area coordinator for a spare**. Also check that your **pump filter is clean**, else adequate flow will not get through.



1. If your chiller still isn't doing its job, call your area coordinator immediately to receive a loaner.
2. Add ice packs or contained ice (frozen in a capped plastic jug) to the tank.

Note: Commercial ice or ice made from city water has chlorine in it, so put it in a large zippered bag and add a few drops of dechlorinator in case any leaks into your tank.

3. Continue monitoring the temperature keep under 55° F if possible.

Even if your chiller is working fine, freeze dechlorinated water in clean milk jugs or other containers to use in your aquarium, if needed. Leave room at the top so freezing doesn't split the plastic jug. Mark container "for salmon use only."



WATER FILTER

Filtration is an essential part of fish rearing. An aquarium filter keeps water healthy for the fish, helps keep the tank looking nice, and can simplify maintenance. The best aquarium filters process three types of waste: biological, dissolved, and solid. Proper balance is needed to limit spikes in ammonia and nitrite.

Porous stones media: Biological waste includes all unwanted contaminants, such as ammonia and nitrate, that must be biologically processed rather than filtered. Biological media in the form of porous stones remove this type of waste by providing surface area for beneficial nitrifying bacteria to grow. These stones can be used again and again for several years.

Chemical- removal media: Organic waste compounds, decaying tissue, and tap water contaminants can dissolve in aquarium water and cause odor and discoloration. Chemical-removal media can be charcoal or ammonia-reducing. Change these media monthly. (*Prime* and *Amquel* chemically bind ammonia, leaving it available for the bacteria to consume; *Ammo Chips* and *Zeolite* do not.)

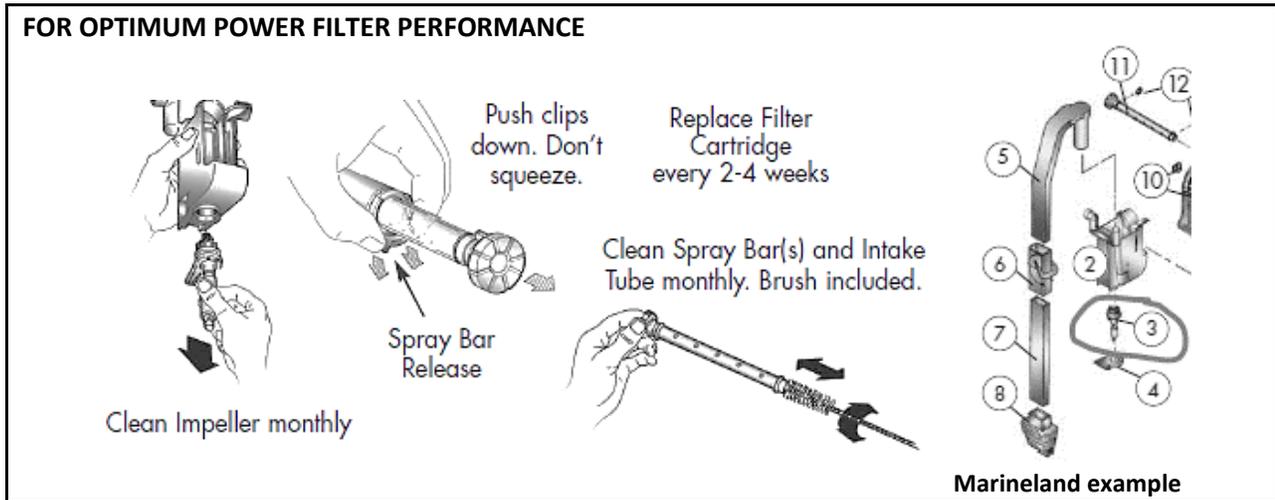
Sponge or pad media: Mechanical filtration removes waste particles or floating debris (fish food and waste). A coarse sponge can be used for several years if properly rinsed.

A new filtration system will not have the nitrifying bacteria necessary for bio-filtration and establishing them can take four to six weeks. You can accelerate this process by adding *Nite-Out*, *Quick Start*, *SafeStart*, or *RediStart* to your tank. The live bacteria will start working immediately to provide a safe and healthy environment for your fish without the long wait. You can also use one of these products after water or filter changes.

FILTER MAINTENANCE

Filters that hang on the back of your tank will require more frequent maintenance than canister filters.

- Avoid cleaning your entire biological filter at the same time. If you have several filter components, alternate cleaning/changing them. Also, do not clean your biological filter with tap water because the chlorine in it can kill your valuable beneficial bacteria.
- Once per week or if you experience reduced water flow through your filter, rinse the filter material in a bucket of tank water to remove slime and waste products, then reinstall. Check the sponge or screen on the uptake tube at the same time to see what may have sucked into the filter.
- Change out filters as recommended by the manufacturer; if you no longer have the information that came with your filter, search online for it.
- Follow the manufacturer's recommendations for cleaning interior pump parts. YouTube is also great.
- Charcoal media can lose effectiveness in as little as 30 days and need to be replaced to control odor and water clouding.
- Mix your media with ammonia or nitrite-reducing material to help with chemical spikes.



