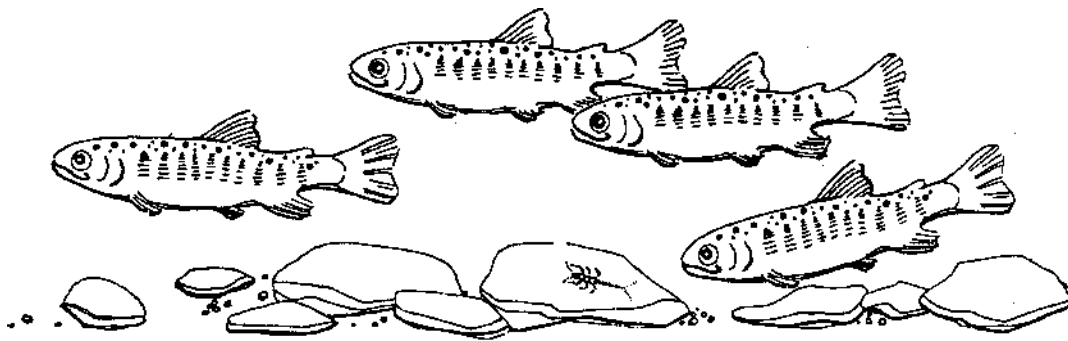


SALMON IN SCHOOL

HOST CLASSROOM/TEACHER MANUAL



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OVERVIEW

PROGRAM OBJECTIVES

Students participating in our program will:

- Observe and learn about salmon and their life cycle
- Learn about fish care as a form of stewardship
- Recognize and respond to salmon's relationship with regional economy and culture
- Cultivate sense of place (humans as part of a place, not apart from it)
- Explore significant life experience (meaningful experiences in nature that create lifelong conservation dispositions)

Our program aims to create a long-term working relationship between Salmon in School and local schools/teachers to enhance awareness of and provide participation opportunities in salmon habitat restoration efforts and community-lead environmental stewardship.

PROGRAM CONTACTS

LOCAL COORDINATOR

Blue Mountain Salmon Alliance/Tri-State Steelheaders

Sarah Moffitt - Education Coordinator
smoffitt@triststatesteelheaders.com
office: 509-529-3543

WA STATE CONTACT

Washington Department of Fish & Wildlife

Matt Davidson - School Cooperatives Program
schoolcoops@dfw.wa.gov
office: 360-902-2798

HATCHERY RESOURCE

Lyons Ferry Fish Hatchery

Derek Gloyn – Hatchery Facility Manager
Derek.Gloyn@dfw.wa.gov
office: 509-646-3454

PARTICIPANT RESPONSIBILITIES

SALMON IN SCHOOL COORDINATOR

- Procure equipment and supplies for aquarium set-up or replacement of worn equipment;
- Provide resources and/or training to support assembly of the aquarium and associated equipment;
- Perform initial set-up and prepare aquarium for summer dry storage;
- Provide fish food, water test, and water conditioning supplies;
- Provide salmon eggs (pick up from Lyons Ferry);
- Provide curriculum materials and technical support for aquarium operations and maintenance
- Connect with host teachers to schedule monthly lessons and end-of-year salmon release
- Coordinate all permits and release reporting on behalf of the Washington Department of Fish and Wildlife;
- Continue to modify the program based on comments and feedback from participating schools/teachers.

SCHOOL/TEACHER RESPONSIBILITIES

- Prepare location for aquarium with high visibility for students, and appropriate environmental factors for salmon survival (away from window, near power outlet, on sturdy table);
- Incorporate salmon life cycle, water quality and environmental stewardship lessons into the curriculum in the classroom;
- Monitor the aquarium equipment condition and chiller, promptly notify Salmon in School staff of any issues;
- Feed the salmon per instructions;
- Monitor water chemistry per recommendations;
- Release the salmon fry at designated release sites in the appropriate watershed;
- Provide site for dry-storage of equipment between continuing school years (summer);
- Perform program assessment/evaluation.

CARE & MAINTENANCE

AQUARIUM SUPPLIES

Provided by Salmon in School as funds allow

| Used Annually | Equipment |
|--|-----------------------------------|
| - Fish Food – 3 sizes: #0, #1, #2 | - Tank/Stand |
| - Ammonia tester | - Aquarium substrate (gravel) |
| - Nitrite tester | - Water Chiller/Computer |
| - Nitrate tester | - Filter and media |
| - Stress Coat (water conditioner) | - Air pump, hoses, air stone, jar |
| - Stress Zyme (promotes good bacteria) | - Fish dip net |

AQUARIUM SETUP

TANK PREPARATION

Your aquarium will be left in dry storage over the summer. Please ensure that non-aquarium items (ie: trash or other classroom equipment) are not also left in your tank.

We will assemble your tank in September, fill it with water, and turn on your equipment. Tanks should be up and running to 53 degrees F for at least 3 weeks prior to egg delivery. This promotes healthy bacteria cycling in your aquarium.

Notes:

Wash and thoroughly rinse any new equipment before first use, such as bucket, gravel, siphon, net, gloves, etc.

CHOOSE A SUITABLE LOCATION

One that is:

- easily accessible from at least 3 sides
- within close proximity to an electrical outlet
- near a water source (if possible)
- properly ventilated so chiller doesn't overheat
- consider proximity to excessive light and heating vents
 - too much heat will require the chiller to run more often
 - too much natural or artificial light will contribute to algae growth requiring more frequent tank cleaning

SETUP TANK STAND

A 55-gallon tank full of water weighs roughly 460 lbs. Ensure that the counter or tank stand you select can support this weight and is stable enough to allow close viewing of the tank by children.

ADD CHILLER

Place chiller unit in well ventilated area according to manufacturer's instructions (see Appendix). Place drop-in coil in tank. Set temperature controller to 53° F. Temperature can be raised (no higher than 55° F) after feeding begins, depending on the speed of growth you are hoping to achieve.

Your chiller comes with a computer that reads the temperature of your aquarium and turns on automatically when it senses that the water is too warm. Ensure the thermometer probe from your chiller is in the water so that the chiller isn't reading the ambient room temperature.

ADD FILTER

Follow manufacturer instructions. Layer filter media (rocks, sponges, ceramic beads) correctly.

ADD AERATOR/AIR STONE(S)

Check to make sure air hoses don't have any kinks in them that could block air flow. Arrange them so they won't accidentally get disconnected from the motor. The air stone attaches to the end of the tube and is placed in the jar with lava rock bags and polyfil stuffing. These help dissipate the air bubbles and store a reserve of good bacteria. Air stones break often, so gently check yours to see if it still appears intact.

FILL TANK WITH WATER

If using municipal water, dechlorinate by adding Stress Coat and start the nitrogen cycle by adding Stress Zyme according to manufacturer's instructions. This is about half a capful (5ml) per bucket (5 gal) of water.

TEST WATER QUALITY

It may take a few weeks for helpful bacteria to establish. They run in a cycle and produce ammonia which spikes first, then nitrite, then nitrate. Measure once a week as the tank establishes and record levels on the *Monitoring Log – Weekly* found in the appendix under Monitoring Forms.

MONITORING

CHECK TEMPERATURE

Normal winter-spring water temperatures in Pacific Northwest streams may range from 32° F to approximately 60° F. Lower temperatures slow hatching rates significantly and increase the time the fish are in the vulnerable alevin stage. Warmer water holds less oxygen and fish may experience thermal stress. Higher temperatures also speed up hatching rates, but encourage growth of bacteria and fungi that may kill eggs or fry.

The ideal controlled temperature for a classroom tank is 52° - 55° F.

Notes:

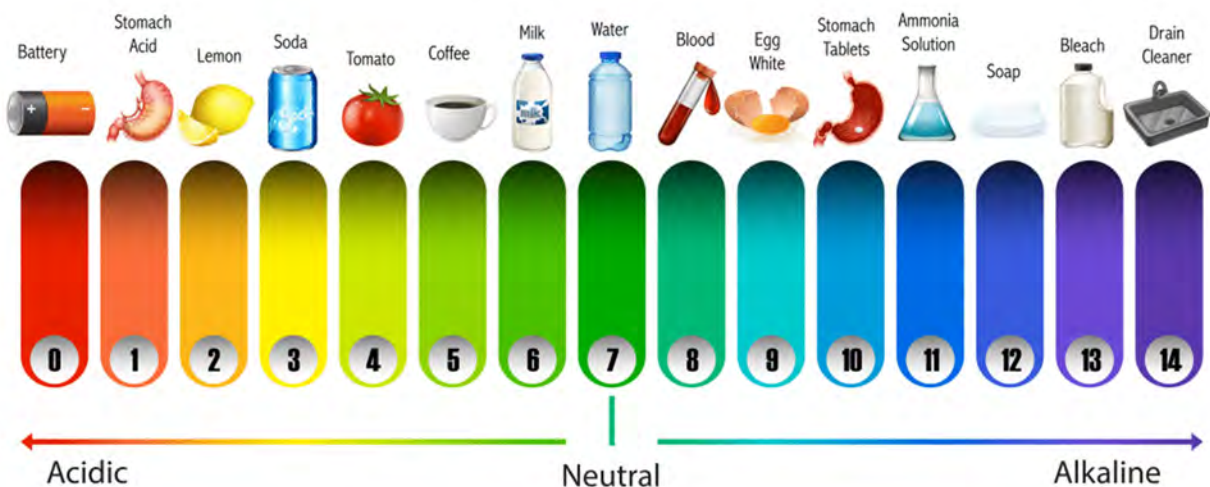
When changing water, make sure the new water is within 1 - 2 degrees of that in the tank. Try to keep aquarium temperature adjustments to less than 3 degrees over a 24-hour period.

