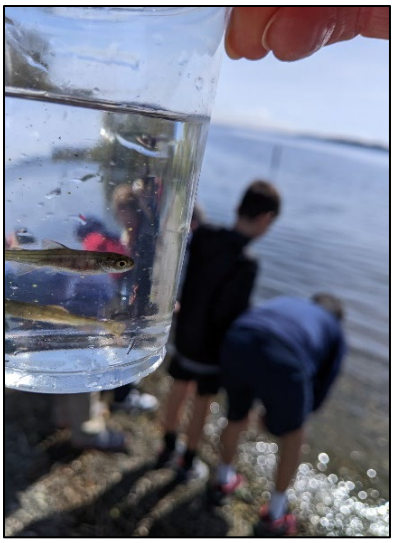
SALMON IN THE SCHOOLS SEATTLE



Salmon in the Schools - Seattle

Teacher Handbook

Welcome to the salmon learning season! Whether you are a first-time salmon teacher at a public school or a returning tank volunteer at a private school, this handbook is your resource for success, from egg delivery to release.

Salmon in the Schools-Seattle (SIS-SEATTLE) supports you raising salmon and guiding students to develop environmental literacy and a stewardship ethic. Find a wealth of other resources at the Seattle Public Utilities SIS-Seattle website.

TOPIC **PAGE**

APPENDICES

ABOUT SALMON IN THE SCHOOLS

Salmon in the Schools uses regional salmon as a gateway to curiosity, wonder, and scientific investigation while connecting students with local watersheds. Students rear salmon from eggs in their school and release them into a nearby waterbody. Through place-based and hands-on learning, the program fosters a strong ethic of stewardship and an understanding of the interplay of stormwater systems and the broader ecosystem.

Throughout this unit, students explore key concepts including:

- Salmon biology, life cycle, and habitat needs
- Local ecology and human-environment relationships
- water quality and the impacts of stormwater pollution
- the cultural, ecological, and economic significance of salmon
- tribal stewardship and Indigenous connections to salmon in the Pacific Northwest

By the end of this unit, each student will

- Build a place-based connection to their local waterbody and watershed
- Recognize salmon as a keystone species with deep cultural and ecological roles
- Develop a personal ethic of care for salmon and their habitats
- Understand and identify how everyday actions and the drainage system impact water quality and salmon health
- Identify civic actions and policies that support salmon recovery and watershed health

This program educates the next generation of environmental stewards, empowering students to see themselves as active participants in protecting this keystone species and shaping the future of their local watersheds.

If you know of another school that might like to participate in this program, refer the teacher or principal to the "Host Salmon in Your School" heading at the Seattle Public Utilities SIS-Seattle website to submit an interest form. Schools seeking to join the program must **apply by MAY 15** for the following school year.

Thanks to the Washington Department of Fish and Wildlife, Seattle Public Utilities, IslandWood, the Carkeek Watershed Community Action Project, the Fauntleroy Watershed Council, the Delridge Neighborhoods Development Association, and staff at participating hatcheries for expertise in developing this handbook. Also, thanks to Celina Steiger and John Sturtevant for page 1 photos. **Your feedback is welcome!! Please contact us at the SIS-Seattle website**

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PARTICIPATING HATCHERIES

- Issaquah Salmon Hatchery: 125 W Sunset Way, Issaquah (425-391-9094)
- Soos Creek Hatchery: 13030 Auburn-Black Diamond Road, Auburn (253-931-3950)
- Grovers Creek Hatchery: 23175 Indianola Road NE, Poulsbo (360-598-3142)

PARTICIPATING WATERSHEDS GROUPS

- Fauntleroy: fauntleroywatershed.org/
- Pipers: carkeekwatershed.org/
- Longfellow: dnda.org/

KEYS TO SUCCESS

Welcome to the exciting adventure of raising salmon! Pacific salmon are key to healthy rivers and forests in the Pacific Northwest - the salmon you and your students rear are part of an educational experience and play a role in salmon recovery. If this is your first year as a Salmon in the Schools - Seattle teacher, here are the most important keys to your success:

ENLIST HELP: We STRONGLY recommend that you enlist a **tank volunteer** or two to help throughout your salmon project, from tank setup through release. These volunteers can do water changes, help students check tank conditions, and generally give a hand so that you can manage this learning experience *and* other responsibilities. Find a sample volunteer recruitment flyer in Appendix 8. If you have difficulty recruiting a volunteer, contact your area coordinator for a possible referral. The Carkeek Watershed Community Action Project is developing a program for recruiting, vetting, and training tank volunteers; learn more by emailing salmonprograms@carkeekwatershed.org.

PARTICIPATE IN OUR WORKSHOP: You and your tank volunteer(s) will learn how to set up and keep your tank and how to incorporate salmon study into multiple curriculum units.

READ THIS HANDBOOK!! It will answer most of your questions. Share it with your tank volunteer(s) and keep a copy close to your tank.

CALL FOR HELP IMMEDIATELY: Ask for technical support 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!

TAKE ADVANTAGE OF OUR OTHER RESOURCES: Use the lesson plans on our website as is or as a spark to develop your own. Rely on your area coordinator to answer questions or link you to someone who can. Register your class for SIS field programs or related field-trip opportunities.

GET YOUR WHOLE SCHOOL INVOLVED: Plan to engage not only your students but also science, art, and math specialists; other teachers; administrative and custodial staff; and families.

LET YOUR AREA COORDINATOR KNOW: IF SOMEONE NEW TAKES OVER AS LEAD SALMON TEACHER AT YOUR SCHOOL.

FINANCIAL ASSISTANCE

SALMON IN THE SCHOOLS - SEATTLE is maintained through volunteer effort, in-kind support, and funding from Seattle Public Utilities and private donations. Depending on available funds, we help with expenses as shown in the table. If your school needs time to buy your equipment, there may be loaner equipment available for schools that need time to buy equipment.

Equipment and Repairs	0%-36% FRL Students	37%- 100% FRL Students	Private Schools
Basic set-up (tank, chiller, stand, filter unit, etc.)	Sliding scale	No charge	Paid by school
Chiller repairs	Sliding scale	No Charge	Paid by school
Maintenance and supplies	Paid by school	No charge	Paid by school
Bus (per field trip)	Up to $150 reimbursement	Full reimbursement	Paid by school

REARING TIMELINE

Following is an approximate timeline if you are rearing coho or chum salmon. If you are rearing chinook, those eggs will arrive about two months earlier, in November, for spring release.