IN THE EVENT OF PUMP FAILURE

Although rare, the pump on your water filter may fail. Almost always, failure happens when the impeller that draws water into the pump has gotten damaged and become roughened. You can pull it out to clean it or you may be able to purchase just the impeller for your filter. If you need to order a part, ask your area coordinator if a loaner filter is available.

Maintaining water circulation is essential! Without proper circulation, the bottom of the tank will be depleted of oxygen and your eggs or fish could die. Use a portable aerator to create mini-currents that will mix oxygen-rich water from the top of the tank with oxygen-poor water near the bottom.

CLEANING, TESTING, AND CHANGING WATER

How often your tank needs cleaning depends on the number and size of fish, their food, how well your filtration system works, and the tank's chemical balance. To avoid sucking up hiding alevin, vacuum gravel only after all your fish are swimmers.

In a chemically balanced tank, beneficial bacteria and proper filtration help break down ammonia and nitrite naturally and reduce the need to clean. The simplest way to know if you have a balanced tank is to **test water quality at least once a week**. Never use test strips as they can give false readings.

Here are guidelines for water changes:

- Eyed-egg stage -replace 5-10 gallons 1/wkly. Remove dead/white eggs daily.
- Hatching and alevin stage - replace 10 gallons 2/wkly and remove the foam from egg casings so protein doesn't build up.
- As fry begin to feed -replace 10 gallons 3/wkly. Test water quality once or twice a week to guide your actions. Remove dead fish daily. Keep count of losses to help you become aware of water-quality problems and to know how many fry your students may release.

Once you begin feeding your fry; yucky bacteria, ("gunk," "water bunnies") will grow in the tank. They aren't the problem directly, but they prompt changes in acidity (pH), ammonia, and nitrite that can kill your fish. They also make your tank smell terrible. If you don't test water quality, you may not know you have a problem until your fish begin to die.

If you must vacuum the tank more than once a week, reduce the amount of food you are giving until water chemistry is balanced again.

HOW TO CLEAN THE TANK

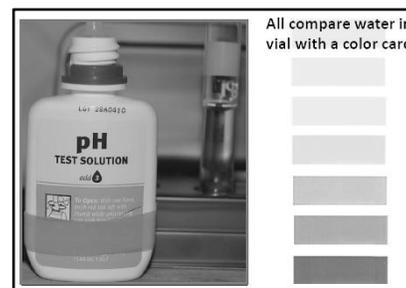
Tools needed: 2 buckets, 5-foot hose, sponge, aquarium vacuum, and small pitcher

Turn off power to filter when water level causes it to gurgle. To restart after cleaning, use a cup to refill the filter chamber with tank water until it overflows back into the tank.

1. Once a week, use a gravel vacuum to pick up uneaten food, egg casings, or other large debris and to tumble debris out of the gravel. A loose mesh or netting attached to the end of the gravel vacuum will help keep fry from being sucked in as you clean. Section your tank into thirds or fourths and clean only one section of gravel at a time, all the way to the bottom. Vacuum a different section next time. Watch your bucket so it doesn't overflow onto the floor. This process can remove 10-15 gallons of water.
2. The more algae growing on the walls of your tank, the more problems you will have with keeping pH within range, plus it clouds the view. Scrape the glass with a tank scrubber or a clean sponge. If your tank is acrylic, make sure your scraper is safe for plastic.
3. Remove any dead eggs (will be a white/yellow-ish color) and/or dead fish daily.
4. Avoid replacing more than one quarter of the water at a time so that you don't stress the fish or upset the chemical balance. If you have a chemical imbalance and need to replace more water, try changing out several gallons over the course of a day instead of all at once.
5. **Always add cold, dechlorinated water** (see Step 6). NEVER USE WARM OR HOT WATER as sudden temperature changes will stress or kill your fish. Although cold tap water won't be 48 degrees, it will be close enough for the amount of water you will be changing.
6. Add an amount of dechlorinator proportionate to the amount of new water (per instructions on bottle) **BEFORE** adding the new water to the tank. **Do not forget this step** as chlorinated water will kill your eggs or fish.

MONITORING WATER QUALITY PARAMETERS

Begin **weekly testing** of water for pH, ammonia, and nitrite **before your eggs arrive**. You need to know if your aquarium has cycled (see page 6), before putting eggs in. *Freshwater* master test kits purchased at an aquarium shop are easy to use and provide a learning experience for students. Here's what to look for when shopping and an example of what's inside.