RECORD MORTALITY

Salmon in School instructors will count the eggs when they first arrive. Please keep a daily record of the number of dead eggs/fish on your own or by using the Monitoring Log (see Appendix). Report any significant mortality to your coordinator.

Ph SCALE

pH - pH (or the power of Hydrogen) is a measure of water acidity or alkalinity. pH values range from 1 to 14. Along this scale, any number less than 7 is acidic. Any number more than 7 is basic or alkaline. Pure, pH-balanced water has a pH of 7. A pH of 7 is neutral and ideal for most aquatic animals.



Any significant change in pH (dropping below 6.0 or rising above 8.0) is reason for concern. Fish take oxygen from the water through their gills and give off carbon dioxide. A simple chemical reaction occurs when carbon dioxide is expelled into water. It produces a weak acid called carbonic acid. Too many fry in a closed aquarium system can change the pH to dangerously low pH (high acid) levels. Acidic water (low pH) irritates gills, causes excess mucus production and reduces the gills' ability to exchange oxygen. Low pH also limits the fish's ability to regulate its blood salts.

FISH

PREDICTING HATCH RATES – Cumulative Temperature Units

The following table is an APPROXIMATE guideline for development rates. A general rule of thumb is that the COLDER the water, the LONGER it will take to reach the temperature units required for various stages of development. Conversely, the WARMER the water, the FASTER the rate of development — up to the point where the water is too warm for fish to survive. For a more complete explanation of Cumulative Temperature Units see Appendix – *Monitoring Forms – ATU's*.

The hatchery sometimes gives us fish that have been eggs for quite a while. You may need to calculate backwards from the hatch date to determine when the eggs were actually fertilized. This is especially true if your eggs hatch within days of delivery.

Approximate Developmental Rates in Cumulative Temperature Units (TU's)

| SPECIES | To Eyed | To Hatch | To Emergence | To Button-Up |
|----------------|-----------|-----------|--------------|--------------|
| Spring Chinook | 536 – 650 | 850 - 900 | 1200-1400 | 1650 - 1857 |

FEEDING

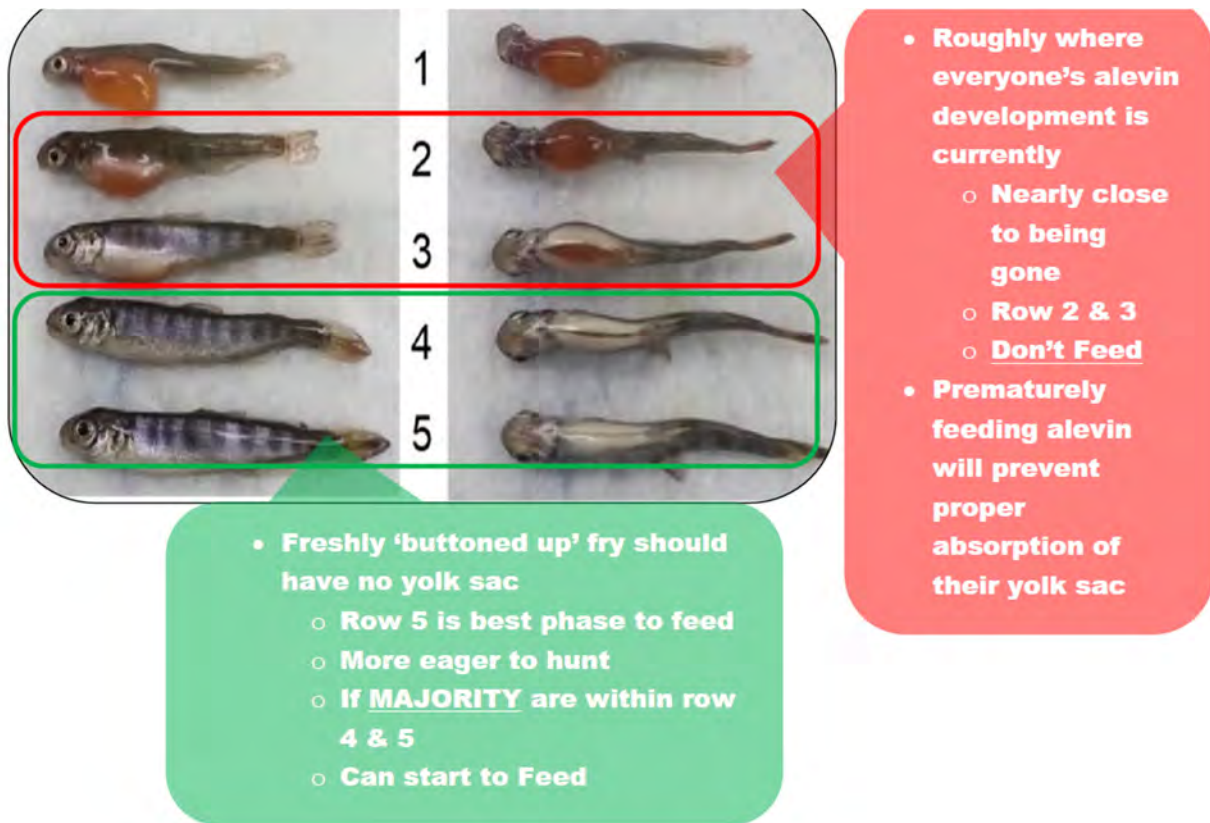
Do not feed your fish until they have all completely absorbed their yolk sacs, or "buttoned up." Check by netting a few fish and looking closely at their bellies. Fish should look like those in the green box in the diagram below.

Feeding too early can result in fish that don't properly absorb their yolk sac. This area can get infected later. Your goal is for most fish to be the correct feeding size when you start to give them food. To begin, sprinkle a tiny amount of size #0 food on the water a few times a day. The fish may mouth it and spit it out, but eventually they will begin to eat. This could take up to a week. Some fish do not learn how to feed at all, and it can be common to see some mortality at this time. Notify Salmon in School staff if you lose more than a couple.

Once fish have learned how to eat, sprinkle tiny amounts of this food on the water two to three times a day. Slow feeding will also ensure that smaller fish get their share.

It works best to give fish small pinches of food. Note that as fish grow, they're going to need different amounts of food. As the size of food changes, you will again need to change how much they are given. **Watch the fish eat** and look at their tummy to see if they are over or under-fed. Overfed fish will have a round circle bulging out of their tummy (this is not their yolk sac). It is either their stomach swollen with food, or a change in their body shape due to over-eating. Underfed fish look skinny when you look at them from above. There would be no sign of a circle where their stomach would be (looking at them from the front of the aquarium). Often, they will hang out near the bottom. Underfeeding may also result in higher mortality or very slow growth.

The number of feeding sessions depends on the size of your food and fish. Aim for 2-3 meals/sessions per day, spread out by 4-6 hours so that fish have time to digest each meal. Each meal can be composed of several pinches of food depending on how your fish are eating.



Notes:

- Fry eat only food falling through the water; they won't eat it once it hits the bottom. The more food waste and fish waste, the more frequently you will need to monitor the water quality and clean/vacuum the gravel.
- Feed only as much as your fish will eat in about one minute. If you find food on the bottom of the tank, reduce the amount in each pinch of food.
- At each feeding, observe the fish for several minutes to make sure they are not being overfed.
- Your fish will survive over the weekend, (even a 3-day weekend), without food; however, bigger fish have a better chance of survival so try and feed them to capacity without overfeeding. Ensure that you have a feeding plan for Winter and Spring Break.

SIZE #1 FOOD

As fish grow, switch to larger #1 food. If your fish have a large range of sizes (some tiny, some really big) start with a mix of #0 and #1 so the little ones can continue to have food. Each aquarium will have different timing for when to change food. If fish are easily gulping down the small food, try a little bigger food and see if they can eat it. If it's a struggle, they aren't ready yet.

SIZE #2 FOOD

Usually, fish are ready to eat #2 food by springtime. Do a test just like when you started #1 to make sure they can eat it. This food is heavier and sinks quickly. To avoid aquarium issues caused by uneaten food, feed many (5-6) very small pinches of food that the fish can eat before it sinks more than 3-4 inches in the aquarium. Wait in between each pinch of food for fish to finish it before giving them more. The goal

is to prevent any food from landing on the bottom. Keep a close watch on nitrite and nitrate and promptly report any changes in clarity or aquarium odor.

