

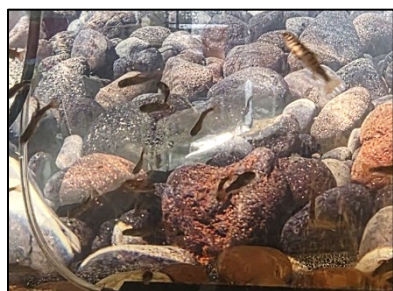


TEACHER HANDBOOK

2026-27

Welcome to the 2026-27 salmon learning season! This handbook is designed for anyone involved in salmon education—regardless of your role, school type, or experience level—and will guide you from the arrival of eggs all the way to releasing fry into the wild.

Salmon in the Schools-Seattle (SIS-SEATTLE) is here to support you every step of the way as you guide students in developing environmental literacy and a stewardship ethic. Find many additional resources on the Seattle Public Utilities website [Seattle.gov/salmon-in-the-schools](https://seattle.gov/salmon-in-the-schools).



TOPIC	PAGE
About Salmon in the Schools	2
Contacts.....	3
Keys to Success.....	4
Financial Assistance.....	4
Rearing Timeline	5
Equipment & Supplies.....	6
Tank Set-Up	8
Tank Maintenance.....	11
Emergency Procedures	16
Egg Pick-Up/Delivery.....	16
Feeding Your Fry	17
Salmon Release & Reporting.....	18
End-of-Year Tank Care.....	21

APPENDICES	PAGE
1. Education Opportunities	23
2. Participation & Expectation Agreement	24
3. Release Sites.....	26
4. Web Resources.....	28
5. Sample Tank Volunteer Recruitment Flyer	29
6. Student Guide & Monitoring Forms.....	30



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.

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

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
- identify the impacts that everyday actions and local drainage systems have on 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 [Seattle.gov/salmon-in-the-schools](https://seattle.gov/salmon-in-the-schools) 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 with consultant Jack Lawless, the Delridge Neighborhoods Development Association, and staff at participating hatcheries for expertise in developing and updating this handbook. Also, thanks to Summit Public Schools: Atlas, Dave Gershgorin, and Tom Trulin for page 1 photos. **Your feedback is welcome!! Please contact us at [Seattle.gov/salmon-in-the-schools](https://seattle.gov/salmon-in-the-schools).**





Contacts

Program Coordination

Michelle Herrmann, Seattle Public Utilities
Stormwater in the Schools Program Manager
Coordinator for Salmon in the Schools-Seattle
michelle.herrmann@seattle.gov

Celina Steiger, IslandWood
Partnership Manager
celinas@islandwood.org (206) 851-2344

Area Coordination

Lake Washington schools

Dan Hannafious, IslandWood
salmon@islandwood.org (206) 713-7704

Pipers Creek schools

David Koon, Carkeek Watershed Community Action Project
salmonprograms@carkeekwatershed.org (206) 819-0614

Fauntleroy Creek schools

Judy Pickens, Fauntleroy Watershed Council
Judy_Pickens@msn.com (206) 938-4203

Longfellow Creek schools

Mikaela Ebbeson, Delridge Neighborhoods Development Association
Environmental Education Coordinator
mikaela@dnda.org (206) 935-2999

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)
- Minter Creek Hatchery: 12710 124th Ave. Ct., Gig Harbor (253-857-5077)

Participating Watershed Groups

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



Keys to Success

Welcome to the exciting adventure of rearing salmon! Pacific salmon are key to healthy rivers and forests in the Pacific Northwest. The salmon you and your students rear as an educational experience play a role in salmon recovery. As a salmon 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 unit, from tank setup through release. These volunteers can do water changes, help students monitor 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 5. If you have difficulty recruiting a volunteer, contact your area coordinator for a possible referral.

Participate in Our Workshops

Through virtual and in-person workshops, you and your tank volunteer(s) will learn how to set up and keep your tank working properly, as well as 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 in Emergencies

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 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 field trips and other education 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 family members.

Communicate

Let your area coordinator know if someone new becomes the 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. Depending on available funds, we help with expenses as shown in this table. If you need time to buy your equipment, ask if we have loaner equipment available.

Our financial support is greater for those schools that have at least 37% of their students qualifying for free and reduced lunch (FRL) as measured by the state school report card. Bus reimbursement is available. You must apply for approval 2 weeks before a field trip and submit proof of payment after your field trip is complete. Find a pre-approval form at Seattle.gov/Salmon-in-the-schools.