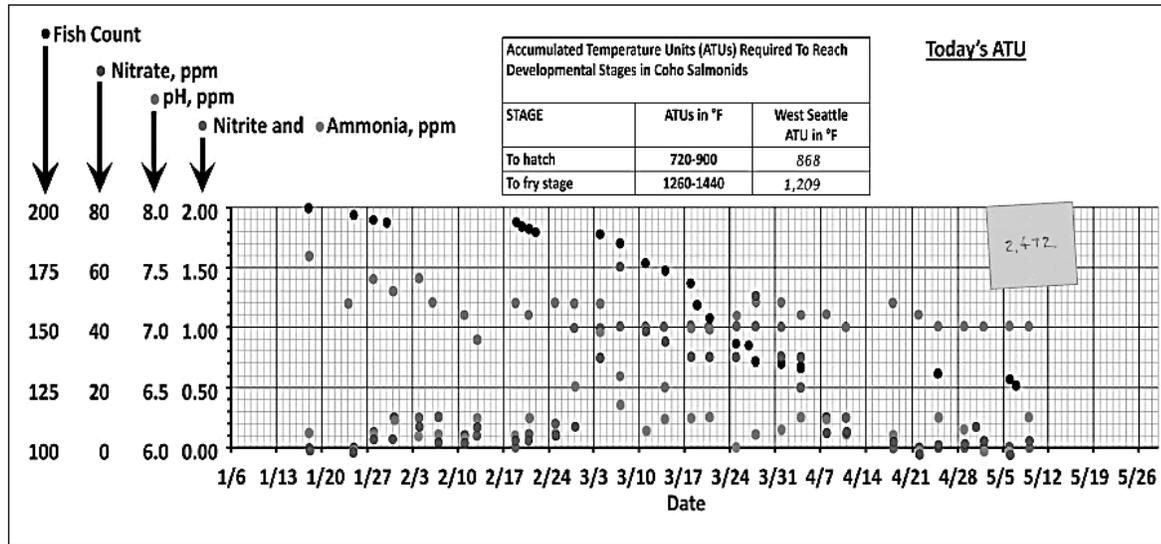
- In a balanced tank, **pH** will be between 7.0 and 7.6.
- If you find more than a trace of **ammonia** or **nitrite**, take the steps that follow to restore balance.
- Your fish will have adequate **dissolved oxygen** if your aerator is working properly and if you maintain the water **temperature** between **46° F and 52° F**.

Test your source water to see how its chemistry may affect results from testing of the water in your tank. If you get a high reading from your source water, retest to be sure of the result before adding chemicals that may not be needed.

If you get a high reading from tank water, re-test before taking corrective action. If the reading remains high, the best and fastest solution is to change out 15 gallons of water and add a double dose of *Prime*. Wait 24 hours, change out another 15 gallons, and test again.

Keep a chart by the tank to monitor for changes (see Appendix H). Students can update this chart each time they test the water. Following is an example of a comprehensive chart that uses colored dots to show multiple parameters.

TRACKING TANK CHEMISTRY: An Example



pH (acidity) - Goal: between 7.0 and 7.6. Pay close attention if it gets too extreme.

You will mostly be using the regular pH test to get your readings. If your water tests at 7.6, use the high-pH test as it will determine how toxic your ammonia reading may be. If you cannot keep pH within this range, consult your local aquarium shop about stabilization products; use them very sparingly and according to directions. Do not change the pH more than 0.2 points within a 24-hour period.

Although you can purchase a pH-raising product (to make the water more basic), it is just baking soda. If the pH is 7.0 or lower, dissolve a half teaspoon of baking soda in 1/2 cup of warm water (for a 55-gallon tank) and add it to the tank. Swish your arm through the tank to mix well.

Your pH level greatly effects the toxicity of your ammonia readings. When you have test results of lower pH and higher ammonia; toxicity will be less.

Ammonia - Goal 0; keep it less than 0.25 ppm.

Ammonia results when not enough beneficial bacteria are present to break down egg casings, fish waste, and uneaten food. It isn't as toxic in acidic water (pH below 7.0) but becomes very harmful (corroding bill and fin tissue) when pH approaches 8.0. To be safe, keep pH below 7.6 **and** ammonia below 0.25 ppm. These articles explain the relationship of temperature, pH, ammonium, and ammonia:

- aquaworldaquarium.com/Articles/TonyGriffitts/Ammonia.htm
- myaquariumclub.com/the-effects-of-ph-on-ammonia-nitrite-and-the-nitrogen-cycle-21226.html

**PERCENTAGE UN-IONIZED AMMONIA IN AQUEOUS SOLUTION
BY PH VALUE AND TEMPERATURE**

pH	Temperature (C)					
	4	6	8	10	12	14
7.0	0.11	0.13	0.16	0.18	0.22	0.25
7.2	0.18	0.21	0.25	0.29	0.34	0.40
7.4	0.29	0.34	0.40	0.46	0.54	0.63
7.6	0.45	0.53	0.63	0.73	0.86	1.00
7.8	0.72	0.84	0.99	1.16	1.35	1.57
8.0	1.13	1.33	1.56	1.82	2.12	2.47
8.2	1.79	2.10	2.45	2.86	3.32	3.85