This is not a complete list of all the tasks you will accomplish but provides a good outline. There are references to page numbers in this handbook when appropriate. Also refer to curriculum resources in Appendix 6 to support year-long instruction.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Recruit tank volunteers	X	X	X						
Schedule Fall Salmon Search fieldtrip	X	X	X						
Plan presentations and lessons	X	X	X						
Participate in SISS workshop		X	X						
Set up tank		X	X						
Student instruction		X	X	X	X	X	X	X	X
Monitor water quality					X	X	X	X	
Receive eggs, predict hatch					X				
Observe changes					X	X	X		
Schedule Spring Release Field Trip						X	X		
Feed fry						X	X	X	X
Release fry and document number								X	X
Complete teacher survey								X	X
Clean and store tank for next year									X
Sign up for next year									X

September

- Recruit tank volunteers
- Schedule Fall Salmon Search fieldtrip
- Schedule presentations and plan lessons for the year

October

- Recruit tank volunteers
- Schedule Fall Salmon Search fieldtrip
- Schedule presentations and plan lessons for the year
- Participate in SISS workshop
- Set up tank – instructions begin on page 9
- Observe salmon returning to local watersheds
- Begin student instruction in salmon development and ecosystem concepts

November

- Recruit tank volunteers
- Participate in SISS workshop
- Set up tank – instructions begin on page 9
- Observe salmon returning to local watersheds
- Continue student instruction in salmon development and ecosystem concepts through school year

December

- Continue student instruction in tank care and salmon ecosystem concepts through school year
- Prepare students for observing salmon hatch and behavior after eggs arrive in January

January

- Begin student instruction in caring for salmon and monitoring water quality
- Begin to monitor water quality
- Receive eggs
- Predict hatch date using SISS lesson posted on IslandWood's site Salmon in The Schools – Learn
- Watch eggs hatch, and begin to observe changes in development

February

- Continue student instruction in caring for salmon and monitoring water quality until fry release in spring
- Continue to monitor water quality until fry are released in spring
- Continue to observe changes in salmon development until fry release in spring
- Schedule Spring Salmon Release Field Trip
- Begin to feed fry after yolk sac is completely absorbed
- Arrange for fish care over mid-winter break

March

- Begin student instruction in salmon release and continued environmental stewardship
- Schedule Spring Salmon Release Field Trip
- Continue feeding fry until they are released
- Arrange for fish care over spring break

April

- Continue student instruction in salmon release and continued environmental stewardship
- Release fry and document number released
- Complete teacher survey

May

- Conduct summative review activities about the year of salmon care
- Release fry and document number released
- Complete teacher survey
- Disassemble tank and store for next year
- Sign up for next year

EQUIPMENT & SUPPLIES

You will find everything except chillers at your local aquarium or pet shop. Full set-ups range from $2,000 to $2,400. Yearly maintenance and replacement costs for consumables will be approximately $100. SALMON IN THE SCHOOLS - SEATTLE may be able to help with equipment and supply expenses; talk with your area coordinator. The diagrams that follow show typical setups for a 55-gallon tank on a stand with an inline chiller.

EQUIPMENT

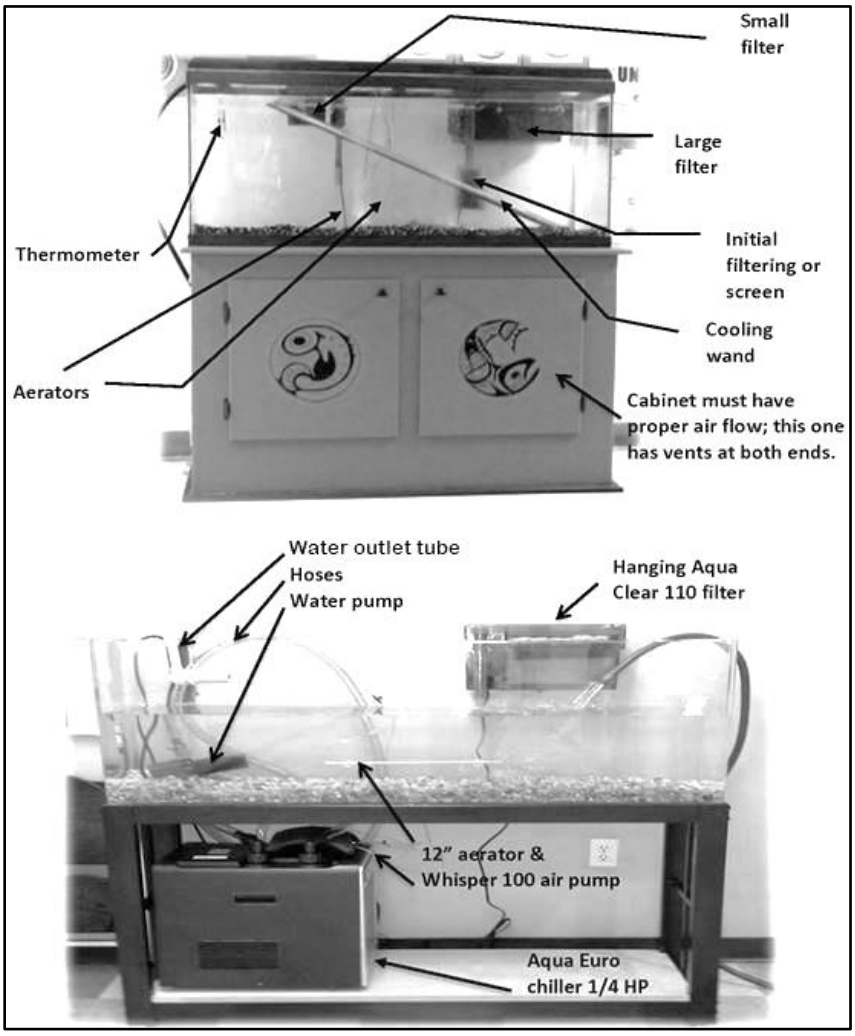
For details about brands and costs, visit sisseattle.org/equipment/ and scroll down to Purchasing Supplies and Equipment.

- 50 or 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. Inline chillers require an in-tank water pump, hoses, and clamps. **Make sure you have those additional parts.**
- 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.
- **3" and 5" fish nets** with long handles.

- 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 lithium battery-operated (rechargeable) **air pump/aerator** for your fry release (area coordinators may have loaners).
- Two new 5-gallon **buckets** to use for tank water exchanges and transporting fry.
- Cotton towels for water spills.

These items are optional:

- 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).



FILTER TYPES

INLINE CHILLER TYPES

SUPPLIES - CONSUMABLES

- 10 lbs. of clean, natural-colored **aquarium gravel** and 12 or more fist-sized **river rocks** to provide places for alevin to hide. Change out gravel every three years or more often 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**.**

These items are optional:

- A **mineral block** to maintain proper pH and water hardness; water changes are, however, a preferred method for maintaining pH levels.
- **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. Hatchery-developed food is more than 50% protein and designed specifically for the growth and health of your fry; you may use it throughout their time in your tank.
- **Frozen/freeze-dried bloodworms** as a step-up food (enough for 2-3 weeks prior to release). Soak them before feeding them to your fry. If you notice that some fry thrive so well on bloodworms that they begin to dominate smaller fish, switch back to other food so all an equal chance to thrive.

TANK SET-UP

Set up your tank **at least six weeks** prior to when you will receive eggs (chinook in mid-October; coho and chum the first week of January). This will enable you to work out any kinks in the system before baby salmon are at risk - 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 for **2-3 days before eggs go in**.

SET UP STEPS

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 AND ROCKS: Use approx. 10-15 lbs. of rinsed, natural pebble-sized gravel for at least half the tank (never colored gravel, dirty gravel, or very old gravel). Use fist-sized rocks and cobbles for the other half. Rinse gravel/rocks well in water to remove dust and algae. Gently spread gravel to at least an inch deep.

IMPORTANT: If you are tempted to add wood to your tank, be sure it is not treated. Do not use green (unseasoned) wood, soft wood (cottonwood, alder), or wood that is exuding sap.