Equipment and Repairs	0%-36% qualifying FRL Students	37%- 100% qualifying FRL Students	Private Schools
Basic set-up (tank, chiller, stand, filter, 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

This approximate timeline for preparing for, rearing, and releasing your salmon applies to either coho or chum. The table below and the text summary on the next page do not include all associated tasks but give you an idea of what to do when.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Recruit tank volunteer(s)	X	X	X	X					
Schedule fall field trip(s)	X	X	X						
Plan presentations and lessons	X	X	X						
Participate in SISS workshop(s)		X	X						
Set up tank		X	X						
Provide student instruction		X	X	X	X	X	X	X	X
Monitor water quality			X	X	X	X	X	X	
Receive eggs and predict hatch					X				
Observe changes					X	X	X		
Schedule 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 equipment									X
Sign up for next year									X

September

- Recruit tank volunteer(s)
- Schedule fall field trip(s)
- Plan presentations and lessons

October

- Recruit tank volunteer(s)
- Schedule fall field trip(s)
- Plan presentations and lessons
- Participate in SISS workshop(s)
- Set up tank (instructions begin on page 8)
- Advise families where they might observe spawners coming into local creeks
- Begin instruction in salmon development and ecosystem concepts

November

- Recruit tank volunteer(s)
- Schedule fall field trip(s)
- Plan presentations and lessons
- Participate in SISS workshop(s)
- Set up tank (instructions begin on page 8)
- Advise families where they might observe spawners coming into local creeks
- Continue instruction in salmon development and ecosystem concepts

December

- Prepare students for observing hatch and behavior after eggs arrival
- Provide instruction in tank care and continue instruction in ecosystem concepts

January

- Begin instruction in caring for salmon and monitoring water quality
- Begin regular water-quality monitoring
- Receive eggs
- Predict hatch date using SISS lesson at learn.islandwood.org
- Watch eggs hatch and begin to observe changes in fish development

February

- Continue instruction in caring for salmon and monitoring water quality
- Begin regular water-quality monitoring
- Continue to observe changes in fish development
- Schedule release field trip
- Begin to feed fry after yolk sac is completely absorbed
- Arrange for fish care over mid-winter break

March

- Begin instruction in releasing fish and in environmental stewardship
- Schedule release field trip
- Continue feeding fry and monitoring water quality
- Arrange for fish care over spring break

April

- Continue instruction in releasing fish and in environmental stewardship
- Release fry and document number released
- Complete teacher survey

May

- Review salmon activities with students
- Release fry and document number released
- Complete teacher survey
- Disassemble, clean, and store equipment
- 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. We may be able to help with equipment and supply expenses; talk with your area coordinator.



Equipment

These items are necessary:

- 50 or 55-gallon glass or acrylic aquarium.
- A table or stand that can support 650 pounds and allows air flow around the chiller.
- A refrigeration unit (“chiller”) sized for at least a 100-gallon tank. Inline chillers require an in-tank water pump, hoses, and clamps. Make sure you have these 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; and Marineland Emperor Pro 450.
- Two air pumps for ≥ 60 gallons with two hose ports, two check valves, and an 8 ft. air hose.
- 3” and 5” fine-mesh fish nets with long handles.
- An aquarium thermometer (preferably with a suction cup).
- An aquarium vacuum OR a 5 ft. clear siphon hose for cleaning the tank when replacing water. Attach a net over the end to prevent fish from being sucked in.
- 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.
- Power strip with 5 outlets and one USB port
- Cotton towels for water spills.
- 1/2” bottle brush for cleaning.

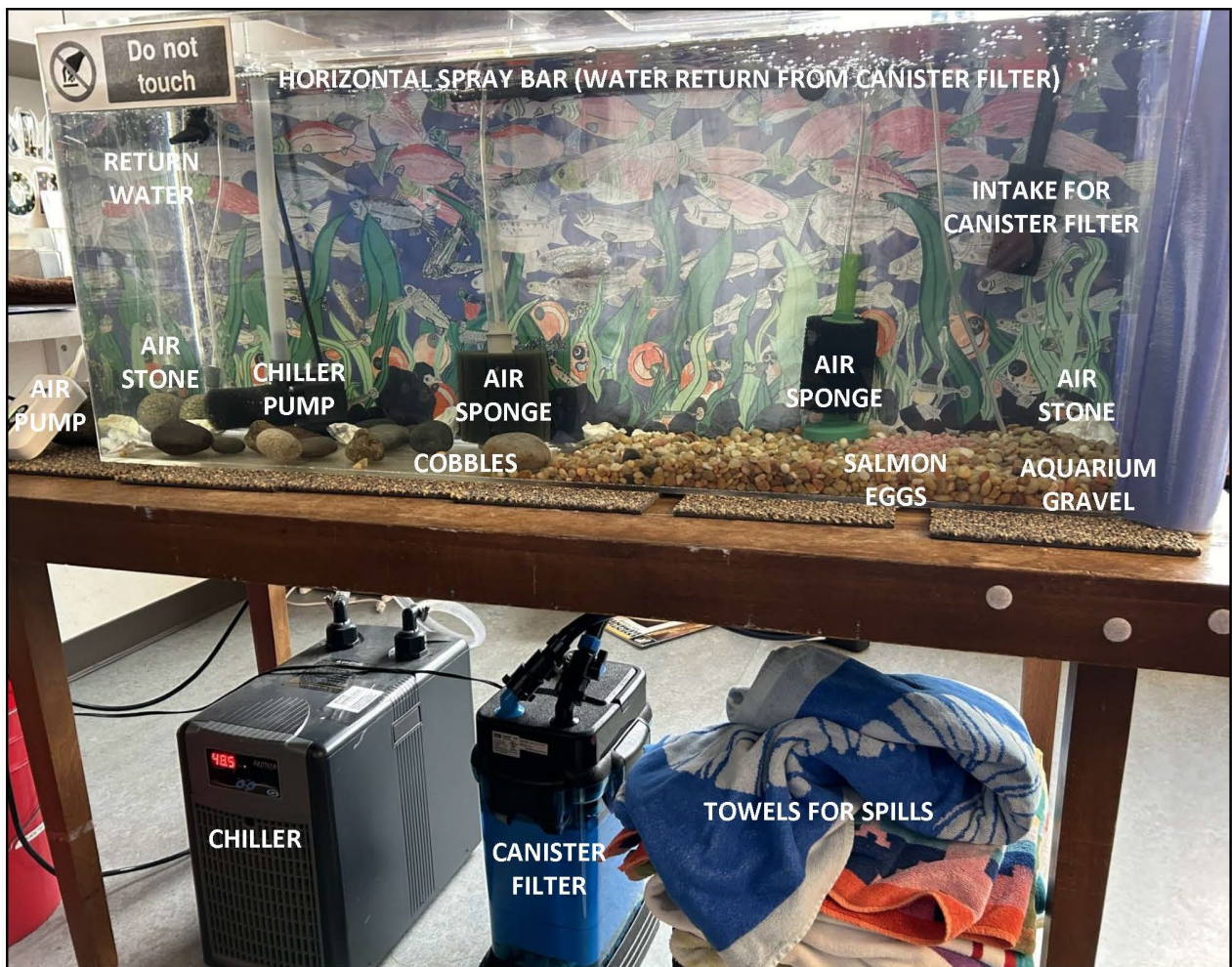
These items are optional:

- 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.
- Weighted **air-stone column diffusers** (such as Aqua Dream), one per air-pump hose port. The weight sits on the bottom of the tank to ensure that the entire water column (top to bottom) is sufficiently aerated, plus it gives fish a place to hide.

Typical Setup

The labeled photograph below shows the typical setup for a 55-gallon tank on a stand with an inline chiller. The chiller and canister filter are under a sturdy table along with an ample supply of towels for cleaning up spills. The aquarium has gravel for holding the salmon eggs and alevins as well as larger cobbles for alevins and fry to swim through. The intake and return for the canister filter are on the bottom on opposite sides of the tank. There are two air stones at the sides of the tank and an air sponge in the middle. The chiller pump is to one side of the tank. The air pump is outside the tank.

A note about gravel and cobble: Spreading clean aquarium gravel in half the tank and cobbles/river rocks in the other half can be a good way to replicate habitat that your fish will experience in the wild. Fry will investigate all areas of the tank, including in this substrate. If it makes maintaining healthy tank chemistry difficult, removing some or all of it is an option.



Supplies & Consumables

These items are required:

- 10 lbs. of clean, natural-colored **aquarium gravel** and/or 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. Use test strips only as a last resort as their accuracy is unreliable.
- **Water conditioner** such as *Prime* (highly recommended) or *Amquel*; zeolite may also be used (see p. 12).
- 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.
- **Baking soda** for cleaning and to raise pH.
- Distilled vinegar for cleaning.

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 Vipar*) 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 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 5-6 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 can have an equal chance to thrive.



Tank Set-Up

Set up your tank **at least six weeks** prior to when you will receive eggs. This timeline allows you to work out any kinks in the system before baby salmon are at risk.

Check that each piece of equipment is working properly, 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 are to go in**.

Steps in Tank Set-Up

Location

Choose a well-ventilated location in a hallway or other common space convenient to a sink and where you, your students, and your tank volunteer(s) have ready access. Locate it away from a sunny window or heat source so that water temperature consistently stays below 50° F.

Tank Cleaning

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

Gravel and/or Rocks

Spread approx. 10-15 lbs. of rinsed, natural pebble-sized gravel over at least half your tank (never colored gravel, dirty gravel, or very old gravel).

Arrange cobbles or fist-sized rocks in the other half if you like. Rinse gravel/rocks well in water to remove dust and algae. Wait for the chlorine in the water to off gas before putting the rocks in your tank. Gravel alone should be spread to about 3/4" 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 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 contained a cleaning product or other chemicals. (A white RV hose for potable water is okay.) 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 using a water conditioner to remove the toxicity of chlorine and heavy metals whenever you add water. **Letting water sit to off-gas chlorine does not remove heavy metals.**

Chiller

Setting up the chiller includes the unit itself, plus hoses. Follow these instructions:

1. Blow or vacuum all the dust off condenser fins, screens, and motors. Failure to do so may cause your chiller to overheat, resulting in failure, fish death, and costly repairs.
2. After moving your chiller into place, allow it to sit for at least 30 minutes before powering up so internal fluids can reset.
3. Make sure that the front and rear of the chiller have at least 1-foot clearance for air flow, else it will not function properly. **DO NOT** place your chiller inside a fully enclosed tank stand!
4. Pre-rinse used hoses with hot water (no soap) to remove any build-up. Clean the intake foam screen on the pump with water and reinstall. Plan to check the pump filter daily for debris and clean as needed (see p. 11).
5. Dry measure hose lengths before cutting anything; the inflow hose is longer than the outflow.
6. Attach the outflow hose to the chiller fitting and clamp it. Softening hoses with hot water will make attaching them easier.
7. Attach the outflow diverter to the other end and hang the clamped hose over the back of the tank.
8. Connect the intake hose to the water pump. It will sit on the bottom of the tank, so leave enough hose to be able to pull the pump out of the water to service it.
9. Connect the other end of the hose to the chiller fitting and clamp it. Set the water pump on the bottom of the tank.
10. Plug in just the water pump and check all fittings for leaks. Run the pump for a few minutes.
11. Plug in the chiller and set the digital reading to 48° F.