Follow these steps to bring down ammonia:

1. Stop feeding and do a one-third water change (half in the morning and half in the afternoon). Check your filter, clean it of any decaying material, and retest.
2. The next day, retest both ammonia and pH. Make sure pH is 7.6 or below. If necessary, do another one-third water change (see p. 14) and retest.
3. Add beneficial bacteria to your tank (*Stability, Quick Start*) to help re-establish bacteria colonies.
4. If high ammonia persists, add an ammonia-absorbing resin to your tank or filter system. Your local aquarium shop can sell you one of several effective products. Leave these products in for only a couple of weeks; if they get saturated with ammonia, it could be released back into the tank.

Nitrite - Goal 0. Pay close attention if it gets up to 0.5 ppm.

Nitrite results when other beneficial bacteria break down ammonia. It harms fish by inhibiting the uptake of oxygen and the release of carbon dioxide. Fish thus weakened are susceptible to infection.

1. Re-establish biological filtration by following the instructions about ammonia. Add beneficial bacteria and be patient; they will solve an ammonia problem faster than they will solve a nitrite problem.
2. If nitrite tests high (0.5 to 1 ppm), do partial water changes more frequently, even daily.
3. If neither technique works, find out what is interfering with production of beneficial bacteria. The culprit could be colored gravel, volcanic rocks, toxic build-up, or inadequate cleaning after the tank was used for turtles or reptiles. Or the culprit might be changing filter materials too often or changing both filter pads at the same time; you need to leave a little "gunk" behind.
4. If high nitrite persists, add a nitrite-absorbing resin or aquarium salt to your tank. Your local aquarium shop can sell you one of several effective products.



EGG PICK-UP/DELIVERY

Pick-up/delivery of eyed coho eggs will happen in late 2021. The hatchery determines the date of pick-up/distribution by the developmental stage of the eggs. Eyed eggs have a small window during which they are stable for transport. Our eggs come from Diru Creek Hatchery, owned and operated by the Puyallup Tribe.

Each school will receive 150 eggs, a small amount of starter food for the fry.

Your tank MUST be ready or no eggs!

Your area coordinator will notify you of dates and times for delivery or pick up of eggs at a central distribution point.

If you are to pick up your eggs and find you cannot do so, ask your tank volunteer, a parent, or a colleague to go in your stead, as getting eggs when they are ready is critical. **Bring a clean, small cooler with an ice pack to put your eggs in.** Provide some sort of buffer (newspaper, towel) so your eggs don't rest directly on the ice. **Plan to take your eggs right back to school** (no stopping for coffee along the way!) as they will be very sensitive to movement and temperature.



Egg and Alevin Stage

Eggs generally hatch during their second week in the tank but may hatch earlier or later depending on their development at the time they left the hatchery. Ask your students to record hatch observations on their Salmon Tank Monitoring Record chart (p. 33). During the hatch, egg casings will appear as foam on top of the water.

If you haven't already, begin weekly water testing. Use testing values to determine if water changes are needed. Check daily for dead eggs and alevin and record any on your monitoring chart. Also start checking your chiller and filler screens for gunk build-up.

Alevin stage is fun for students and, apparently, for alevin. Watch as they bounce on their big bellies and bury their heads in the gravel. Then during the first month you may notice that they have all disappeared! Don't be alarmed; they are under the gravel and will emerge when they are ready, just as they would in the wild. Be sure check your filters for any that went astray!

➔ **Note:** Don't disturb your gravel or rocks while cleaning as eggs and alevin are very fragile! Don't start vacuuming the gravel until all fry are able to swim out of the way.



FEEDING YOUR FRY

Do not feed your fish until they have all mostly absorbed their yolk sacs ("buttoned up"). You should not see even a little pink line.

Helpful Hint: Put one to three fish in a clear plastic cup so you can look under them to view their bellies.



This is the "suture line," where the salmon's yolk sac used to be. **It needs to be almost completely gone ("buttoned up") before you start feeding.** These chinook were first fed about a week **AFTER** this photo was taken. Your fish will look very skinny at this point, but they are OK!

IMPORTANT NOTES ABOUT FEEDING

Salmon feed at the top and bottom of the tank and feed better with some daylight on the tank.