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 check 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 never contained a cleaning product or other chemicals. (A white RV hose for potable water is OK.) Fill 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 or vacuum 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 resettle.
- **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. **Clean this intake pump sponge weekly**

Attaching chiller hoses:

1. Dry measure hose lengths before cutting anything; the inflow hose is 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 to 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.

NOTE: Always turn off power to your chiller and filters before making water changes. Call your coordinator or use the internet to learn more about your chiller.

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 bottom of the tank. Use a rock or gravel to keep them there.

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.

AIR SPONGE FILTERS: This type of filter will optimize surface area for beneficial bacteria in your tank and help retain that bacteria when changing out other filter media. Install inexpensive coarse sponge filters on filter intakes and air hoses.

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 properly, 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.

BIOLOGICAL FILTRATION (NITROGEN CYCLE)

A biological filter is often referred to as a population of beneficial bacteria that eat waste products in the aquarium, thus helping to maintain healthy water chemistry. Some bacteria produce waste products (such as ammonia) that can be very harmful. Others consume ammonia and give off nitrite, which can also be very harmful. Still others consume nitrite and produce nitrate, which is much less harmful. Ideally, very little if any ammonia or nitrite will be measurable in your tank by the time your eggs arrive.

A well-established biological filter keeps tank chemistry under control, and this is why you're asked to establish a functional biological cycle **before** putting eggs in your tank. (Find more detail at fishlab.com/biological-filtration.*)* By assembling your tank and filling it with water, you will be starting your biological filtration (bio filter) system.

Simply put, filtration is done **biologically**, **mechanically**, and **chemically** using multiple media. Many cartridges or inserts that hang on the back of the tank offer some combination of mechanical (sponges) and chemical (charcoal) filtration. Bio filtering (growth of beneficial bacteria) happens within the sponges and on other surfaces within the tank over time.

BIO FILTERING: Ceramic balls, bio balls, or ceramic rings improve tank chemistry by increasing the surface area on which beneficial bacteria can grow. Once established and cared for according to product directions, they can be used over many seasons. Ceramic rings are typically integrated into stand-alone or external in-line filter systems, although can be incorporated into just about any system.

SPONGES: Good bacteria live on the surface areas provided by sponges, so do not scrub them clean. When cleaning, it is best to use a bucket of tank water to squeeze sponges clean. With proper care, they can be effective for many years before they start to disintegrate. At the start of the rearing season, rinse off the largest particles then rinse again if the filter appears to have reduced flow. Rinse again a final time when you take down your equipment at the end of the season. This advice applies to air-driven sponge filters, intake pre-filters, and any other sponge filters within canister systems.

CHARCOAL: It can be used temporarily to reduce a toxin that somehow gets spilled into your tank but best if removed within 4-6 weeks. Left too long, it no longer removes contaminants and may even release the contaminants it's been holding.

Because your system is starting anew, we recommend encouraging beneficial bacteria to grow anew by adding water from an existing tank, which will introduce live inoculant. If you don't have access to that, you can add a product such as Microbe-Lift *Nite-Out*, API *Quick Start*, or *Fritz Zyme 7* to your tank. It is also good to use a dose of one of these products after water or filter changes.

Be sure your system is operational at least 6 weeks ahead of receiving salmon eggs. Do water-quality testing up to the time you get your eggs so that you avoid having to make extreme adjustments after eggs are in the tank. Because the nitrogen cycle will start faster in warm water, set up your tank, confirm that the chiller works, then turn off the chiller (not the pump) to let the system operate at room temperature until a week before you put in your eggs.

TANK MAINTENANCE

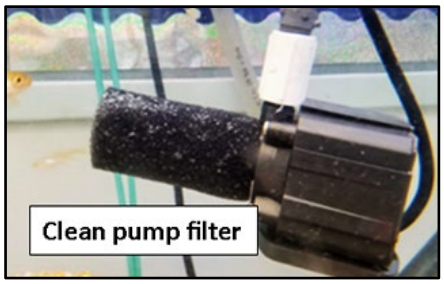
You can sometimes solve both mechanical and water-quality issues on your own with a little investigation and troubleshooting. The important thing is to keep up with maintenance so you catch problems early. If you have a concern, check this handbook to try to solve the problem yourself. If you conclude that you need help, call or email your area coordinator. **Don't wait until the end of the day!** If your chiller needs repairing, your area coordinator can arrange for you to have a loaner. Most schools will need to budget for their own chiller repairs, which can run upwards of $500.

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 if a malfunctioning chiller cannot keep the water cold enough.

If the temperature rises into the danger zone (above 55° F), and you see no digital display on your in-line chiller, the fuse may have popped; **call your area coordinator for a loaner.**

Also check that your **pump filter is clean**, else adequate flow will not get through.



If your chiller still isn't doing the job:

1. 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 checking the temperature to keep it 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 tank if needed. Leave space 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, and it 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 repeatedly for several years.

CHEMICAL-REMOVAL MEDIA: Organic waste compounds, decaying tissue, and tap water contaminates can dissolve in tank 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 unavailable for the bacteria to consume; *Ammo Chips* and *Zeolite* do not.)

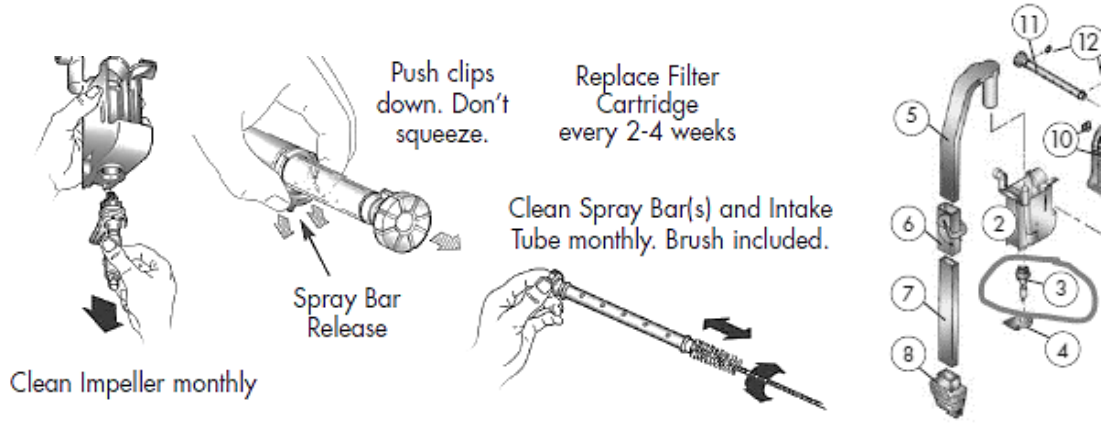
SPONGE OR PAD MEDIA: Mechanical filtration removes waste particles or floating debris (fish food and waste). A coarse sponge can be used for several years if properly rinsed.