Continue feeding at least two-three times daily until release.

Notes:

Some fish have difficulty learning to eat. They hang out in the bottom of the aquarium and may just starve. They are called “pinheads.” This seems to occur most often when feeding begins too early. Some of them may not even absorb the last of their yolk sacs.

RELEASE

BEFORE YOUR SALMON RELEASE

Salmon in School educators will come early before your scheduled release to collect your fish and dewater your aquarium for dry summer storage. It is better to start releasing fish as soon as possible after you arrive on site. If you wait too long, the water may get too warm and injure the fish. Be sure to put the bucket in the shade if you must leave it to sit, and check on the fish regularly. Remember that shade moves as the sun does!

Notes:

Use a portable aerator (if available) to give the fish more oxygen during transport. Do seal the top of the bucket with a lid. Put the aerator tube through a hole in the lid and make sure it doesn't get pinched by the lid.

INTRODUCE CREEK WATER

When it's time for your release, we may transfer your fish from a bucket to a small aquarium with ice packs in it to keep it cold. We'll keep the aerator in there so fish have enough oxygen. We will also add some water from the release location so that fish can start to get used to their new home.

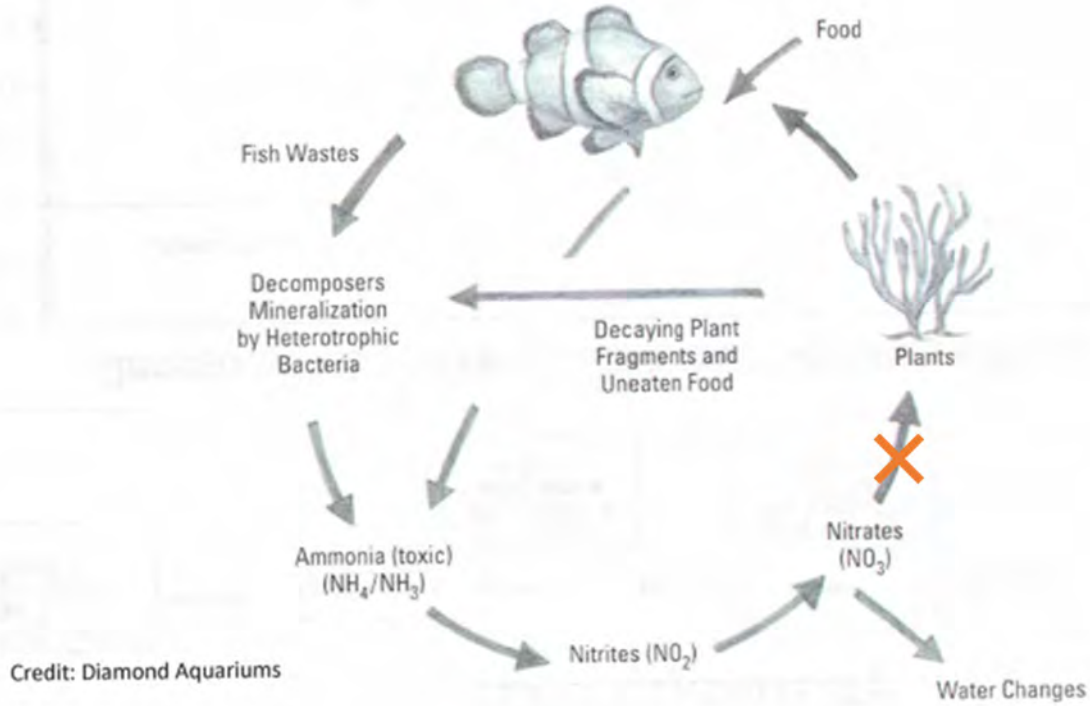
RELEASE FISH INTO WATER

We will distribute the fish into cups for each student to release. Instruct the students to put their hand over the top of the cup so that the fish can't jump out. This is when kids have the opportunity to name their fish and give them well-wishes or a blessing for the journey ahead of them.

Smaller children may need help navigating the rocks along the shore of the creek. When they are ready students will 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.

Notes:

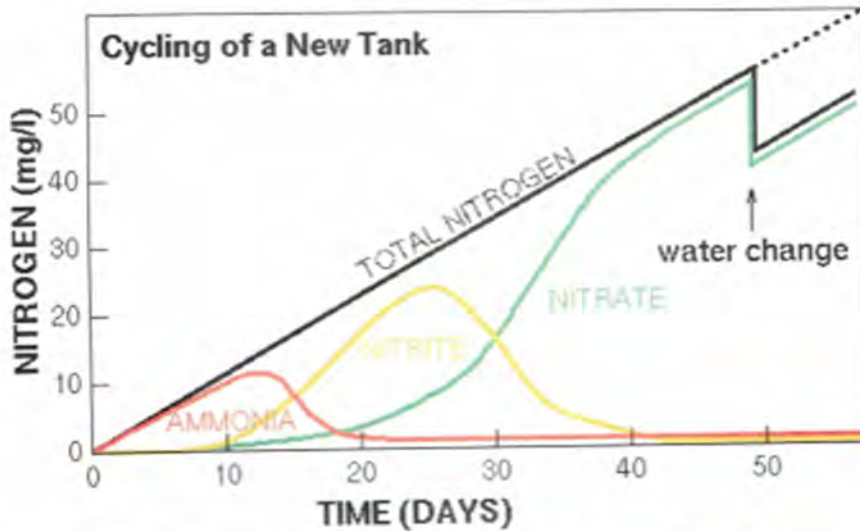
- Take time to observe the camouflage markings on your fish. Salmon fry are easy to see when they are in a cup but their marking will make them nearly invisible in their new home.
- Due to a cool feature called “chromatophores” salmon will change color slightly to match their environment. An orange bucket is preferable. A white bucket can stress chromatophores, and a darker color can heat up quickly.
- We will count your fish and report your release numbers and location back to the State of Washington to close out the year's permit process.



Adaptation of Salmon in the Schools - Seattle (2015)

WATER QUALITY

Your aquarium's water quality is an important part of the maintenance process. The diagram above shows a simplified cycle showing what is happening in your aquarium. We do monthly water changes on all of our aquariums. We don't have plants capable of removing all of the nitrates from your system, so in this way your aquarium presents an incomplete version of this cycle.



The chart above illustrates the typical progression of tank cycling.

Regular water tests help us to know how your aquarium is doing. While there are many tests that you can do, we focus on ammonia, nitrite and nitrate. These chemicals are part of a cycle. Bacteria break down each chemical into the next form.

AMMONIA TEST KIT INSTRUCTIONS

Why test for Ammonia?

Fish continually release ammonia (NH_3) directly into the aquarium/pond through their gills, urine, and solid waste. Uneaten food and other decaying organic matter also add ammonia to the water. Ammonia in the aquarium/pond may damage gill membranes, and prevent fish from carrying on normal respiration. High levels can be stressful or fatal to fish.

DIRECTIONS: These are also on the bottles. Note that ammonia has two bottles that need to be added separately to your vial of water.

1. Fill one clean test tube with 5 ml of water to be tested (to the line on the tube).
2. Add 8 drops from Ammonia Test Solution Bottle #1, shake for a few seconds.
3. Add 8 drops from Ammonia Test Solution Bottle #2, shake vigorously for about 5 seconds.
4. **Wait 5 minutes for the color to develop.**
5. Read the test results by comparing the color of the solution to the appropriate Ammonia Color Chart (for aquariums, use the freshwater option on the card). The tube should be viewed in a well-lit area against the white area of the card. The closest match indicates the ppm (mg/L) of ammonia in the water sample. A healthy sample is light yellow. If you are concerned (any sign of green in sample), take a picture of your results next to the color card and email it to your Salmon in School coordinator.
6. Finally, rinse the test tube with clean water after use and allow to dry. Note: Never pour test tube contents back into the aquarium.

What the Test Results Mean

In a new aquarium/pond, the ammonia level may surge to 4 ppm (mg/L) or more, and then fall rapidly as the biological filter becomes established. The ammonia will be converted to nitrite (also toxic), then to nitrate. This process may take several weeks. Use API STRESS ZYME® to speed up the development of the biological filter. In an established aquarium, the ammonia level should always remain at 0 ppm (mg/L); any level above 0 can harm fish. The presence of ammonia indicates over-feeding, too many fish, or inadequate biological filtration.

Reducing Ammonia Levels

In a newly setup aquarium, ammonium, nitrite, and nitrate levels will rise and then fall in the first few weeks, indicating the formation of the biological filter (helpful bacteria). AMMO LOCK® is an ammonia reducing additive. After it is added the ammonia will be converted into a non-toxic form. The Ammonia test kit will still show the ammonia, even though treating with AMMO LOCK® has made it non-toxic. The biological filter will then consume the non-toxic ammonia, converting it to nitrite and then to nitrate. A water change may also be needed, and should be treated with StressCoat and StressZyme when replacement water is added to the aquarium.