NOTE: Always turn off power to your chiller and filters before making water changes. See Appendix 4 for links to manufacturer details about your chiller.

Air System

1. Install two 60-gallon air pumps with two hose ports each.
2. Install check valves on the pump side of the hosing to prevent back-flow.
3. If using weighted air stone column diffusers, connect one per pump on the tank-side ends of the hoses and place them on the bottom of the tank.

Filtration

At a minimum, your filtration system needs to be capable of filtering a 100-gallon tank. You may use one or two filter systems to do the job. Follow these instructions for installing either a hang-on-the-back filter system or an external canister filter system:

1. Wrap netting over the filter intake or attach a foam rubber "fish sponge" to prevent alevin from being sucked in.
2. Always start the new season with fresh filter materials. Remove plastic packaging, rinse new filter materials thoroughly with water only. (See Appendix 4 for links to manufacturer recommendations.)
3. 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.

You may choose to include inexpensive, coarse air-sponge filters as part of your filtration system. They optimize surface area for beneficial bacteria in your tank and help retain that bacteria when changing out other filter media. Follow manufacturer instructions for attaching them on filter intakes and air hoses.

Powering Up

1. Check to make sure all equipment is working properly and that water temperature is down to 48° F. If after two days water temperature is not at or near 48° F, contact your area coordinator for assistance.
2. If everything is working properly, you may turn off the chiller until three days before your eggs arrive. Leave air pumps and water filters on to keep water circulating.

About 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. 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.

In this biological filtration system, some bacteria produce waste products (such as ammonia) that can be very harmful. Other bacteria consume this ammonia and give off nitrite, which can also be very harmful. Still other bacteria 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.

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.

"Cycling" your tank to build up nitrifying bacteria on gravel/rocks and filters can take four to six weeks. This is why we recommend setting up your tank six weeks before you receive your eggs.

Bio Filtering

Bio filtering (growth of beneficial bacteria) happens within sponges and on other surfaces within the tank over time. 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 best integrated into hang-on-back or external in-line filter systems.

Sponges

Beneficial bacteria live on the surface of sponges, so do not scrub them clean. Simply squeeze them clean in a bucket of tank water. 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 sponge appears to be causing 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 filtration systems.

Charcoal

Use a charcoal (carbon) filter temporarily if a toxin somehow gets into your tank. If needed long-term, replace it every 4-6 weeks. If these charcoal filters are left in the tank too long, they stop removing contaminants and may even release the contaminants they had been holding. When replacing carbon filters, rinse the new ones under cold tap water to remove any charcoal dust and let them off gas before putting them in your tank.

If your system is starting anew, we recommend encouraging beneficial bacteria to grow by adding water from an existing tank, which will introduce live inoculant. If you don't have access to one, you can add a product such as *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. Using a dose of one of these products after water or filter changes is also a good idea.

Timing

Be sure your system is operational at least 6 weeks ahead of receiving salmon eggs. Do water-quality testing up to egg arrival 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 all equipment is working, then turn off the chiller (not the pump) to let the system operate at room temperature until a week before water needs to be down to 48° F for egg arrival.



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 for you and your tank volunteer(s) to keep up with maintenance, so you catch problems early. If you have a concern, use this handbook to try to solve the problem yourself.

If you conclude that you need help, contact your area coordinator. **DO NOT wait until the end of the day!** If your chiller needs repairing, your area coordinator can arrange for a loaner.



Maintaining Water Temperature

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 water temperature rises above 55° F and you see no digital display on your chiller, the fuse may have popped. **Contact 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 the container *FOR SALMON USE ONLY*.

🍊 Maintaining Air Flow to Chiller

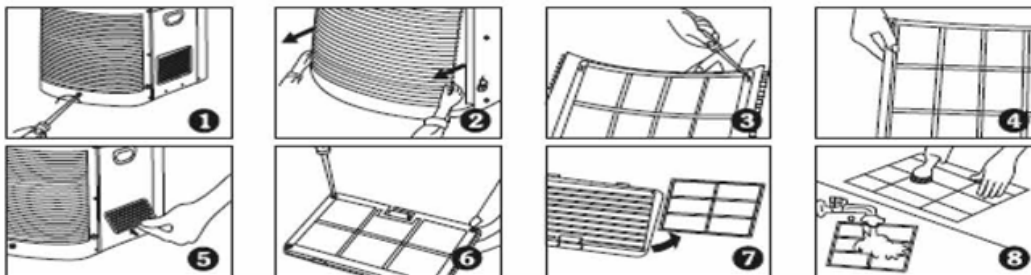
Chiller Condenser

Avoid refrigeration problems by keeping your chiller's condenser free of dust and having plenty of air circulation around it. Wipe away lint with a damp cloth or use a vacuum on it once or twice a year to keep the condenser in good working order.