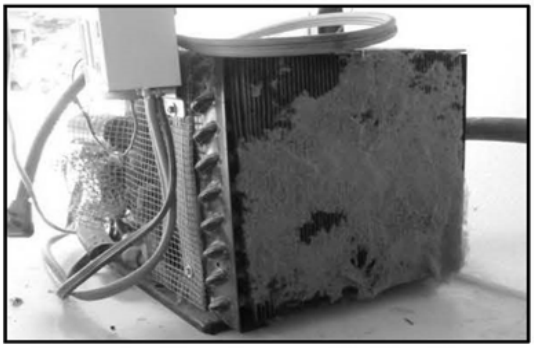
A new filtration system will not have the nitrifying bacteria necessary for biofiltration and establishing them can take four to six weeks. You can accelerate this process by adding *Nite-Out, Quick Start*, *Fritz Zyme 7, SafeStart*, or *RediStart* to your tank. The live bacteria will start working at once to provide a safe and healthy environment for your fish without a 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.

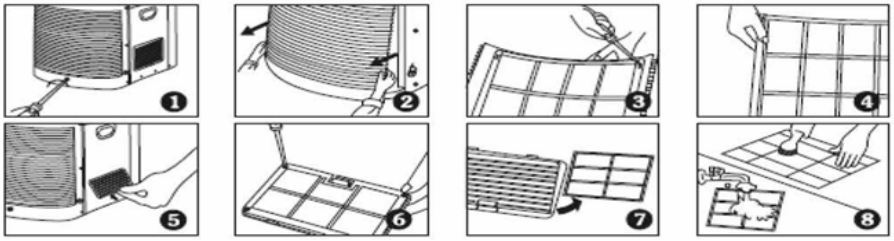




A good way to avoid refrigeration problems is to keep the condenser (the motor, filters, etc.) free of dust and have plenty of air circulation around it. Giving it a thorough cleaning with pressurized gas once or twice a year will go a long way toward keeping it good working order. This photo shows a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



WATER PUMP

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 buy 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 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 hidden 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**. We don't recommend using test strips as they can give readings that don't provide a suitable level of accuracy.

CLEANING 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 cotton cloth, a tank scrubber or a clean sponge. Note: If your tank is acrylic, make sure your scraper is safe for plastic.
3. Remove any dead eggs (will be a white/yellowish 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.

CHANGING WATER
The volume and frequency of water changes is different depending on the development stage of the salmon.
NOTE: Always turn off power to your chiller and filters before making water changes.

- Eyed-egg stage -replace 5-10 gallons once per week. Remove dead or white eggs daily.
- Hatching and alevin stage - replace 10 gallons twice weekly and remove the foam from egg casings so protein doesn’t build up.
- As fry begin to feed -replace 10 gallons three times weekly. 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.

MONITORING WATER QUALITY

Your fish will have adequate **dissolved oxygen** if your aerator is working properly and if you keep the water **temperature** between **46° F and 52° F**. Consequently, your monitoring of water quality will focus on different parameters.

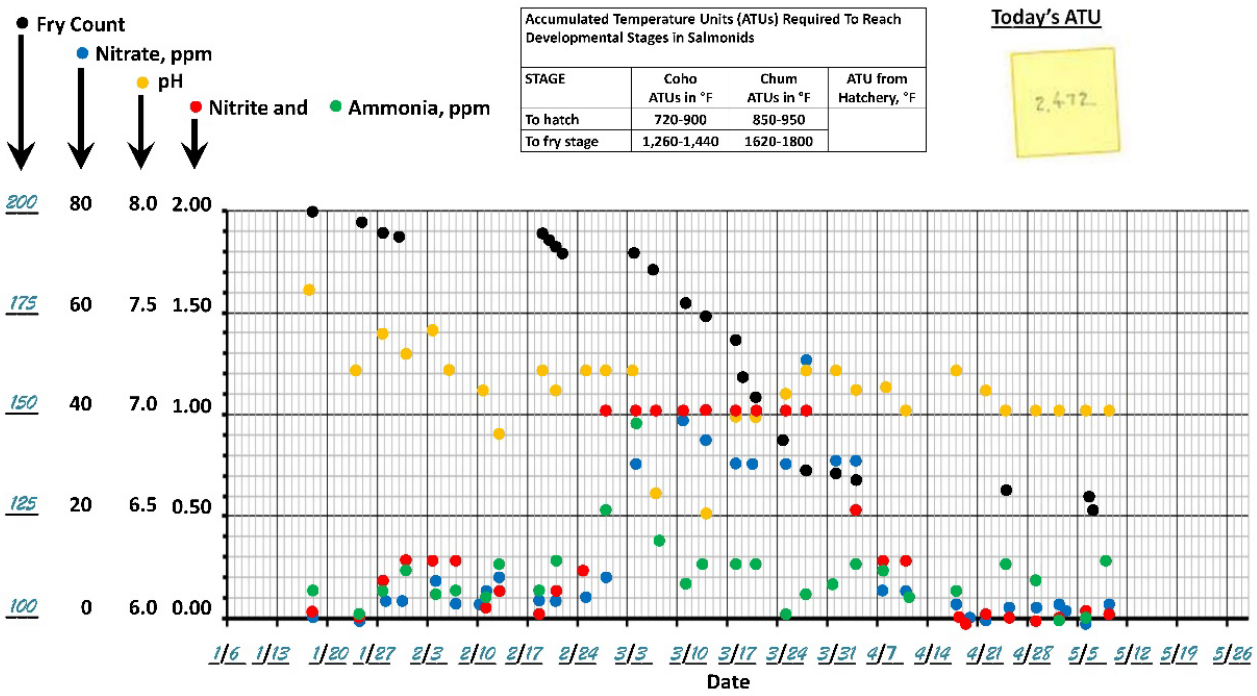
Before your eggs arrive, begin **weekly water testing** for ammonia, nitrite, and nitrate to be sure your tank's nitrogen cycle is established (see page 11). *Freshwater* master test kits bought at an aquarium shop are easy to use and provide a learning experience for students. Here's what to look for when shopping and an example of what's inside.

Test your source water to see how its chemistry may affect test results from 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 is still high, the best and fastest solution is to change out 15 gallons of water and add a double dose of *Prime*. Wait 24 hours, then change out another 15 gallons and test again.

Keep a chart by the tank to document changes (see Appendix 8). Students should update this chart each time they test the water. The following example of a comprehensive chart uses colored dots to show multiple parameters.

TRACKING TANK CHEMISTRY: It's useful and educational to track tank chemistry using a wall chart. This allows you to see trends and verify that the water has been tested You can download a copy of a wall chart on the Seattle Public Utilities SIS-Seattle website.



Accumulated Temperature Units (ATUs) Required To Reach Developmental Stages in Salmonids			
STAGE	Coho ATUs in °F	Chum ATUs in °F	ATU from Hatchery, °F
To hatch	720-900	850-950	
To fry stage	1,260-1,440	1620-1800	

Today's ATU

2,472

pH (ACIDITY): Goal: between 6.6 and 7.6.

Pay close attention if it gets too extreme; a pH below 6.0 can inhibit the establishment of a strong colony of beneficial bacteria. **NOTE:** Water changes are the most effective way to balance pH. Contact your area coordinator if you need more guidance.

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, which will show 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 within a 24-hour period.

Although you can buy 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 a net through the tank to mix well.

Your pH level greatly affects 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 gill 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 between temperature, pH, ammonium, and ammonia:

- Ammonia toxicity and the pH relationship - aquaworldaquarium.com/articles/Ammonia.html
- Effects of pH on ammonia, nitrate, and the nitrogen cycle – myaquariumclub.com

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 off 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. Excess nitrite harms fish by disrupting uptake of oxygen and release of carbon dioxide, leaving them 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 often, 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.