- The bigger your fish are when released, the better their chance of survival in the wild. That said, however, try to feed them just to capacity as overfeeding will cause ammonia to spike. Slowly feed only as much as your fish will eat in one to two minutes.
- At each feeding, observe the fish for 5 minutes. If you find uneaten food on the bottom of the tank, feed more slowly next time. If your fish still don't eat it all, reduce the amount.
- Warn students and the building staff about the perils of giving the fish "just a little more." Avoid temptation by keeping your fish food out of sight.
- Your fish will survive over a weekend (even a 3-day weekend) without food; simply feed end of day on Friday and start of day on Monday. For longer periods, **arrange for someone to feed your fish or consider buying an auto feeder.**

WEEK 1 - TEASE FEEDING: Wait until nearly all your alevin are free-swimming fry before "tease feeding" so they will learn to eat. Sprinkle a finger pinch of hatchery food on the water a few times a day. **The fish may spit it out but, after a week, they will begin to eat normally.**

WEEKS 2 - 3: Use a 1/4 teaspoon measuring spoon to dip out hatchery food and gently sprinkle the food over the surface of the water. Slow feeding will give small fish a chance to get their share and prevent food from going straight to the bottom. **Increase the amount each week as you see that they are consuming all the food.** Typically, you should feed 2-3 times a day.

PINHEADS: Some fish ("pinheads") have difficulty learning to eat, most often when feeding begins too early. They hang out on the bottom of the tank and may starve to death. Some may not even absorb the last of their yolk sacs. If you have buttoned-up fish that "fail to thrive," try transferring them to a small, aerated container where they don't need to compete with more aggressive feeders, then try hand feeding them hatchery food or bloodworms with an eyedropper or pipette. Fish require several weeks to starve, so be patient and keep trying. In fact, a fish that is not eager to rise to the top of the water may survive better when released into a natural environment.

An important function of feeding at this stage is to nurture the biological filter so that it will be ready to handle the waste as they eat and create waste. **Test water weekly and increase water changes from now until release.** Consider adding some live beneficial bacteria regularly to your tank to avoid spikes in ammonia or nitrite.

Show students how to use the monitoring chart to record feeding sessions and, until a pattern is established, note in the “Comments” column how much food they dispensed. This record is your check that the fish were fed properly.

WEEKS 4 through 7: If you wish, switch from hatchery food to a flake food twice daily. Because flakes settle slowly, your fish will have a good chance to nibble all this food. A pet or aquarium store will have what you need. **Test water chemistry weekly.**

WEEK 8 to RELEASE: If filtration is working well and you have no problems with ammonia or nitrite, you may switch to feeding frozen bloodworms when the fish are vigorously free-swimming (not resting at all on the bottom). Test water twice weekly for spikes in ammonia and nitrite as bloodworms contain extra protein. To enable students to compare feeding behavior, try using a small amount of hatchery food up to five times daily and supplement with bloodworms once a day. The fish should really attack the more natural food (bloodworms). Use an auto feeder if you find feeding this often isn’t manageable.



SALMON RELEASE

Releasing your fish is often the highlight of the experience of raising salmon! In the spring, your release field trip for 5th graders will be coordinated by your partner. Half day dates will be assigned between March 25 - April 1, 2022. Students will conduct a mini stream survey guided by partner educators. Additional details will be provided in spring.

- Release location complies with permit.
- Water is cool and flowing (aerated) with pools for fry to rest.
- Habitat includes vegetation, woody debris, and/or rocks to provide shelter from predators.
- Students can safely reach the water.
- Your class (or each family group you schedule) will have enough space to gather and not trample habitat.

EQUIPMENT NEEDED

- 1 or 2 clean 5-gallon buckets with handles and lids, preferably light colored so everyone can see the fish
- White non-fragranced plastic garbage-can liners (optional)
- Battery-operated portable aerator; available in local pet stores or online (less than \$20)
- Extra batteries for the aerator
- 2-3 small aquarium fish nets
- Several small, clear plastic cups

TRANSFERRING FRY FOR TRANSPORT

This process could take 30-60 minutes, depending on experience. **If your water is dirty** and hard to see through, consider a water change the day before release. It is heartbreaking to find extra fry in the tank when you go to clean it.

1. Try to **catch fish as close to departure time as possible** so that the water in their bucket doesn't get too warm. You may use an ice pack to keep the water cool but take it out of the bucket before transport as items can crush your fry in transit.
2. Use the same **clean bucket** you have used for water changes. (Some teachers line the bucket with a white non-fragranced plastic garbage bag - white, so you can see the fish.)
3. Fill your bucket about **half full of water from the tank** (only half full because it will be heavy, and water will slosh out). If you have more than 150 fry, use two buckets, with aerators.
4. Put the bucket on a table or sturdy chair close to the tank so that you can quickly release the fry from your net into the bucket.
5. Attach a portable aerator to the rim of each bucket to keep the water in this temporary home oxygenated until your fry are released.
6. **Turn off all tank equipment except the tank aerator. Remove any large rocks and most of the water** to a level of about 6 inches so that catching the fry is easier. Don't worry about counting fish at this point as counting is easier as they are released.
7. Using a large, long-handled net, gently catch the fry and put them in the bucket. If you have particularly feisty fry, you may need to drain even more water from your tank to get the last few. Station a helper with another net on the opposite side of the tank to gently herd fish your way. **Be sure to check the corners of the tank and under large rocks for stragglers.**
8. If you are using a bucket liner, loosely secure it around the aerator tube. If you are using a bucket lid, cut a finger-size hole in it, put the aerator tube through it, making sure the tube end is under water, and tape the aerator to the lid.