Chiller Filter

This series of diagrams shows how to clean filters on an AquaEuro 1/4 HP Chiller. Adapt the process if your chiller is a bit different.

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



🍊 Maintaining Water Filtration

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

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.

Removing Unwanted Chemicals

Organic waste compounds, decaying tissue, and tap water contaminants can dissolve in tank water and cause odor, chemical imbalance, and discoloration. Charcoal (carbon) filters can absorb these impurities and eliminate odor.

NOTE: Do not use charcoal (carbon) filters at the beginning of the season as they disrupt the nitrogen cycle (beneficial bacteria). To remove chlorine, ammonia, or nitrite, use a water conditioner such as *Prime* or *Amquel* whenever needed. Zeolite is also effective against ammonia.

Sponges or Filter Pads

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

Filter Maintenance

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

- Avoid cleaning your entire biological filter at the same time. If you have several filter components, alternate cleaning/changing them.
- Do not clean your biological filter with tap water because the chlorine in it can kill the valuable beneficial bacteria in your tank.
- Once per week or if waterflow through your filter slows, 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 annually but only as needed. Many filter types can be used over many seasons if cleaned properly.
- Follow manufacturer's advice for cleaning interior pump parts at the end of the season.
- Charcoal media can lose effectiveness in as little as 30 days and will need to be replaced if you have an issue controlling odor and/or water cloudiness.
- You can add ammonia or nitrite-reducing material to temporarily help with chemical spikes.

Maintaining Water Pump

Although rare, the pump on your water filter may fail. Failure occurs when the intake filter is completely clogged or the impeller that draws water into the pump has gotten damaged. First ensure the filter is clear, then you can investigate the impeller if the problem persists.

Contact your area coordinator for more assistance with inspecting/changing an impeller. Without proper circulation, the bottom of the tank will be depleted of oxygen and your eggs or fish could die. Ensure all air stones are located at the bottom of the tank to create mini-currents that will mix oxygen-rich water from the top of the tank with oxygen-poor water near the bottom.

Cleaning & Changing Water

How often your tank needs cleaning depends on the number and size of fish, their food, how well your filtration system is working, 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 and Removing Water

You will need:

- 2 buckets
- 5-foot hose
- a cotton cloth or tank scrubber
- a clean sponge
- a gravel vacuum
- a small pitcher

Before you start cleaning, turn off power to the 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 the vacuum to pick up uneaten food, or other large debris and to tumble debris out of the gravel. Remove foam from egg casings with the vacuum or a net. A loose mesh or netting attached to the end of the vacuum will help keep fry from being sucked in as you clean. Section your tank into thirds or fourths and clean one section of gravel at a time, all the way to the bottom. Vacuum a different section next time. Watch your bucket so water doesn't spill out. This process can remove 10-15 gallons of water.
2. If you find you must vacuum the tank more than once a week, reduce the amount of food you are giving until water chemistry is balanced again.
3. The more algae left to grow on the walls of your tank, the more problems you can expect to have 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.
4. Remove any dead eggs (will be a white/yellowish color) and/or dead fish daily.
5. Avoid replacing more than one fourth 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.
6. **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° F, it will be close enough for the amount of water you will be changing.
7. 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.

Replacing Water

The volume and frequency of water changes are different depending on the developmental stage of the salmon. Let your water quality testing guide water changes and maintenance

- **Eyed-egg stage:** Replace 5-10 gallons once per week. Remove any dead/white eggs daily.
- **Hatching and alevin stage:** Replace 10 gallons twice weekly and remove the foam from egg casings with a vacuum or net so protein doesn't build up.
- **When fry begin to feed:** Replace 10 gallons three times weekly and remove dead fish daily.

NOTE: Always turn off power to your chiller and filters before making water changes.

Test water quality once or twice a week to guide frequency. If you don't test regularly, yucky bacteria ("gunk," "water bunnies") can start growing and prompt changes in acidity (pH), ammonia, and nitrite that can kill your fish. This bacterial will also make your tank smell terrible. Testing will let you know to fix the problem before your fish begin to die.

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 from 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.