NITRATE: - Goal 10-60 ppm; keep it below 80 ppm.

Nitrate is the final product of the nitrification process in the nitrogen cycle. Bacteria break down organic material to release ammonia; ammonia breaks down to form nitrite and nitrite oxidizes into nitrate. Nitrate is the form of nitrogen that is readily taken up by plants and released as a gas. It can be harmful to fish if persistently high (80 ppm or more). Nitrification requires a good amount of oxygen, which is one reason to have plenty of oxygen bubbling in your tank. If nitrate exceeds 80 ppm, follow these steps:

1. Be sure you follow water-change guidelines because the rate of changes in water chemistry varies with each stage of fish development (see p. 13).
2. Test water quality at least once a week to guide your actions.
3. Alternate changing or cleaning your filter systems; don't do them all at once.
4. If values are still above 80 ppm, change more water and do not clean filter systems.

EMERGENCY PROCEDURES

Emergencies can result from chiller failure, electric power failure, or failure of other parts of your aquarium system. Temperature, aeration, and filters must be checked daily for proper operation. To guarantee that action will be taken before your fish are compromised, multiple people must be aware of the steps to take in the event of any failure.

ALWAYS HAVE BACKUP PERSONNEL KNOWLEDGEABLE ABOUT EMERGENCY PROCEDURES.

CHILLER FAILURE: Have or get a bag of ice to keep tank water cool. Put the ice in a bag so that chlorinated water does not enter the tank. Once ice is in the tank, **call your area coordinator at once to arrange for a loaner chiller.**

POWER OUTAGE: You need to restore aeration quickly, in addition to keeping tank water cool. A portable aerator is very much a temporary fix because it will not put out much air. If you do not have an aerator that turns on when the power fails, keep an emergency aerator with instructions by the tank.

You'll find a variety of battery-operated aerators on the market but be sure to select a well-reviewed one able of supporting a 55-gallon tank. A rechargeable lithium battery-operated aerator is a practical choice because it will continue to run during an outage and can be your portable aerator during release season. Several models are available, so shop around.

Some battery-operated aerators have a sensor that turns on when the power goes off. The Penn Plax Silent Air B11 Air Pump is an example (approx. $26); however, it is sized for 29 gallons so two would be needed. Another choice would be Penn-Plax Air Pod Aquarium Air Pump for Power Outage (Model:APB1) that incorporates automatic battery backup for up to 55 gallons (approx. $35). It has enough battery power for 150 hours. It would be your primary aerator as it is not portable.

Another way to power your aerator and filter might be back-up batteries used for computers. (They would be too expensive to power your pump and chiller and might not work.) One such unit is the APC UPS Battery Backup Surge Protector, 425VA Back-Up Battery Power Supply, BE425M (approx. $55). It would keep the aerator and filter running for over 24 hours.

EGG PICK-UP/DELIVERY

Pick-up/delivery of eyed coho and chum eggs happens in early January, just after winter break. If you are expecting chinook eggs, they will be ready late October/early November. Because eyed eggs have a small window during which they are stable for transport, the hatchery determines the best time for pick-up/distribution.

Depending on your WDFW permit, you will receive 100 - 220 eggs, a small amount of starter food, and (depending on the hatchery), a small container of iodine to disinfect the eggs before putting them in your tank. **Your tank MUST be ready, and your Participation and Expectation Agreement (Appendix 2) must be signed or no eggs!** Your area coordinator will let you know when eggs will be delivered or ready for pick up at a central distribution point.

DISINFECTING: If it is your hatchery's recommendation, follow these directions to disinfect your eggs by following these instructions:

1. Put pre-measured iodine (provided by the hatchery) in **1 gallon of tank water** in a clean bucket or other container. Never use a container that has been exposed to soap, detergent, or other chemicals.
2. Pour eggs from the hatchery cup into a strainer, colander, or large aquarium net.
3. Set the strainer in the bucket of iodine water and leave it there for **10 minutes, making sure all eggs are covered by the liquid.**
4. Lift out the strainer and catch any drips on the rim of the bucket (iodine will stain clothing or carpets).
5. Gently sprinkle eggs from the strainer into the front area of your tank.
6. Dispose of iodine in a sink.
7. Replace **dechlorinated** water in your tank to the fill line.

PREDICTING HATCH: Our ATU lesson plan guides students in predicting hatching and developmental stages. (See the lessons at the Seattle Public Utilities SIS-Seattle website). 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 During the hatch, egg casings will appear as foam on top of the water.

ALEVIN STAGE: If you haven't already, begin weekly water testing. Use testing values to decide 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.

The 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 to 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 almost all have absorbed their yolk sacs. Your fish will look very skinny at this point, but they are OK!

Put one to three fish in a clear plastic cup so you can look under them to view their bellies. You should see a "suture line" where the salmon's yolk sac used to be. It needs to be almost completely gone – buttoned up – before you start feeding. You should not see even a little pink line.

In the picture below, the suture line is still visible on these chinook fry. They were fed about a week after this photo was taken.

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. However, overfeeding is one way to 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.**

FEEDING SCHEDULES

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.** Ideally, you should feed 2-3 times a day.

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 note in the "Comments" column how much food they dispensed. This record is a check that the fish were fed properly.

WEEKS 4 THROUGH 7: Add extra flake food once 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 once or twice a week when the fish are vigorously free-swimming (not resting at all on the bottom). Test water twice a week for spikes in ammonia and nitrite as bloodworms have 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.

PINHEADS: These are fish that have difficulty learning to eat or other fish may out-compete them for food. This also happens when feeding begins too early. They laze on the bottom of the tank and may starve to death. Some may not even absorb all their yolk sac. If you have buttoned-up fish that "fail to thrive," try transferring them to a small container within the tank 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 keep trying. In fact, a fish that is not eager to rise to the top of the water may survive better in a natural environment.

SALMON RELEASE & REPORTING

Releasing your fish is often the highlight of the experience of raising salmon! In the spring, your area coordinator will email you to coordinate your release event. Depending on when your fry are vigorously swimming and feeding, as well as available dates for release, your release might need to happen after spring break. You will be wise to plan how to feed them over that break.

We encourage you to include students and/or families in the release. **You must release at the location specified on your state permit.** (See Appendices 3, 4, and 5 for details about releasing in Carkeek Park, Lake Washington, and Fauntleroy Creek.)

SEATTLE RELEASE SITES

Visit your release site in advance if possible! You don't want to release into an algae bloom or have a park closure put a kink in your plans. A visit will tell you how many volunteers are needed to help make your release field trip go smoothly.

Your release site should have the following characteristics:

- It complies with your WDFW 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 group you schedule) will have enough space to gather and not trample habitat.

TRANSFERRING FRY FOR TRANSPORT

Fish depend on ample air. Test your aerator before transport to ensure it is working and that it has a weighted aerator stone that sinks into the water. It is important to test that the air stone will remain on the bottom of the bucket during transport - fry have died when the air stone floats. The aerator will ride on top of the lid while the air stone is in the bucket.