Never cover your bucket tightly with a solid lid or plastic! Beware though: If water can slosh out, so can your fry!!

And again, ***never have anything in your bucket except your fish, a small bubble stone, and the aerator tube.***



RELEASING YOUR FRY

Bring small zippered bags of ice to place in your bucket to keep fry chilled and be sure to put the bucket in the shade. Recheck portable aerator and open the lid/bag to give the fish more oxygen. Someone will need to watch the bucket during the program. The partners will help you release the fish.

1. Carry the bucket close to the water's edge. Add some lake water to your bucket. Have students line up or form small release groups.
2. Optional: Explain to your students that the fry doesn't like sudden changes in their water. Direct them to bring a 3-4 cups of water from the creek/lake and pour it into the release bucket to mix with the aquarium water so the fish can begin to get used to the water in which they will be living.
3. Have an adult ready to tally the fish as they are released. Either the adult that is dipping fry or the student that is releasing may call out the number of fish. Clear cups are great for accurate counting. Note: This count is a check against the mortality count that students did while fish were in your tank.
4. Position an adult at the water's edge to steady students as they kneel and stand back up.
5. When all students are ready to release, explain the procedure by saying
 - "When you get a fish or two, immediately put one hand over the top of your cup so that the fish can't jump out, then count the fish and tell the counter how many you have."
 - "Walk carefully to the water and kneel down."
 - "Take time to observe the camouflage markings on your fish. Salmon fry are easy to see when they are in a cup, but their markings will make them nearly invisible in their new home." "Look at them from above; look at them from below. Is there a difference?" "How do the colors help them?"
 - "Hold the cup at the surface of the water and gently tip it to let the fish swim out. Never pour them from high above the water; high diving will stun or kill them!"

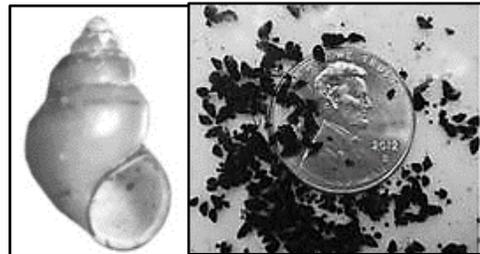
After all fry are released, pour the remaining water from the bucket on the ground. Collect your equipment and, if you had a bucket liner, use the bag for any litter students find in the area.

BEWARE OF HIGHLY INVASIVE MUD SNAILS

New Zealand mud snails (*Potamopyrgus antipodarum*) are tiny freshwater invaders known to be in Thornton Creek, several tributaries to Lake Washington, and the lake shoreline itself. These non-natives have no natural predators, parasites, or diseases so they can multiply very quickly and cause a serious economic and ecological problem for the Puget Sound region.

Adult mud snails are similar in length to a grain of rice, with a pointy tip; coloring can range from gray to dark brown. For more about them, visit kingcounty.gov and search for mud snails.

If you enter the water or adjacent damp areas during a release in an infested location, clean your boots thoroughly (bring a brush for this purpose) and check carefully afterwards to be sure snails haven't hitched a ride. If you go to more than one release spot, change damp or muddy clothing and gear between each. At home, dry your clothing and gear in a dryer on high heat for at least 2 hours or air dry them for at least 48 hours.





END-OF-YEAR TANK CARE

Here is what to do after your salmon are released:

- Carefully remove the chiller from your tank. If using a wand chiller, be careful not to bend soft copper pieces. If using an inline chiller, be gentle with plastic fittings. Set tank hoses down into a bucket before removing hoses from the chiller. Thoroughly rinse hoses in hot water and air dry. A small round ½” brush attached to a 16-gauge wire can be used to push /pull through hoses. Consider replacing if gunky.
- Empty remaining water and rinse the tank/gravel/rocks with clean water (no soap or chemicals). If the tank is dirty, scrub it with baking soda or a strong salt solution, then rinse thoroughly and air dry both the tank and gravel/rocks. Thoroughly blow (with a computer duster/air canister product) or vacuum the dust-off chiller vents.
- Thoroughly clean all filter pieces with warm, clean water, removing any tubing and impellers and brushing clean. **Keep coarse sponges and ceramic cubes**. Dispose of any used carbon/zeolite packs.
- Organize your equipment and inventory to know what you will need for next season. Plan to change out gravel/rocks every three years, more frequently if pH has been difficult to maintain.
- Clearly mark your equipment “SIS-SEATTLE” and add your contact numbers to keep it safe from possible disposal while in storage.