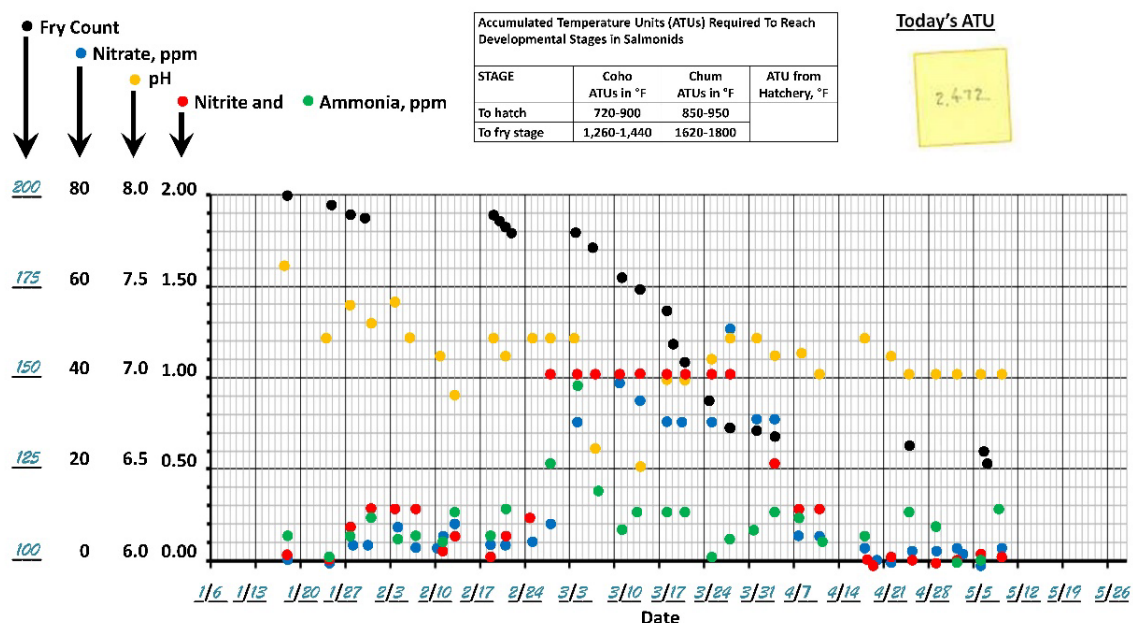
Test your source water to see how its chemistry may affect test results from the water in your tank. **If you get a high reading from your source water**, retest to be sure of the result before adding chemicals to your tank that may not be needed.

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.

Tracking Tank Chemistry

Keep a chart by the tank to document changes (see example below). Students should update this chart each time they test the water. The chart will enable students to see trends and verify that the water has been tested.

Download a wall chart from our resources at Learn.islandwood.org. Following is an example of a comprehensive chart that uses colored dots to show multiple parameters.



pH (Acidity): Ideal is 6.6 - 7.6

Pay close attention if pH falls outside this range as pH level greatly affects the toxicity of ammonia.. A pH reading below 6.0 can inhibit the establishment of a strong colony of beneficial bacteria. You will mostly be using a regular pH test to get your readings. If water tests at 7.6, use the high-pH test to indicate how toxic ammonia may be.

Water changes are the most effective way to balance pH but, if you cannot keep it within a healthy 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.

Products to raise pH are just baking soda. If 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.

Ammonia: Ideal is 0 - 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 corrodes 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 less. If necessary, do another one-third water change 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 your product in for only a couple of weeks; if it gets saturated with ammonia, it could release ammonia back into the tank.

Nitrite: Ideal is 0 - 0.5 ppm

Nitrite results when other beneficial bacteria break down ammonia. Excess nitrite harms fish by disrupting their 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: Ideal is 10-60 ppm

Nitrate is the final product of the nitrification process in the nitrogen cycle during which 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, make sure that multiple people know what steps to take in the event of an emergency. Also prepare equipment and supplies ahead of time.



Chiller Failure

Prepare for this event by freezing bags or water jugs of tank water ahead of time.

Have or get a bag of ice to keep tank water cool. Put the ice in a bag so that chlorinated water from melting ice 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

Prepare for this event by keeping a spare battery-operated aerator handy.

You need to restore aeration quickly. 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. The dual-port lithium battery aerator from Aquarium Coop is a dependable choice but 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. \$40); however, it is sized for 29 gallons so you would need two.
- Another choice is the 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.



Egg Pick-Up/Delivery & Care

Pick-up/delivery of eyed coho and chum eggs typically happens in early January, just after winter break. Because eyed eggs have a small window during which they are stable for transport, the hatchery determines the best time for pick-up/distribution.

We apply to the Washington Department of State Fish and Wildlife for the permit that enables you to get eggs and specifies where you are to release fry. Depending on tank size, you will receive 100 - 220 eggs, plus 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 before you can receive 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 your hatchery recommends disinfecting your eggs with iodine, follow these instructions:

1. Pour hatchery-provided iodine into **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 and carpets).
5. Gently sprinkle eggs from the strainer into your tank.
6. Dispose of iodine in a sink.
7. Replace **dechlorinated** water in your tank to the fill line.



Predicting Hatch Date

Our ATU lesson plan guides students in predicting hatching and developmental stages. Find it in the lesson resources at Learn.islandwood.org. Eggs generally start hatching 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. Use a vacuum or net to remove it.



Alevin Stage

If you haven't already, begin weekly water testing. Use testing values to decide when 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 can 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 up 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 tiny pink line.



In the photo on the right, the suture line is still visible on these fry. Feeding started about a week after this photo was taken.



Feeding Advice

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 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

The amount you feed depends on fry life stage. Read details below.