NITRITE TEST KIT INSTRUCTIONS

Why Test for Nitrite?

Nitrite (NO_2^-) is produced in the aquarium by the helpful bacteria as they act as a natural filter by consuming dangerous chemicals. Beneficial bacteria in this “biological filter” convert ammonia into nitrite. Nitrite is in the

middle of the chemical cycle, and can also be dangerous to fish if it is not converted to nitrate (NO₃-) later. Nitrite can prevent fish from carrying on normal respiration, and high levels will quickly lead to fish death. Even trace amounts of nitrite stress fish, suppressing their immune system and increasing the likelihood of disease. Too many fish, as well as uneaten fish food and decomposing plants and other organic matter can cause excessive nitrite levels.

DIRECTIONS

1. Fill a clean test tube with 5 ml of water to be tested (to the line on the tube).
2. Add 5 drops of Nitrite Test Solution
3. Cap the test tube and shake for 5 seconds.
4. **Wait 5 minutes for the color to develop.**
5. Read the test results by comparing the color of the solution to the Nitrite Color Card. The tube should be viewed in a well-lit area against the white area of the card. The closest match indicates the ppm (mg/L) of nitrite in the water sample. A healthy sample is light blue. If you have concerns (deep blue or purple), take a picture of the vial with the color card and send it to your Salmon in School Coordinator.
6. Rinse the test tube with clean water after use and allow it to dry. If you do not rinse immediately, it can leave a blue residue behind. To remove this, fill the vial with tap water, cap it, and let it sit for 24 hours before rinsing again.

What the Test Results Mean

In an established aquarium, the nitrite level should always remain at 0; any level above 0 can harm fish. When we do our monthly water changes, we are removing nitrite, but a tank with a medium, or higher level of nitrite will require an additional water change.

NITRATE TEST KIT INSTRUCTIONS

Why test for Nitrate?

Nitrate (NO₃-) is also produced in the aquarium by the helpful bacteria as they act as a natural filter by consuming dangerous chemicals. Nitrate is the final step of the aquarium ammonia cycle. It is less harmful than nitrite, but should still be removed if it builds up in the aquarium.

DIRECTIONS

1. Fill one clean test tube with 5 ml of water to be tested (to the line on the tube).
2. Add 10 drops of Nitrate Test Solution from Bottle 1, shake vial.
3. Add 10 drops of Nitrate Test Solution from Bottle 2
4. Cap the test tube and shake for 5 seconds.
5. **Wait 5 minutes for the color to develop.**
6. Read the test results by comparing the color of the solution to the Nitrate Color Card. The tube should be viewed in a well-lit area against the white area of the card. The closest match indicates the ppm (mg/L) of nitrite in the water sample. Healthy water will turn light yellow. If you have concerns (orange or red test), take a picture of the vial with the color card and send it to your Salmon in School Coordinator. Rinse the test tube with clean water after use and allow it to dry.

What the Test Results Mean

High levels of nitrate can stress fish by making it harder for them to breathe, resulting in tired fish. It can also promote algae growth which can look unpleasant and sometimes create a strong odor.

AQUARIUM MAINTENANCE: WATER CHANGES

Tank setup tips and instructions for water changes

1. Try to set up the tank in a convenient location. Close access to water and water disposal is important—the easier it is to change the water, the better. Water changes can take around 45 minutes.
2. Try to place tank in an area that is easily viewable and something the class and school can take pride in.
3. Using a cart or wagon to move water is a good idea because the water is heavy and can spill. This is especially true if your tank is far away from a water source.
4. We will set up your aquarium in September so that it is ready for eggs to arrive. Ensure the water temperature is consistently around 53 (+/- 2 degrees) and the ammonia, nitrite, and nitrate levels are within the desired range. Contact your Salmon in School coordinator if the tank is not ready by your anticipated October “Egg Day” since it may need another water change before it is safe for salmon.

Instructions for water changes

Salmon in School instructors will provide monthly cleanings when we are at your school for lessons, but you may be asked to do additional cleaning if your aquarium develops chemical imbalances or other issues during the month. Our instructors will do their best to come to your site, but if you are at a school that’s further away or if we are at other lessons, you may be asked to provide this care for your salmon.

1. Please email your Salmon in School coordinator describing the issues you are concerned about, and take a picture of the aquarium gravel and water. Also perform your water quality tests (ammonia, nitrite, and nitrate) and take a picture of each of these with their color card next to the vial. Send all of this in an email to your coordinator. They will let you know if a water change is needed.
2. If you are advised to do a water change, you will need supplies including a bucket, siphon, dip net, and water conditioners (StressCoat and StressZyme). It is helpful to have some towels nearby for spills.
3. When it is time to change the water, unplug your equipment, taking note of how many plugs you unplugged so that you can make sure you get everything plugged back in after you’re done.
4. There are numerous ways to create suction in your siphon. I’d suggest immersing your entire siphon and tube in the aquarium and then holding up different parts up to help the air escape (you might need to hold your thumb over the end of the tube until you are ready for a bubble to be released).
5. Carefully use the siphon and suck up waste and particulates in the gravel, where most of the waste has settled. Try not to suck up fish, but if you do, use the dip net to scoop them back out of your bucket as soon as feasible.
6. You will siphon out about half the water from your aquarium (6 partially full buckets). In between buckets, stick the siphon and tube back in the water so you don’t need to go through the process of creating suction again. This also works if you need to switch your siphon to the other side of the aquarium.

7. Clean your filter media (sponges and rocks), **for waterfall filter only!** Lift off lid and rinse filter materials in siphoned water or sink water. Check for any build-up around the magnetic propeller in the left compartment of your filter. Return the media to your filter- aim for even layers.
8. Refilling: Avoid hurting your back! Use a small pitcher to scoop water out of your bucket into the aquarium until it is light enough to safely lift. Add the water gently, especially if you have very young alevin or eggs. Sometimes the bigger fish like to chase the bubbles. Fill until water is half an inch from the black plastic rim to limit fishes' ability to jump out.
9. Add 5ml of StressCoat and StressZyme per bucket of water. This is about 2.5 capfuls of each for a 55-gallon aquarium (which is what most are).
10. Make sure your filter is primed by adding water into the top. Then turn on all of your equipment by plugging it back in (count the number of plugs to be sure you got everything). Look at your aquarium and make sure everything restarted correctly (also look at chiller computer to make sure it's on).
11. Wipe up any spills/slippery floors.
12. You did it!!

APPENDIX

GLOSSARY OF TERMS

SPECIES OF PACIFIC SALMON

MONITORING FORMS & EQUIPMENT MANUALS

- MONITOR LOG – DAILY
- CHILLER INSTRUCTIONS

EDUCATIONAL RESOURCES

- THE EXTERNAL ANATOMY OF A SALMON
- THE INTERNAL ANATOMY OF A SALMON
- LIFE CYCLE FILL IN THE BLANK
- LIFE CYCLE WORD SEARCH
- LIFE CYCLE DISPLAYS/TEACHING MATERIALS

SALMON IN SCHOOL WEB EXTENSION

Contains additional information sorted by content, workbooks, and other activities. Learn more about a specific topic or extend your lesson.

<https://www.tristatesteelheaders.com/salmon-in-school/teacher-materials/>

GLOSSARY OF TERMS

A

Acidity- is a measure of the ability of a solution to neutralize alkaline substances (low pH)

Adult- Life stage of a salmon that is living in the ocean.