For fish safety, there should be nothing in your transport bucket except fish, water, and the aerator stone. You may use a cooling pack to cool water on site but remove during transport to avoid crushing fry. Prepare cooling packs by freezing some tank water and placing cubes in sealed plastic bags.

Transferring fish from your tank to the transport bucket should be done on the release day as close to your departure time as possible. It will take 30-60 minutes, depending on experience. It is a good plan to assign someone to collect the fry while having someone separate assigned to managing students. Plan ahead to make this a calm experience for both you and your fish.

Preparing Your Tank
Vacuum clean the bottom of the tank on the day(s) prior to collecting the fry. Consider a water change the day before release. Dirty water makes the process more difficult and more stressful for the fry.

Prior to netting the fry, unplug the chiller, chiller pump, and any filters. Remove enough water from the tank so about 8 inches remain. Remove as many obstacles in the tank as possible including large rocks, decoration(s), and the air sponge. The tank should look relatively "empty."

Transfering Fry From Tank To Bucket

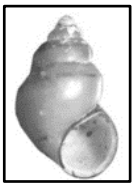
Equipment Needed

- one or two 5-gallon buckets for removing water from the tank
- one clean 5-gallon bucket for transporting the fry, preferably dark in color to reduce the light stress on the fish, and/or a large towel to cover bucket and further reduce light
- one lid for the transport bucket with a small hole near center large enough for the aerator air hose to pass through
- rechargeable (lithium battery) aerator with hose and **weighted** air stone.
- several aquarium fish nets of various sizes
- extra/new batteries for the aerator if your aerator uses batteries

Procedure

1. Fill your bucket 2/3 full of water from the tank – more water will slosh out during travel.
2. Place the bucket on a sturdy location close to the tank so that you can quickly handle the fry from the tank to the bucket.
3. Prepare the aerator. Separate the hose from the aerator, thread the hose through the hole in the lid (inside to outside), and reconnect the hose to the aerator. Ensure there are plenty of bubbles coming from the air stone.
4. Move slowly while netting fry so they are not injured. The last few fry can be the most challenging to net, so be patient and go slow.
    a. Use one net to push the fish and one to catch them
    b. Grab the bottom of the net with the fish before turning the net upside down into the bucket. Then drop the net through the net frame so no fish get caught.
    c. Be sure to check the corners and other places of the tank for stragglers.
5. Replace the lid with the aerator on the bucket. Verify the aerator produces ample bubbles.

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 deep 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.

RELEASING YOUR FRY

If possible, release as soon as you arrive on site. If you are to have a program first, place small, zippered bags of ice in your bucket to keep fry chilled and put the bucket in the shade. Recheck that your portable aerator is working to keep fry oxygenated. Assign someone to watch the bucket during the program.

1. Carry the bucket close to the water's edge. Add some water from your release site to your bucket. Have students line up or form small groups.
2. Optional: Explain to your students that the fry don't like sudden changes in their water. Direct them to bring 3-4 cups of water from the creek/lake and pour it into the release bucket to mix with the tank 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 getting an accurate count. 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!"

CLEAN UP DIRECTIONS

After all fry are released, pour any water remaining in the bucket onto nearby grass or brush. Collect your equipment and, if you had a bucket liner, use that bag for any litter students find in the area.

Plan to clean up the tank/equipment in the next few days while the hoses, tank and filters are still somewhat 'soft' and more easily cleaned. The goal is to have everything cleaned and dried for the off-season. Anything left slightly wet in the off-season has the potential to develop harmful black mold.

RELEASE REPORTING AND TEACHER SURVEY

The Washington Department of Fish and Wildlife requires us to report how many fish all Salmon in the Schools - Seattle schools released, when, and where. You will be notified if your area coordinator plans to do this reporting for you. Make a note of how many you released in case we need to check with you directly.

Shortly after your release, you will receive the link to our online teacher survey, which is your opportunity to tell us what worked for you and what we might improve. We highly value what you have to say and appreciate your taking a few minutes to tell us.

END-OF-YEAR TANK CARE

Soon after your salmon release, t**ake photos of your set-up**; you'll be glad you did when set-up time comes around next fall! **Turn off power to all equipment** and have towels and buckets at hand before you start to clean.

WATER

Dip or siphon out all the water into buckets. You'll likely need sponges to soak up the last of the water. Wait until the very end of your cleaning process to clean gravel/rocks and the tank as you will need those buckets.

CHILLER

Instructions vary based on your chiller type. These instructions are for these filters: JBJ 1/10 hp Arctica Chiller or Aqua Euro 1/4 hp Max-chill Titanium

1. To maintain chiller effectiveness, "backflush" it according to manufacturer instructions. Do this after disconnecting the chiller and chiller pump from the tank.
2. With the hose still attached to the chiller pump, submerge the pump in a bucket of tap water. Place the outflow end into another bucket that's empty or, alternatively, into a sink.
3. Swap inlet and outlet hoses at the chiller by unscrewing them and trading places at the connectors.
4. Fill the bucket with the chiller pump with tap water.
5. Plug in the chiller pump and turn it on to pump water from the bucket into your empty bucket. Monitor the outflow end.
6. Repeat at least 3 times.
7. Place approximately 1 cup of distilled vinegar in the last bucket to disinfect the chiller. The vinegar will dissipate when you're ready to use the chiller again.
8. Drain the chiller by tipping it on its backside over the sink.
9. After backflushing, remove the connectors from either end of the hoses and remove any hose clamps. You may have to cut the hoses.
10. Take the hoses to a large sink and thoroughly rinse them in hot water as you push/pull a round 1/2" bottle brush attached to a 16-gauge wire though the hoses. Hoses are clean when no residue remains inside (they may still have coloring). If they are hard, consider replacing them.
11. Gently turn over your chiller to remove any remaining water.
12. Thoroughly rinse the pump filter.
13. Remove any dust from chiller screens (may require a screwdriver).

FILTERS

End-of-year care of your filter depends on which type you have.

Canister Filters
Penn Plax Cascade 1000 or 1200 OR Fluval 306 or 406

1. Turn off hose valves at canister. Detach plastic pieces from hoses inside tank. Carefully lift out hoses and put them into a bucket, then open valves to drain a little water before opening the top of the canister. Take canister to a large sink to finish draining.
2. Keep all coarse sponges and ceramic cubes. Dispose of any used carbon/zeolite packs and white fiber media as you will need new supplies for next fall.
3. Use a brush to thoroughly clean all filter pieces with warm, clean water; remove any tubing and impellers to clean them.

Hang-On-The-Back Filters
Aqua Clear, Marineland, Emperor, or Tetra

1. Remove and throw away any carbon or zeolite packs. **You will need new supplies for next fall.**
2. Rinse bio-wheels in warm water and air dry. Rinse sponge; replace only if torn.
3. Carefully lift out the filter as it will be full of water. Drain and rinse thoroughly with warm water and clean the impeller.
4. Rinse sponge filter thoroughly and air dry. It will last for many years if rinsed regularly.

TANK

1. Remove any rocks or gravel and rinse with clean water (no soap or chemicals). Fill a bucket halfway will gravel and swish with hands under running water. Continue until all is clean, then air dry in buckets.
2. If the tank is crusty, gently scrub with a micro-fiber towel soaked in vinegar, then rinse thoroughly and air dry.