Week 1 - tease feeding

Wait until nearly all your alevin are free-swimming fry before "tease feeding" so they will learn to eat. Sprinkle just a 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 slow feeding

Use a 1/4 teaspoon measuring spoon to dip out hatchery food and gently sprinkle it over the surface of the water. This 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 fish eat and create waste. **Test water weekly and increase water changes from now until release** (see page 12). 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 your check that the fish were fed properly.

Weeks 4 – 7 add flakes

Add 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. **Continue testing water chemistry weekly.**

Week 8 until release, add bloodworms

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.

About Pinheads

Pinheads have difficulty learning to eat or that other fish out-compete for food. It can also happen 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 the wild.



Salmon Release & Reporting

Releasing your fish is often the highlight of the experience of raising salmon! In the spring, your area coordinator will contact 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 may 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 fry at the location specified by the state.** (See Appendix 3 for details.)

Release Site Characteristics

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 state permit.
- Water is cool and flowing (aerated) with pools for fry to rest.
- The 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.

Preparing Fry for Transport

Air Supply

Fish depend on having ample air. Test your aerator before transport to ensure it is working and that it has a weighted aerator stone that will not only sink into a bucket of water but remain on the bottom during transport. **Fry could die if the air stone floats.** The aerator unit will ride on top of the lid cover your transport bucket.

Fish Safety

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

Timing

Transfer fish from your tank to the transport bucket as close as possible to your departure time. Catching them could take 30-60 minutes, depending on experience. A good plan is to assign someone to collect the fry while someone else manages getting students out the door so that it is a calm experience for both fish and people.

Preparing Your Tank

Have at least one 5-gallon bucket at hand to receive tank water and follow these steps:

1. Vacuum clean the bottom of the tank a day ahead of collecting the fry. Consider a water change the day before as well as dirty water makes the collection process more difficult and more stressful for the fry.
2. Unplug the chiller, chiller pump, and filters.
3. Remove all but about 8 inches of water from the tank and as many obstacles (e.g., rocks, air sponges) as possible. The tank should look relatively empty.

Transferring Fry to Their Bucket

Have the following equipment at hand:

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

Now follow these steps to get fish into the bucket:

1. Fill the bucket 2/3 full of water from the tank. Any more will slosh out during travel.
2. Place the bucket on a sturdy location close to the tank so that you can quickly move fry from the tank into the bucket.
3. Prepare your aerator. Separate the hose from the unit, thread it through the hole in the lid (inside to outside), and reconnect it to the unit. Ensure that bubbles are vigorously coming from the air stone.
4. Move slowly while netting fry so you don't injure them. The last few can be the most challenging to net, so be patient and go slowly.
 - a. Use one net to push the fish and one to catch them.
 - b. When you have some in the net, grab the bottom of it, then turn it upside down into the bucket. Swish the net in the bucket to make sure no fish are caught in it.
 - c. Check corners and any other places in the tank for stragglers.



Releasing Your Fry

Assuming students will be taking turns releasing, you will need **several sturdy, clear cups** and **one adult to dip fish** into a cup when each student is ready.

Release as soon as possible after arriving on site. If you are to have a program first, place small, zippered bags of ice in your bucket to keep fry chilled and set 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.

Here are possible steps for salmon release:

1. Carry the bucket close to the water's edge and use one of the cups to mix water from your release site with the tank water that is in the bucket. Explain to your students that fry don't like sudden changes in their water and that mixing in creek or lake water will help them get used to where they will be living.
2. Have students line up or form small groups.
3. Have an adult ready to tally the fish as students count and release them. **NOTE:** This count is a check against the mortality count that students kept while fish were in your tank.
4. Position an adult at the water's edge to steady students as they kneel and get back up.
5. Explain to all students or to each group in turn:
 - When you get a cup of fish, immediately put one hand over the top so the fish cannot jump out.
 - See how many fish you have and call out that number to the counter.
 - Walk carefully to the water and kneel.
 - Take a close look at 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. Do their colors look different from above and below? How will their colors help keep them safe?
 - 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!

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). 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 location.



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.

Cleaning Up

After all fry are released, pour any water remaining in the bucket onto nearby grass or brush. Collect your equipment. Plan to clean up your tank and equipment in the next few days while debris on hoses, filters, and the tank itself is still somewhat 'soft' and more easily cleaned. The goal is to have everything cleaned and dried for the off-season. Anything left slightly wet has the potential to develop harmful black mold.

Release Reporting & Teacher Survey

The Washington Department of Fish and Wildlife requires us to report how many fish all participating schools have released, as well as dates and locations. 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, **take 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 are for 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 are 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 through 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 filter 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 water-conditioner packs as you will need new supplies for next fall.
2. Rinse bio-wheels in warm water and air dry. Rinse the 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 the sponge 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 with 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

1. Organize your equipment and inventory your supplies to know what you will need for next fall. Buy them now, if possible, so you don't forget. Plan to change out gravel/rocks every three years (more often if pH has been difficult to maintain).
2. Clearly mark your equipment "SIS-SEATTLE" and add your phone/email to keep it safe from possible inadvertent disposal while in storage.