Alevin - hatched salmon that still has a large yolk sack for nourishment

Alkalinity - is a measure of the ability of a solution to neutralize acids to the equivalence point of carbonate or bicarbonate (high pH)

Ammonia - is a compound with the formula NH_3 , produced as a waste product in the aquarium

Anadromous - migrates from salt to fresh water as adult

Anatomy- Study of the structure and internal workings of a living thing

Aquatic invasive - a non-native plant or animal with negative impact on a new habitat

E

Ecosystem - a natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the non-living physical (abiotic) factors of the environment

Eddies - water current moving contrary to main current

Erosion - natural processes including rain, weathering, dissolution, abrasion, corrosion and transportation, by which material is removed from the earth's surface

F

Fish Hatchery- A place where select fish are spawned, hatched and released

Fry - a recently-hatched fish

H

Habitat - environment in which an organism normally lives that meets its needs

Hydropower- A way of generating electricity that uses water and spinning turbines

M

Macroinvertebrate- Organism that can be seen with the naked eye that has no backbone

N

Nitrate – (NO_3^-) a salt of nitric acid, waste product found in aquarium as part of ammonia cycle

Nitrite – (NO_2^-) waste product found in aquarium as part of ammonia cycle

P

Parr - parr is a juvenile fish, one preparing to leave the fresh waters of its home

PCBs - polychlorinated biphenyls (PCBs) are a class of organic compounds used in machinery. PCB production is toxic and was banned in the 1970s. PCBs are classified as persistent organic pollutants which bioaccumulate in animals.

pH - is the measure of the acidity or alkalinity of a solution

Plankton - microscopic water born-organisms

Pollution-the presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects

R

Redd – nest made of rocks where a mother salmon lays eggs

Rehabilitation - the process of restoring the land, and natural environment

Riffle - rocky shoal or sandbar lying just below a waterway

S

Smoltification - process of fish such as salmon becoming physiologically adapted to saltwater






Spawning - the act of laying eggs or milt

Spawning Adult-Life stage of a salmon that is ready to return to fresh water and spawn

Stocked fish - released by fish hatcheries into the wild

Y

Yolk sac - serves as the food source for the developing alevin

| | |
|--|--|
| <p>CHINOOK or KING, SPRING, TYEE, BLACKMOUTH Mature at two to seven years and weigh up to 130 pounds. Most highly prized by sport fishermen. The Washington sport record is approximately 70 pounds. Chinook have a black lower gum line where teeth project from the jaw and they are heavily spotted on the tail.</p> |  |
| <p>COHO or SILVER Mature at two to four years and may exceed 30 pounds in weight. The Washington sport record is approximately 24 pounds. Coho have a white lower gum line where teeth project from the jaw and they are lightly spotted on the upper part of tail.</p> |  |
| <p>PINK or HUMPBACK Live only two years and weigh up to 15 pounds, Pinks are taken primarily in odd-numbered years by both sport and commercial fishermen, and they are usually sold canned. Pinks are characterized by tiny scales and a "rubbery" jaw and they are heavily spotted on the tail and back. Only mature males develop the pronounced humped back associated with pink salmon.</p> |  |
| <p>CHUM or DOG They mature at three to five years and weigh up to 30 pounds, Chum seldom strike sport lures, but are taken commercially and sold canned. Spawners have purple striped shading on their sides. Ocean caught chum are edible but freshwater caught are not and have a distinct unpleasant odor.</p> |  |
| <p>SOCKEYE or RED, BLUEBACK They mature at three to five years and weigh up to 15 pounds. Although rarely taken on sport tackle, landlocked sockeye called "kokanee," "redfish" or "silver trout" are popular freshwater game fish. Flashy red and green spawning coloration.</p> |  |

Installation Instructions for Drop-In (Wand) Style Chiller

1. Location of Chiller

It is essential that the chiller be located in a well-ventilated location. The chiller will not function correctly if even partially confined. If placing the chiller inside the aquarium stand or cabinet is the only option, make sure to have at least two vents to allow fresh air into the chiller and to allow the warm air produced by the chiller to escape from the chiller's location. These vents must be at least as large as the chiller's condenser (part that looks like a radiator). The condenser (front) and rear portion of the chiller should be at least 24" from any wall, and air flow should be directed so as to first enter the condenser. The chiller's cover can be left on or removed, however if the chiller is located outside the cover should be left on and the chiller protected from the elements by a partial enclosure.

2. Location of Drop-In Coil

The Drop-In coil must be located in an area of the sump or main tank where there is sufficient water flow in and around the coil. If the coil does not get adequate water flow it may create a temperature barrier around it, drastically reducing its cooling efficiency.

3. Flow Rate

The following flow rates refer to the sump region where the Drop-In coil is typically located. If the coil is located in the main tank, it should be placed in front of a submersible pump or water inlet with the same flow rate range.

| | |
|-----------------------|--------------------------------|
| 1/5hp Drop-In | 5-14 gpm (300-840 gph) |
| 1/4hp Drop-In | 7-20 gpm (420-1200 gph) |
| 1/3hp Drop-In | 8-25 gpm (480-1500 gph) |
| Super 1/3hp Drop-In | 10-30 gpm (600-1800 gph) |
| Compact 1/2hp Drop-In | 10-30 gpm (600-1800 gph) |

4. Temperature Controller Installation

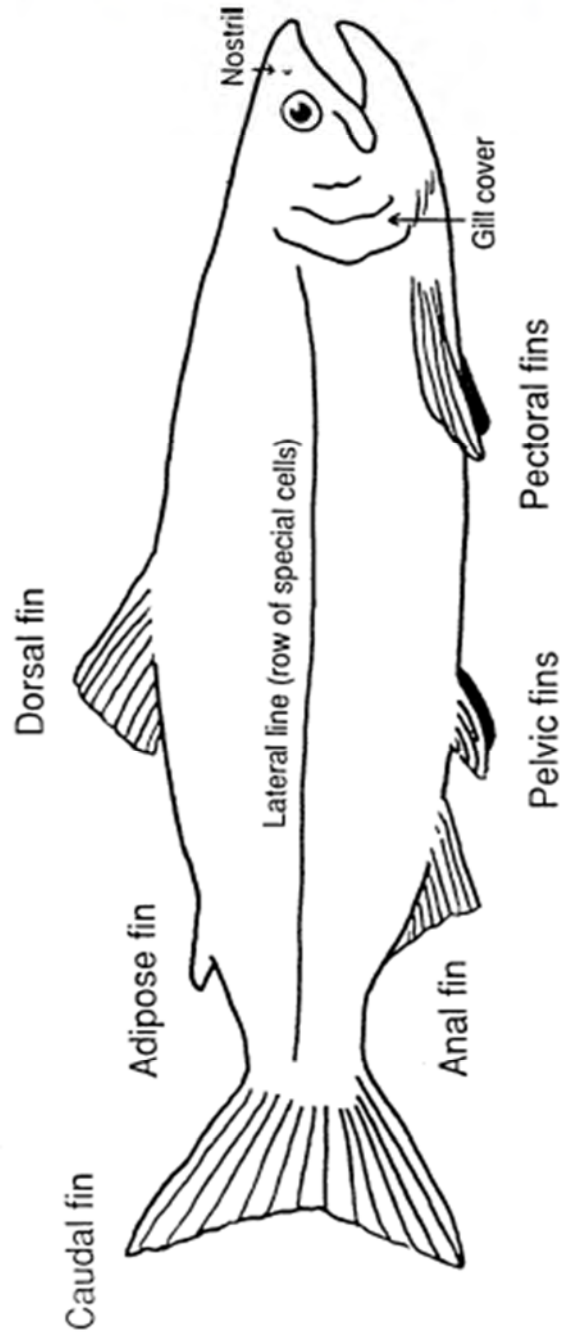
The chiller and controller should be on a dedicated circuit (GFCI recommended). The controller must be placed in a location away from water or spray. Plug the male power cord of the chiller into the female power cord of the controller, and plug the male power cord of the controller into a 115v wall outlet (extension cord not recommended).

Maintenance

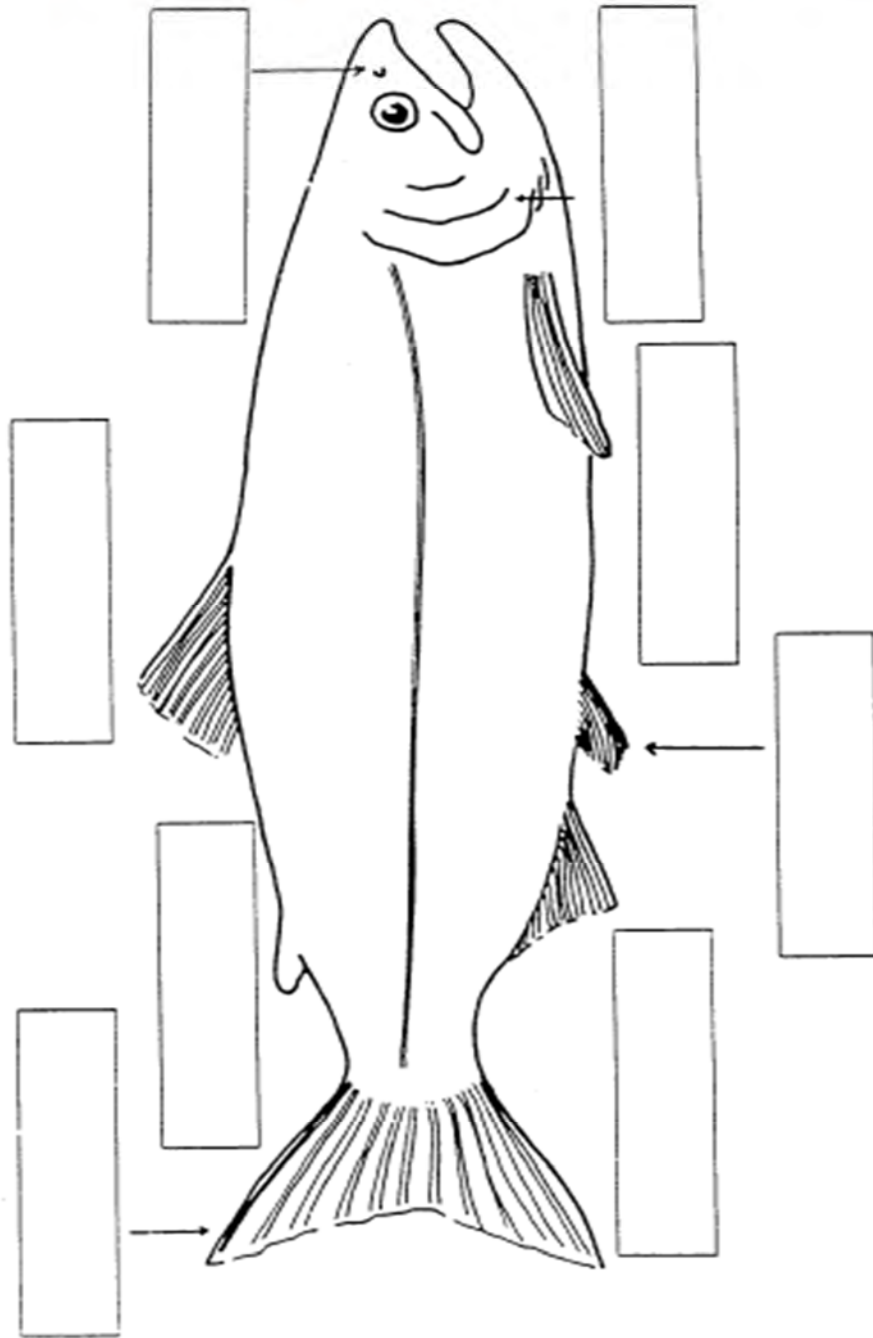
The condenser of the chiller should be cleaned regularly (once a month) using a brush and a vacuum. If the condenser ever appears dirty to the eye it may be necessary to clean it more often. A dirty condenser will drastically reduce the cooling efficiency of the chiller and can reduce its life span.