STORAGE

- Organize your equipment and inventory your supplies to know what you will need for next fall. Buy them now, if possible. Plan to change out gravel/rocks every three years (more often if pH has been difficult to maintain).
- Clearly mark your equipment “SIS-SEATTLE” and add your phone/email contacts to keep it safe from possible inadvertent disposal while in storage.

If the staff at your school decide 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 active school database. Unless other arrangements are made, we will pick up the equipment to pass along to another school.

APPENDIX 1: EDUCATION OPPORTUNITIES

There are activities and resources posted on the IslandWood Learning website related to salmon biology, habitat, stewardship, and the importance of salmon to Pacific Northwest culture and commerce. Most of them now support Next Generation Science Standards and/or Common Core. Find them at learn.islandwood.org/ under the category Salmon in the Schools.

FALL SPAWNING FIELD TRIPS

Fall Salmon Program: Seattle Public Utilities and IslandWood offer a FREE naturalist-led program in the fall at Carkeek Park, which will prepare your students for rearing salmon. It will introduce them to basic salmon biology and ecological concepts during a hands-on and interactive outdoor program. Space is limited and scheduled on a first-come first-serve basis. Contact Celina Steiger at celinas@islandwood.org for details.

The Carkeek Watershed Community Action Project offers tours and classes about returning salmon in the fall. In the spring, students can feed thousands of chum fry in imprint ponds. Both fall and spring programming may be customized in content and length. Email David Koon at salmonprograms@carkeekwatershed.org for details.

Salmon SEEson: Prepare your students for rearing salmon by seeing spawners during this most exciting phase of the salmon life cycle. Find details about opportunities in King County at Salmon SEEson King County.

CREEK-O-SYSTEM FIELD STUDY

In partnership with Seattle Public Utilities, IslandWood offers 5th graders in Seattle Public Schools a field study aligned with Next Generation Science Standards. It is designed to enhance and localize the Amplify Ecosystems Restoration unit. Find details at islandwood.org/ecosystems-field-study/.

FRIENDS OF THE ISSAQUAH HATCHERY (FISH)

FISH offers guided tours of the hatchery and a changing menu of other learning opportunities. To inquire, email education@issaquahfish.org, call 425-392-1118, or visit issaquahfish.org.

SALMON DISSECTIONS

Offered when spawner carcasses are plentiful, dissections are an engaging way to acquaint upper-elementary and older students with salmon anatomy and how a body's major systems work together. Check with your area coordinator about availability. A fee may apply.

CEDAR RIVER WATERSHED EDUCATION CENTER

This regional facility above the shores of Rattlesnake Lake in the Cascade foothills is a gateway to the watershed that provides drinking water for 70% of people living in the greater Seattle area. Visit the Seattle Public Utilities Cedar River Watershed Education Center website for details about current learning opportunities.

APPENDIX 2: PARTICIPATION & EXPECTATION AGREEMENT

Salmon in the Schools - Seattle is a coalition of educators, agencies, and advocates working together to support the Salmon in the Schools program in Seattle. This agreement itemizes responsibilities and expectations for this partnership.

SALMON IN THE SCHOOLS - SEATTLE SHALL

- Coordinate permits and release reporting with the Washington Department of Fish and Wildlife (WDFW). Organize logistics for the delivery and/or pick-up of eggs (as shown on WDFW permit).
- Advise the school about what equipment and supplies to get for initial setup or for replacement.
- Guide the school acquiring the necessary equipment.
- Provide training and support to assemble the aquarium and associated equipment and maintain healthy water quality to ensure salmon survival.
- Provide guidance and support for the end-of-season cleanup and storage.
- Provide loaner equipment in case of damage or failure. Any loaner equipment will be available only until the school is able to repair or replace the equipment.
- Assist with equipment repair costs (if funding is available and based on documented school need).
- Provide learning resources, technical support, and advice from the time of tank setup and through the season to fry release and end-of-season cleanup.

PARTICIPATING SCHOOLS SHALL

Tank and Fish Care

- Maintain the tank, chiller, and other equipment, per recommendations.
- Monitor water chemistry regularly, per recommendations.
- Feed the fish per instructions.
- Provide funding for equipment based on school's identified ability to pay.
- Replace filter components and other consumables as needed and per instructions.
- Release salmon fry at the location designated in the WDFW permit.
- Complete and submit all reports, including end-of-year teacher survey and other requested information.
- Keep the tank and equipment in a location that the whole school can access while ensuring the location is secure and regularly monitored. Create a school culture about the importance of leaving the tank undisturbed.
- Ensure the power supply is secure and undisturbed throughout the season.
- Coordinate a plan to help with feeding the fish and maintaining the water quality over breaks.
- Use the tank only for salmon since hosting any other species may endanger the health of the fish and is in violation of your permit.
- Retain a copy of WDFW permit.
- Perform end-of-season equipment care and storage, per recommendations. Ensure everything is well labeled and secure in the off-season. The school is responsible for missing equipment.

Classroom Learning

Classroom learning about salmon may take any form that a teacher finds effective and appropriate for their students, both in providing special salmon lessons and/or incorporating salmon into other activities that address

state learning standards. The IslandWood lesson resources website learn.islandwood.org provides a collection of learning resources. At a minimum every participating teacher is required to:

- Orient students to the importance of salmon in the Pacific Northwest, including to indigenous peoples, and to the water-quality, habitat, and other challenges they face.
- Involve students in observing eggs, alevin, and fry in their tank, documenting their observations, and caring for their fish.
- Engage students in learning about salmon and sharing what they learned with others.
- Include students in the salmon release and take them on other field trips as possible to learn about salmon habitat and connect what they experience with personal stewardship.

Project Wrap-Up And Reporting

- Release fry where specified in the permit.
- Summarize classroom learning activities/objectives by completing and filing the teacher survey.
- Inform Salmon in the Schools - Seattle if you no longer wish to participate, are changing schools, or are passing the salmon care along to another teacher in your current school.

HOLD HARMLESS AGREEMENT

The school named below and its lead salmon teacher shall hold Salmon in the Schools - Seattle, Seattle Public Utilities, IslandWood, the Carkeek Watershed Community Action Project, the Fauntleroy Watershed Council, and Delridge Neighborhoods Development Association harmless from personal injury or property damage associated with having a salmon aquarium and related equipment at either the school or an offsite location during any closure of the school building.

The lead teacher and any volunteer and other school staff helping that teacher shall make every effort to ensure that equipment is safely placed, and electrical connections are safely made. Should an equipment malfunction occur that the teacher or volunteer cannot resolve, the teacher shall contact Salmon in the Schools - Seattle technician and/or area coordinator, immediately for repair or replacement at salmon@islandwood.org.

By signing this agreement, you agree to adhere to all points above to the best of your ability.

The principal and the lead salmon teacher must sign this contract. Keep one copy with the tank, file one copy with the principal, and scan the original signed copy and email it to salmon@islandwood.org.