If the staff at your school decides not to participate next year, let us know. If your school does not participate two years in a row, we will drop it from our database and pick up the equipment to pass along to another school, unless other arrangements are made.



Setting Temperature on Johnson-Controls A419

Read these instructions thoroughly if you have this thermostat and need to change the temperature setting.

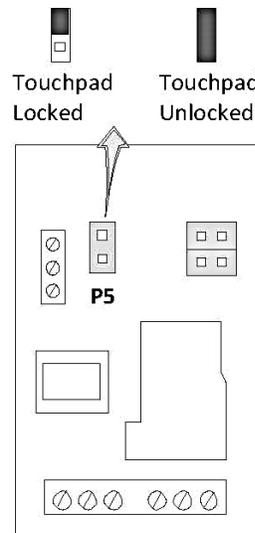
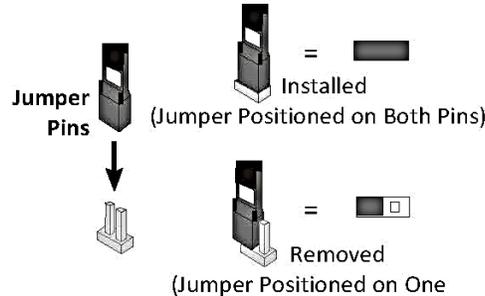
Positioning the Jumpers

The P5 Jumper Pin Block has a single set of jumper pins and is used to lock or unlock the touchpad.

To position a jumper in the “Installed” position, place the jumper on both pins. To position a jumper in the “Removed” position, place the jumper on only one pin. (Save the jumper in case you need it later.)

Position the jumpers as follows. Refer to drawings at right.

1. Verify that all power to the control is disconnected.
2. Remove the cover by loosening the four screws.
3. Position the jumpers to set Cooling/Heating, Setpoint, and Touchpad Lock functions.
4. Replace the cover and fasten in place with the four screws.
5. Restore power to the control.



Setting the Setpoint

To view and adjust the temperature setpoint, follow these steps:



1. Press and hold the **MENU** button until the display changes to flashing **SP**. This will take about 2
2. Press the **MENU** button again. The current setpoint is displayed.
3. Press the **Up** or **Down** button to adjust the setpoint
4. Press the **MENU** button to save. The display then returns to the sensor temperature.

Notes: If no entries are made for 30 seconds while programming is in progress, the control reverts to the normal temperature display.

If the **MENU** button is not pressed after changing the setpoint value, the new value is not saved and the control reverts to the previously saved setpoint value.

Any **saved** control setting values will remain in the control's memory during power interruptions.



APPENDIX F: WEB RESOURCES

CURRICULUM RESOURCES AND REARING TIPS

Tacoma Salmon in the Classroom on Microsoft Teams

Salmon in the Schools-Seattle

sisseattle.org/

Columbia Springs (Vancouver, WA)

columbiasprings.org/salmon-in-the-classroom/sitc-teacher-resources/

Comprehensive learning resources, including materials for download

Fisheries and Oceans Canada

www.pac.dfo-mpo.gc.ca/education/index-eng.html “Stream to Sea” resources for K-12 environmental education

Alaska Department of Fish and Game - Salmon in the Classroom

adfg.alaska.gov/index.cfm?adfg=educators.salmonclassroom

A wide variety of resources

Trout Unlimited - Trout in the Classroom

troutintheclassroom.org

Lots of resources to connect students with their watershed

Franklin Conservation District, 53 videos

franklincd.org/salmon-in-the-classroom

MAINTENANCE REFERENCES

Salmon in the Schools-Seattle YouTube Channel

youtube.com/channel/UC085cm7IRydop6gqbgnsV3Q

Salmon rearing live video, maintenance, set-ups

Filters

Fluval 306 and 406: usa.hagen.com/File/b3378f42-51ae-42e9-8c10-44fdc858d921

Penn Plax Cascade: youtube.com/watch?v=H1Qlh5Mh8Nc; youtube.com/watch?v=XPZgrq4uBFc;

youtube.com/watch?v=T9Q8ucc4Fyc

Marineland/Penguin: marineland.com/customer-service/product-manuals.aspx

Hagen/Aqua Clear: usa.hagen.com/usefultools/instructionmanuals

Gravel Vacuum

youtube.com/watch?v=D6Re04cYJcY

Python Water changer: www.youtube.com/watch?v=d6OoPn0HAAI

Chillers

Aqua Euro: aquaeuroussa.com/image/Chiller Manual for .25HP and .50HP.pdf;

youtube.com/watch?v=uNNPegVpYYI

JBJ: marineandreef.com/v/vspfiles/pdf/DBE-200_manual.pdf



WANTED

SALMON TANK VOLUNTEERS

No experience necessary

High school service credit hours

Flexible schedule during school day or right after

Our school is participating in the Salmon in the Schools program that enables students to experience rearing Pacific salmon from eggs to fry, then releasing them into a nearby waterway. Students develop an understanding of salmon biology, habitat, stewardship, and importance to regional culture and commerce.