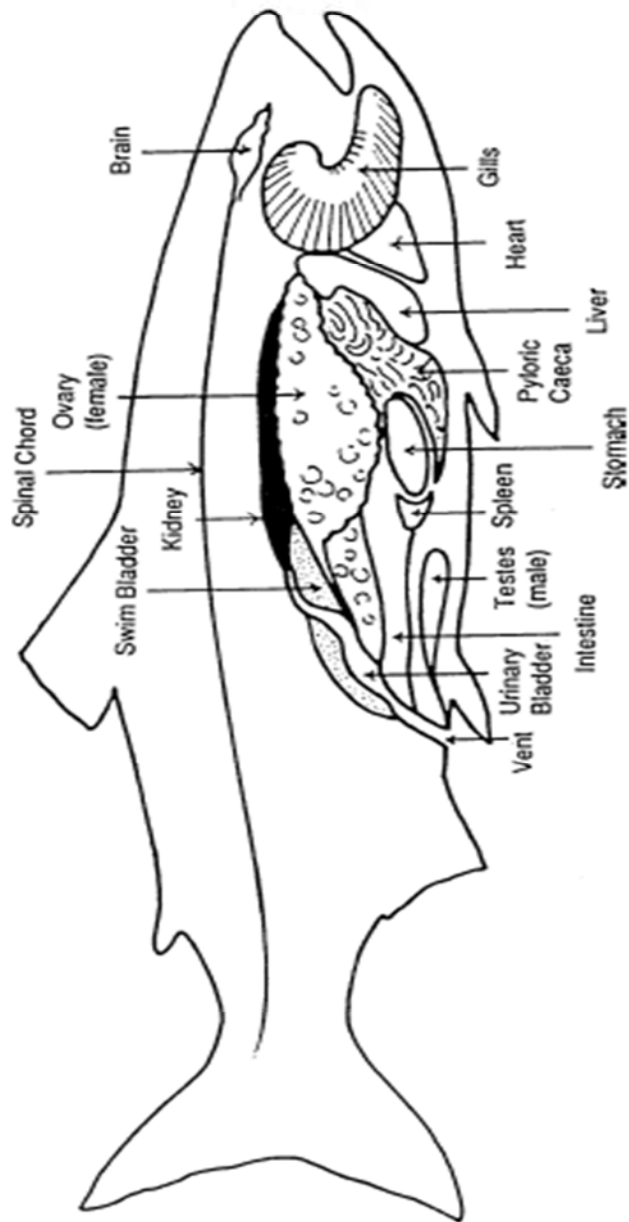
The external anatomy of a salmon



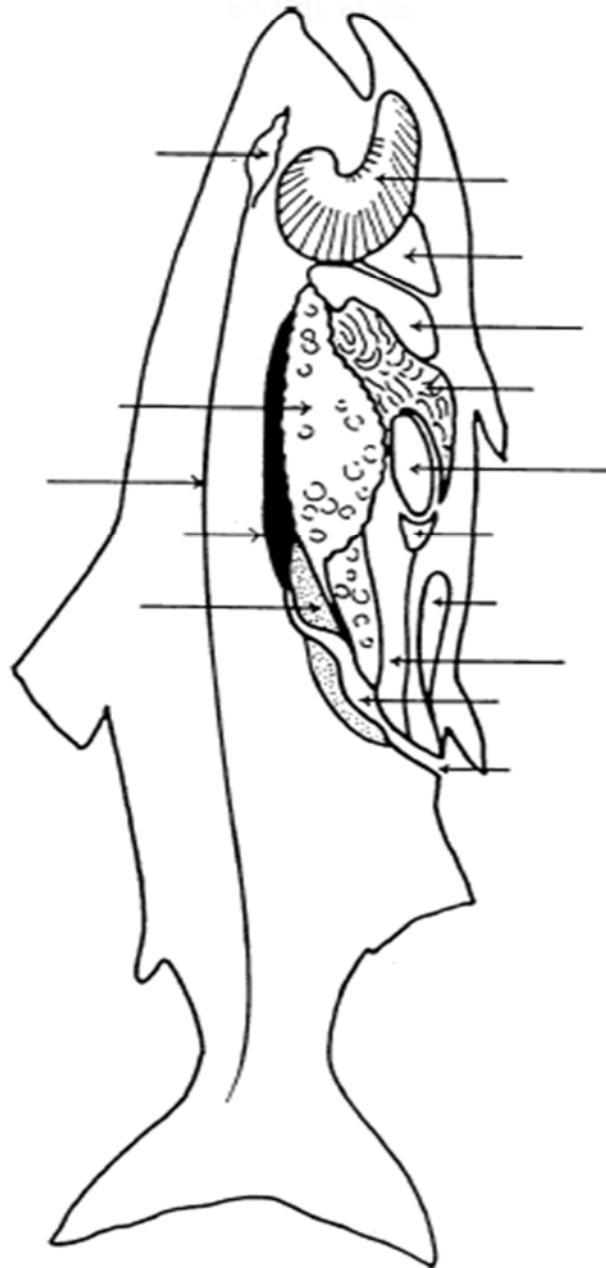
Label the parts of a salmon



The internal anatomy of a salmon



Label the internal anatomy of a salmon





Salmon Life Cycle

Fill in the blanks below with words from this box:

| | | |
|-----------------|----------|-----------|
| hatches | gravel | egg |
| alevin | live | saltwater |
| species | estuary | fry |
| shrimp and fish | spawning | smolts |
| fertilize | rapidly | redd |
| avoid | leap | adult |
| smell | cycle | nature |

A Freshwater Start

The life of a salmon begins as an _____ buried in _____ at the bottom of a stream. After the egg _____, the tiny fish with its yolk sac still attached lives in the gravel. This tiny fish with a yolk sac is called an _____. The yolk sac nourishes the alevin. After the yolk sac is absorbed, the salmon emerges from the gravel as a _____ and starts to catch _____ prey.

Journey to the Sea

Some _____ of salmon head directly to the sea, while other species live in freshwater for a while. As salmon move to the sea they have to get used to the _____. The best place to do this is in an _____, which is a place where the freshwater rivers and streams meet the saltwater ocean. Salmon that are getting ready to live in saltwater are called _____. Once in the ocean, the salmon grows _____ because there are plenty of _____ to eat.

The Return Home

Then after spending several years in the ocean the _____ salmon head back to the streams where they were born. How they get there is a wonder of _____. Scientists think they use their sense of _____.



The _____ salmon face many obstacles. They have to _____ over waterfalls and _____ animals such as bears. When they reach a nice gravel bed, females use their tails to make a nest, called a _____ where they lay their eggs. The males _____ the eggs and the _____ begins again.