School Name _____ **Office Phone** _____

Principal Signature _____ **Printed Name** _____ **Date** _____

Lead Teacher Signature _____ **Printed Name** _____ **Date** _____

Grade(s) represented by Lead Teacher _____

(Optional) Other Staff _____ **Printed Name** _____ **Date** _____

APPENDIX 3: CHUM FOR RELEASE IN CARKEEK PARK

Here is advice unique to rearing chum fry for release into the Pipers Creek system in northwest Seattle's Carkeek Park:

BACKGROUND

Pipers Creek and its tributary, Venema Creek, in Carkeek Park supported wild coho and chum salmon runs until the 1930's when increased urban development in the watershed led to their extinction. In 1980, the Carkeek Watershed Community Action Project (CWCAP) began salmon recovery efforts and still coordinates them today. Your chum salmon eggs are provided through a partnership between CWCAP and the Suquamish Tribe's Grover's Creek Hatchery in Kitsap County. Grover's Creek is the nearest hatchery source for eggs and therefore the closest possible genetic match to the original salmon in the Pipers Creek system.

Chum salmon were selected as the target species for restoration efforts in Carkeek because they have a shorter creek residency as compared to other species. Soon after emerging from the gravel, chum fry move quickly out of the flashy urban creek system and into the more stable environment of the estuarine waters of Puget Sound. Because chum released directly into the creek system as fry would not remain there long enough to enable them to find their way back as spawners, they must imprint to the creek water. Accordingly, CWCAP volunteers operate and maintain the Les Malmgren Imprint Pond, where school fry are imprinted for a minimum of two weeks, then released into Venema Creek in the evening before a morning high tide to ease their migration from the creek system to the Sound.

RELEASING YOUR FRY

If you are rearing chum, your permit requires that you release them into the imprint pond in Carkeek Park, rather than directly into a creek. Watch for an email with details on scheduling your release. The Les Malmgren Imprint Pond is used for multiple releases so the dates for imprinting school fry are limited and must be adhered to.

APPENDIX 4: COHO FOR RELEASE IN LAKE WASHINGTON

Here is advice unique to releasing coho fry at the location of your choice along Lake Washington:

RELEASING YOUR FRY

In partnership with Seattle Public Utilities, IslandWood offers a limited number of salmon-release field programs that include an educational scavenger hunt. These programs are prioritized for low-income and public schools, and bus reimbursements in line with our bus policy are also available. Watch for a registration email in early spring. You may also request help from Salmon in the Schools - Seattle for your release by contacting your area coordinator. In addition, read recommendations in the "Salmon Release & Reporting" section of this handbook. Contact Ry Yahn at ry.yahn@seattle.gov to inquire about getting a transportation subsidy for your field trip.

TOXIC ALGAE BLOOMS

Check for toxic algae blooms near your preferred release site (nwtoxicalgae.org) and always have an alternate site in mind in case of a bloom. Cyanobacteria (or blue-green algae) can produce toxins at levels that are harmful to humans, pets, domestic animals, and wildlife. High biomass blooms, whether of toxic or nontoxic species, can accumulate as thick scums and mats, which decompose causing excessive oxygen consumption (hypoxia). Most cyanobacterial blooms occur during warm months (summer and early fall). Just avoid them.

RELEASE LOCATIONS NORTH OF THE SHIP CANAL

- Matthews Beach (release at the beach north of Thornton Creek)
- Magnuson Park (release at the beach in the north end)

RELEASE LOCATIONS SOUTH OF THE SHIP CANAL

- Madrona Park
- Seward Park
- Pritchard Beach
- Be'er Sheva Park

INVASIVE ALERT

See information on p. 23 about highly invasive New Zealand mud snails that could be present at your Lake Washington release site.

APPENDIX 5: COHO FOR RELEASE IN WEST SEATTLE CREEKS

Replacement of the 45th Ave. SW culvert in the Fauntleroy Creek system to restore spawner access to the middle reach is expected to start in spring 2026. Ensuring the health and safety of fish throughout the two years of construction will require having no releases in Fauntleroy Park in 2026 and 2027.

Nearly all schools assigned to the Fauntleroy Watershed Council will instead release in Longfellow Creek for the duration of the culvert project. Council volunteers will fully support these schools, from tank set-up through the release field trip. A few small-group releases will happen in lower Fauntleroy Creek by special arrangement. The Delridge Neighborhoods Development Association will work with several schools located within the Longfellow watershed to connect students to their local watershed.

APPENDIX 6: WEB RESOURCES

CURRICULUM RESOURCES AND REARING TIPS

Salmon in the Schools - Seattle
Salmon in the Schools Seattle- Utilities | seattle.gov
Field trips, bus reimbursement, general information

IslandWood
Salmon In the Schools – Learn
Learning resources

Columbia Springs (Vancouver, WA)
columbiasprings.org/salmon-in-the-classroom/sitc-teacher-resources/
Comprehensive learning resources, including materials for download

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

MAINTENANCE REFERENCES

Franklin Conservation District (Pasco, WA)
franklincd.org/salmon-in-the-classroom
Resources include many tank-related videos

Filters
Fluval 306 and 406: Fluval 306 Manuals | ManualsLib
Penn Plax Cascade: youtube.com/watch?v=H1Qlh5Mh8Nc
Marineland/Penguin: marineland.com/customer-service/product-manuals.aspx
Hagen/Aqua Clear: HAGEN AQUACLEAR 20 PRODUCT INFORMATION Pdf Download | ManualsLib

Gravel Vacuum
Aqueon siphon: youtube.com/watch?v=D6Re04cYJcY
Python water changer: youtube.com/watch?v=d6OoPn0HAAI

Chillers
Aqua Cooler manual: Microsoft Word - 001-D130 (R Series I,II and III Manual)
Aqua Euro manual: Aqua Euro USA Chiller User Manuals Download | ManualsLib
JBJ Artica manual: DBE-200_manual.pdf

JOIN US!

AS A SALMON TANK VOLUNTEER

No experience necessary

High school service credit hours available

Flexible schedule during school day or right after

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

ACTIVITIES IN WHICH YOU MIGHT PARTICIPATE AS A VOLUNTEER

Help set up our salmon tank (3-4 hrs., fall)

Attend training on the basics of maintaining a salmon tank (4 hrs., fall)

Pick up our salmon eggs if not delivered to our school (1-2 hrs.; fall-winter)

Help students observe, monitor, and maintain our tank (1-2 hrs./week; winter-spring)

Remove and replace tank water (1 hr. twice weekly; winter-spring)

Prepare our salmon for transport to the release site (1-2 hrs., spring)

Help chaperone salmon-related field trips (3-4 hrs. 1-3 times; fall-spring)

This assignment requires passing a Washington state background check.

For more information, contact _____

at _____

APPENDIX 8: STUDENT GUIDE & MONITORING FORMS

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 degrees 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.

Water Testing Once a Week

- 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.
- Test more often if ammonia rises.

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

Weekly Tasks After Alevin Develop Into Fry

- 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:
  - Remove any large stones (put them back when you finish adding new water).
  - 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.
  - 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.
  - 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

TEAM ASSIGNMENTS	GREEN TEAM	BLUE TEAM
Temperature Specialist:		
Feeder:		
Trash / Mortality / Systems Specialist:		
Ammonia Tester:		
Nitrite Tester:		
pH Tester:		
Cleaners:		

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 include date of hatching, chemical additions, cleaning, etc.**

POST NEAR FISH TANK

Date		Feeding	Trash/ Systems	Mortality	Count
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		
	PM	☐	☐		
	AM	☐	☐		

Ammonia	Nitrite	pH	Nitrate	Temp °F	ATU °F	Comment