TANK VOLUNTEERS

Help set up salmon tank (3-4 hours, fall)

Attend a half-day training on the basics of maintaining a salmon tank (4 hours, fall)

Pick up salmon eggs if not delivered to school (1-2 hours, fall/winter)

Help students observe, monitor, and maintain tank (1-2 hours/week, winter/spring)

Remove and replace tank water (1 hour/2x weekly, winter/spring)

Prepare salmon for transport to release site (1-2 hours, spring)

Help chaperone salmon-related field trips (3-4 hours, 1-3 times, fall/winter/spring)

Contact _____ for more information.



STUDENT GUIDE TO CARING FOR SALMON

FEEDING YOUR FISH

- Tease feedings: Sprinkle a tiny amount of hatchery food on the water a few times a day. The fish may spit it out but after a few days, they will begin to eat normally.
- Routine feedings: Feed no more than your fish can eat in one minute. Salmon feed only as food is falling through the water; they won't touch it once it hits the bottom of the tank. If after 5 minutes you see food on the bottom, reduce the amount. Slow feeding will also ensure that smaller fish get their share. Start with 1/4 teaspoon of hatchery food; if they eat it all, slowly increase the amount.
- To cover for weekends, feed the last thing on Friday and the first thing on Monday. Your teacher will arrange with a custodian to cover for long school holidays.
- Enter the amount of food and time of feeding on the tank monitoring record.

MAINTAINING YOUR TANK

What To Do Every Day

- Check and record water temperature. It should stay between 46° and 50° F. If it's higher or lower, **tell your teacher right away.**
- Check for any trash that might be in the tank and remove it with a net.
- Check for any egg or fish that might have died (mortality). Dead eggs are white. Dead fish could be floaters on the surface or bodies caught at the filter. Remove them with a net and subtract them from the total count.
- Check that the filter system is running and make sure that the air system is bubbling.

What To Do Once a Week (or more frequently if ammonia rises)

- Use the ammonia test kit to check how much ammonia is in the water.
- Use the nitrite test kit to check how much nitrite is in the water.
- Use the pH test kit to check chemical balance in the water.

If any test indicates that the water is not healthy, **tell your teacher right away.**

What To Do Once a Week for Six Weeks Prior to Release

- Rake a net across the gravel to check for any buildup of uneaten food or fish waste.
- Tell your teacher if you think the tank needs cleaning and follow these instructions:
 1. Remove any large stones (put them back when you finish adding new water).
 2. Vacuum the gravel, putting the old water into a bucket. You may have to turn the filter off during cleaning and prime it for ease in restarting. Dump the old water outside on grass if possible.
 3. Working with an adult, fill the bucket with 3-4 gallons of tap water and treat it with a chlorine-removal chemical, as directed on the bottle. The bucket will be heavy so enlist an adult to help.
 4. Replace the water you took out with water from the bucket until the tank is full again.
- Mop up any water spilled on the floor.

SALMON MONITORING TEAMS

GREEN TEAM	RED TEAM
Temperature Specialist:	Temperature Specialist:
Feeder:	Feeder:
Trash / Mortality / Systems Specialist:	Trash / Mortality /Systems Specialist:
Ammonia Tester:	Ammonia Tester:
Nitrite Tester:	Nitrite Tester:
pH Tester:	pH Tester:

A cleaning team will be assigned as needed.

SALMON TANK MONITORING RECORD

1. Make an X to show that feeding and trash/systems have been checked.
2. Track mortality (dead eggs or fish) and keep the total count of live eggs or fish up-to-date.
3. Test and enter your results for ammonia, nitrite, pH, nitrate (if done), temperature, and ATUs.
4. Comments to include date of hatching, chemical additions, cleaning, etc.

POST NEAR FISH TANK

Date		Feeding	Trash/ Systems	Mortality	Count	Ammonia	Nitrite	pH	Nitrate	Temp °C	ATU °C	Comment
	AM	<input type="checkbox"/>	<input type="checkbox"/>									
	PM	<input type="checkbox"/>	<input type="checkbox"/>									
	AM	<input type="checkbox"/>	<input type="checkbox"/>									
	PM	<input type="checkbox"/>	<input type="checkbox"/>									
	AM	<input type="checkbox"/>	<input type="checkbox"/>									
	PM	<input type="checkbox"/>	<input type="checkbox"/>									
	AM	<input type="checkbox"/>	<input type="checkbox"/>									
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