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Salmon Life Cycle

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B | C | O | H | O | D | Y | Z | Z | J | Q | R | S | Q | H | T |
| P | C | G | F | L | P | B | W | S | R | E | C | G | X | V | E |
| O | H | A | L | E | V | I | N | N | T | G | N | I | V | N | W |
| F | U | W | Z | G | F | K | I | A | E | I | C | G | X | A | K |
| M | M | R | W | G | W | C | W | L | K | M | B | L | G | E | D |
| P | X | E | N | E | F | T | S | O | C | K | E | Y | E | C | L |
| P | I | N | K | G | L | Z | C | E | W | C | B | H | S | O | B |
| A | F | W | D | A | T | B | R | F | S | R | M | L | J | W | S |
| D | T | A | S | F | Z | M | W | E | F | T | O | J | R | W | K |
| U | A | P | D | R | A | F | V | O | D | L | U | E | I | S | E |
| L | A | S | E | E | D | M | N | S | C | D | B | A | M | O | L |
| T | A | B | R | S | L | L | K | M | Q | H | F | J | R | I | N |
| M | L | T | Y | H | P | E | V | O | L | T | I | R | H | Y | A |
| B | S | N | A | W | R | V | C | L | C | F | E | N | V | S | U |
| W | W | K | J | A | R | A | P | T | C | V | R | S | O | N | E |
| N | W | G | L | T | A | R | L | H | I | K | Y | Y | V | O | R |
| I | N | N | B | E | P | G | H | R | F | I | Z | F | G | T | K |
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Find these words related to the Salmon Life Cycle:

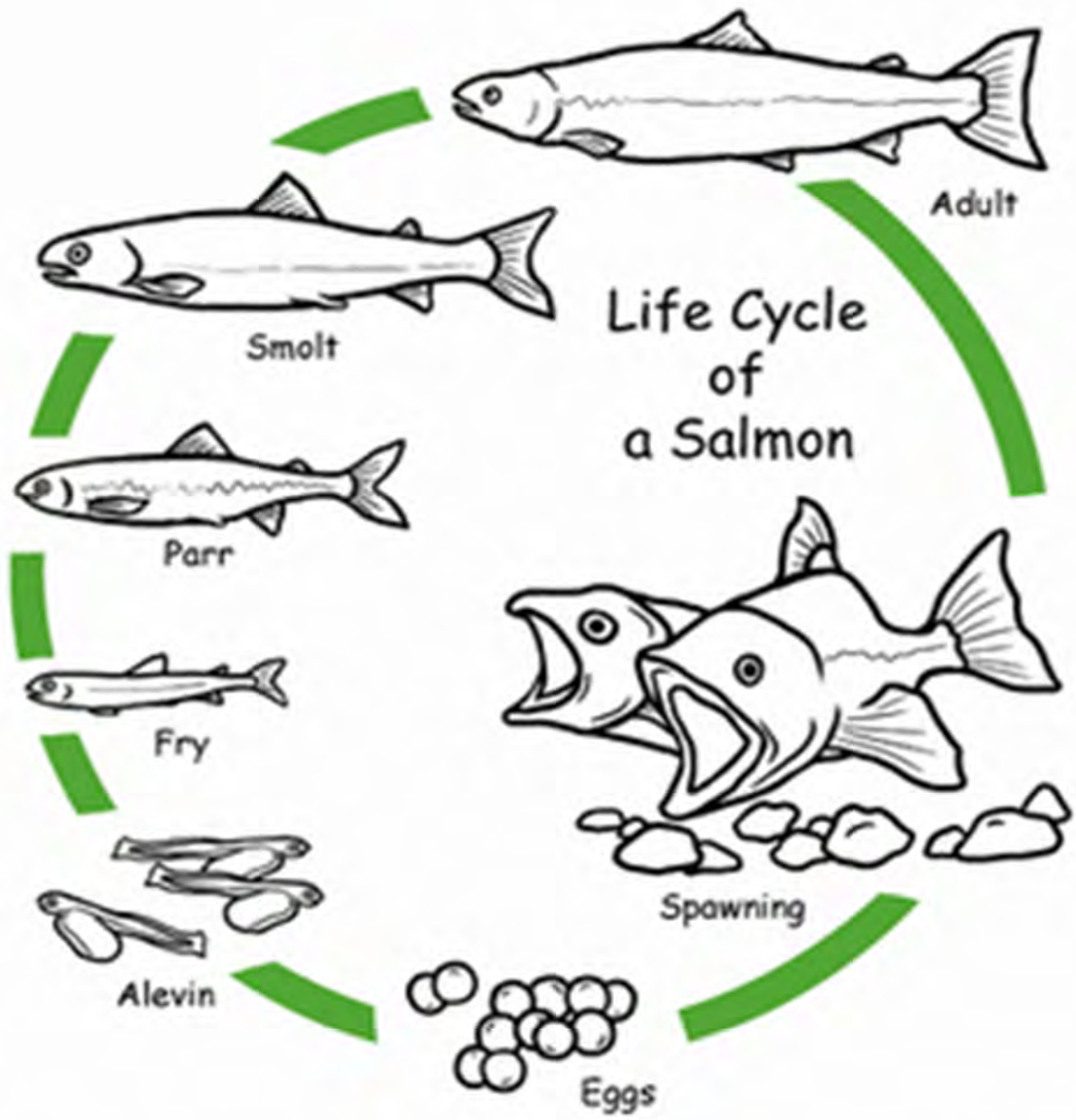
- adult
- alevin
- chinook
- chum
- coho
- estuary
- freshwater
- fry
- gravel
- ocean
- parr

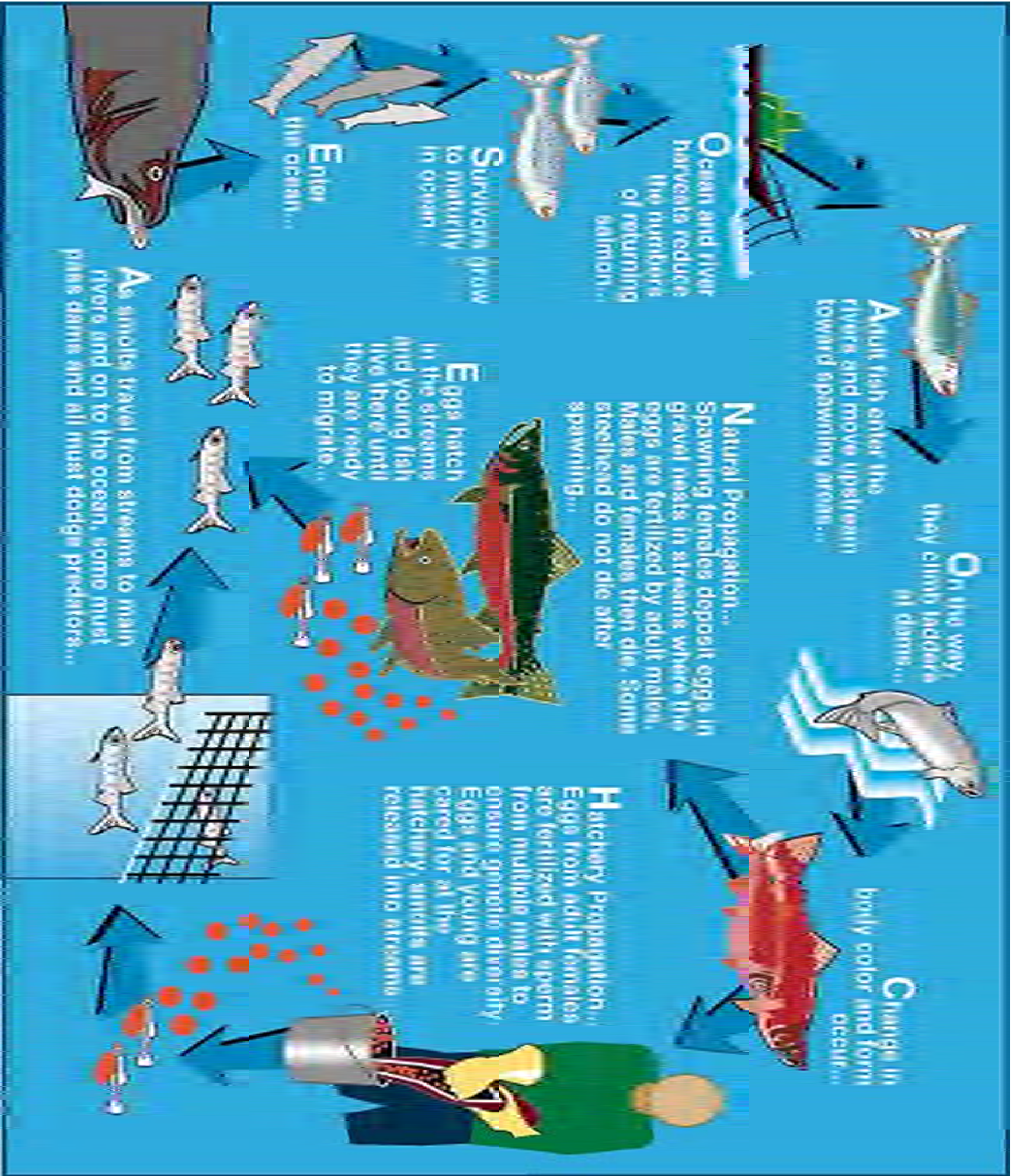
- pink
- red
- river
- roe
- saltwater
- smolt
- sockeye
- spawner
- stream