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



Appendix 1: Education Opportunities

Activities and resources related to salmon biology, habitat, stewardship, and the importance of salmon to Pacific Northwest culture and commerce are posted at learn.islandwood.org under the category **Salmon in the Schools**. Most lessons support Next Generation Science Standards and/or Common Core.

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](http://SalmonSEEsongKingCounty.org).

Weekend viewings: Students in the Fauntleroy Creek and Longfellow Creek watersheds may have opportunities to view spawning activity with their families on weekends in November. Watch the *West Seattle Blog* or contact your area coordinator to learn when would be a good time to visit.

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.

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](http://CedarRiverWatershedEducationCenter.org) website for details about current learning opportunities.



Appendix 2: Participation & Expectation Agreement

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

Salmon in the Schools-Seattle Shall:

- Coordinate and submit egg permit applications and release data 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 schools about what equipment and supplies to get for initial setup or for replacement.
- Provide training for setting up, maintaining, and disassembling aquarium and equipment, and maintaining healthy water quality.
- 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 (based on documented school need as funding is available).
- Provide learning resources, technical support, and program 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

- Follow training and program recommendations to
 - Maintain the tank, chiller, and other equipment
 - Replace filter components and other consumables as needed
 - Monitor water chemistry regularly, and make necessary adjustments
 - Feed and care for fish throughout the year
- Provide funding for equipment based on school's identified ability to pay.
- 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 and post near location of tank.
- Perform end-of-season equipment maintenance, labeling, and storage to keep all equipment secure. The school will be responsible for any lost or missing equipment from the previous season.

Classroom Learning

Classroom learning about salmon is required and 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 salmon fry at the location designated in the WDFW permit.
- Summarize classroom learning activities/objectives by completing the year-end 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, its staff, and other persons involved in tank care 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.

The lead teacher and any volunteer(s) 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 lead salmon teacher and principal must sign this contract.

School Name _____ **Office Phone** _____

Principal Signature _____ **Principal Name** _____

Lead Teacher Signature _____ **Teacher Name** _____

Grade(s) represented by Lead Teacher _____



Appendix 3: Release Sites

You may also request help with your release by contacting your area coordinator. In addition, read recommendations in the "Salmon Release & Reporting" section of this handbook.

Bus reimbursement for field trips is available for public schools. Find a pre-approval form at Seattle.gov/Salmon-in-the-schools.



Carkeek Park – Chum

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

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 fry released directly into the creek system would not remain there long enough to learn the creek's scent, 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 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.



West Seattle Creeks - Coho

Fauntleroy Creek

Replacement of the 45th Ave. SW culvert in the Fauntleroy Creek system to restore spawner access to the middle reach is expected to be under way through 2027. Consequently, no releases can occur in Fauntleroy Park until construction is finished.

Longfellow Creek

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 occur in lower Fauntleroy Creek by special arrangement.

The Delridge Neighborhoods Development Association will support West Seattle schools located within the Longfellow watershed to connect their students to their local watershed.

Lake Washington – Coho

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.

Toxic Algae Blooms

Check nwtoxicalgae.org to learn of any toxic algae blooms near your preferred release site and always have an alternate site in mind in case of a bloom. Cyanobacteria (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 cause excessive oxygen consumption (hypoxia) when they decompose. Most cyanobacterial blooms occur during warm months (summer and early fall).

Invasive Alert

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

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)
- South of the Ship Canal
 - Madrona Park
 - Seward Park
 - Pritchard Beach
 - Be'er Sheva Park



Appendix 4: Web Resources



Curriculum Resources & Rearing Tips

Salmon in the Schools-Seattle

Seattle.gov/Salmon-in-the-schools

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 – Salmon in the Classroom

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 – PetSolutions Cascade Canister Filters](#)
- Marineland/Penguin: [marineland.com – Product Manuals](#)
- Hagen/Aqua Clear: [Hagen AquaClear 20 Product Information](#)

Gravel Vacuums

- Aqueon siphon: [youtube.com – Aqueon siphon vacuum gravel cleaners](#)
- Python water changer: [youtube.com – How to use a Python water changer](#)

Chillers

- Aqua Cooler manual: [Aqua Cooler User Manuals Download | ManualsLib](#)
- Aqua Euro manual: [Aqua Euro USA Chiller User Manuals Download | ManualsLib](#)
- JBJ Artica manual: [MarineandReef.com - DBE-200 manual.pdf](#)



Appendix 5: Sample Tank Volunteer Recruitment Flyer



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-Seattle program, which enables students to rear 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., 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 6: 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.
- **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.
- **Record:** 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.

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:
 - a. Remove any large stones (put them back when you finish adding new water).
 - b. 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.
 - c. 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.
 - d. Refill the tank to the water-level mark with water from the bucket.
 - e. 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

POST NEAR TANK

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 all water quality tests (for example ammonia, nitrite, pH, nitrate temperature, and ATUs)
4. Comments include dates of hatching, chemical additions, and cleaning.

Date	AM Feed	PM Feed	Trash/ Systems	Mortality	Count	Ammonia	Nitrite	pH	Nitrate	Temp.	ATU	Comment