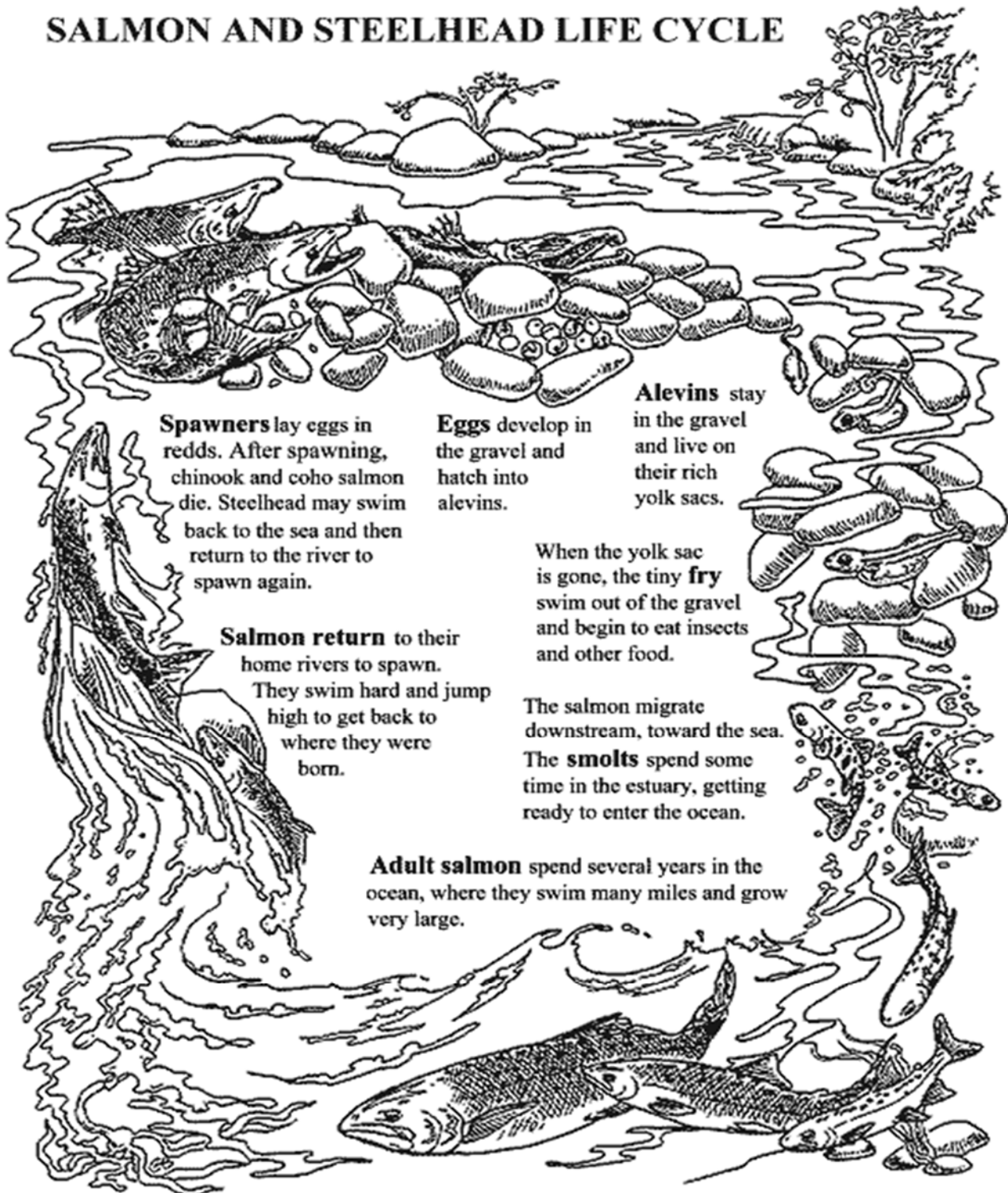
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SALMON AND STEELHEAD LIFE CYCLE



Spawners lay eggs in redds. After spawning, chinook and coho salmon die. Steelhead may swim back to the sea and then return to the river to spawn again.

Salmon return to their home rivers to spawn. They swim hard and jump high to get back to where they were born.

Adult salmon spend several years in the ocean, where they swim many miles and grow very large.

Eggs develop in the gravel and hatch into alevins.

Alevins stay in the gravel and live on their rich yolk sacs.

When the yolk sac is gone, the tiny **fry** swim out of the gravel and begin to eat insects and other food.

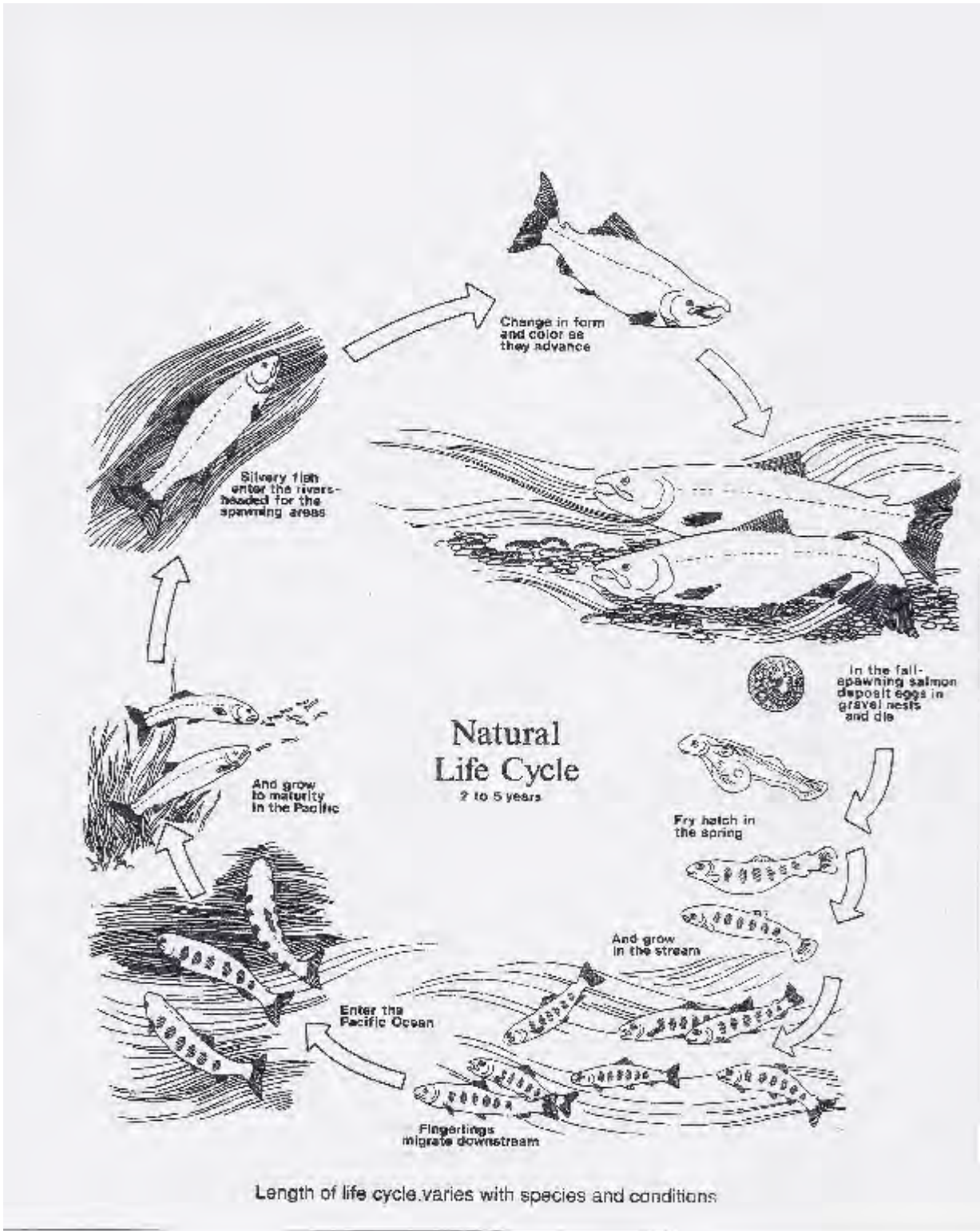
The salmon migrate downstream, toward the sea. The **smolts** spend some time in the estuary, getting ready to enter the ocean.

From *Salmon & Trout Go To School* by D. Higgins

Illustration by Gary Bloomfield

CDFG 1996





- 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]
- 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]
- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]
- 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
- 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]



- MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [*Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.*]
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]
- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.***[Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

