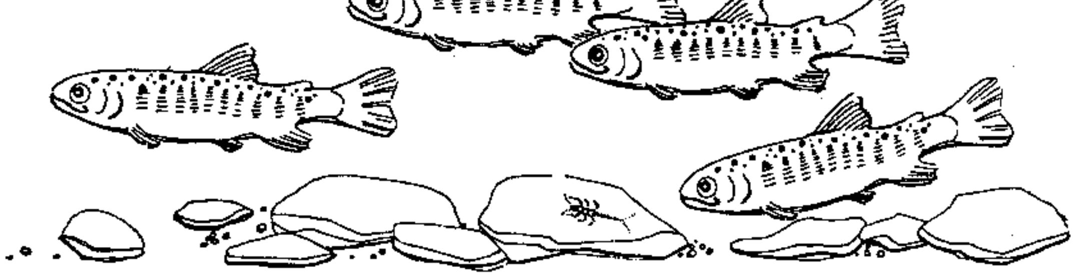
SALMON IN SCHOOL

with TRI-STATE STEELHEADERS



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OVERVIEW

PROGRAM OBJECTIVES

- To provide hands-on education of salmon life cycle, water quality and environmental stewardship for kindergarten through 12th grade students in Asotin, Columbia, Garfield and Walla Walla counties;
- To create a long-term working relationship between Tri-State Steelheaders (TSS) and local schools/teachers to enhance awareness of and provide participation opportunities in salmon habitat restoration efforts and community-lead environmental stewardship;
- To integrate Washington State Science Curriculum requirements with the "salmon in the classroom" experience;
- To encourage a 'place based' approach to learning by supporting teachers in introducing students to specific historical, cultural and environmental components of salmon restoration efforts in this region.

PROGRAM CONTACTS

LOCAL COORDINATOR

Tri-State Steelheaders

Andrew Bassler - Education & Outreach Coordinator
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office: 509.529.3543 | **cell:** 460.570.4631

WA STATE CONTACT

Washington Department of Fish & Wildlife

Joshua Nicholas - School Cooperatives Program
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office: 360.902.2685

HATCHERY RESOURCE

Confederated Tribes of the Umatilla Indian Reservation

Jon Lovrak - Umatilla Hatchery Satellite Facilities O&M Project Leader
JonLovrak@ctuir.org
office: 541.429.7278

EQUIPMENT & SUPPLIES

City Zoo Pets, L.L.C.

Ron Matthews - Owner
cityzoopets@yahoo.com
office: 509.525.1160

PARTICIPANT RESPONSIBILITIES

LOCAL COORDINATOR RESPONSIBILITIES

- Procure equipment and supplies for initial set-up or for replacement;
- Provide resources and/or training to support assembly of the aquarium and associated equipment;
- Provide fish food, water quality monitoring and water treatment supplies;
- Organize delivery or pick up schedule for salmon eggs;
- Provide curriculum materials, technical support, and advice about maintenance, problems, and fry 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

- Locate tank and display in area where the largest number of students can observe the salmon development;
- Incorporate salmon life cycle, water quality and environmental stewardship lessons into the curriculum in the classroom;
- Maintain the tank, chiller and other equipment per recommendations;
- Feed the salmon per instructions;
- Monitor water chemistry per recommendations;
- Recruit tank volunteer(s);
- Release the salmon fry at designated release sites in the appropriate watershed;
- Perform end-of-season equipment care and storage per recommendations;
- Perform program assessment/evaluation.

VOLUNTEER(S) CONTRIBUTIONS

- Assist with initial tank set up;
- Stay in consistent communication with school to address concerns or problems;
- Assist with feeding, water quality monitoring, tank and equipment maintenance;
- Be available if possible in case of emergencies;
- Participate in spring salmon release;
- Help teachers clean and store equipment at the end of the school year;
- Suggest program improvements and training needs.

CARE & MAINTENANCE

EQUIPMENT

Provided by Tri-State Steelheaders

Annually	As Funds Allow
- Fish Food – 3 sizes: #0,#1,#2	- Tank
- Ammonia tester	- Tank Stand
- Nitrite tester	- Water Chiller
- pH tester	- Filter
- Stress Coat (water conditioner)	- Air pump
- Stress Zyme (water cleaner)	- Siphon
- Ammonia Detoxifier – if needed	- Aquarium thermometer
- Pipette – for water quality testing	- Fish Net
	- Gloves
	- Water storage containers (10-20 gallon)
	- Dolly (for moving water storage containers)
	- 5 gallon bucket (for siphoning old water out of tank)

TANK SETUP

CLEAN TANK

Before adding water, wash tank thoroughly with a 10% bleach and water solution. Then rinse with water 5 times to remove all bleach residue. Tanks should be up and running to 47 degrees F for at least 2 weeks prior to egg delivery.

Notes:
Wash all other equipment before first use also, such as 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 his weight and is stable enough to allow close viewing of the tank by children.

ADD CHILLER & THERMOMETER

Place chiller unit in well ventilated area according to manufacturer's instructions (see Appendix). Place drop-in coil in tank. Set temperature controller to 47° F. Temperature can be raised (no higher than 54° F) after feeding begins, depending on the speed of growth you are hoping to achieve.

Place thermometer at opposite end of tank from chiller.

ADD FILTER

Follow manufacturer instructions.

ADD AERATOR/AIR STONE(S)

Follow manufacturer instructions.

- ensure air check valve is not in water
- keep air pump above or as close to tank water level as possible

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.

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1 tsp (5 ml) **per 10 U.S. gallons** (38 L) **of water**

TEST WATER QUALITY

Forty-eight hours after setting up tank, use API liquid testing kits to measure ammonia, nitrite and pH according to manufacturer's recommendations (see Appendix). It may take a few weeks for the biological filter to become established and a healthy nitrite cycle to develop. Record levels on the *Monitoring Log – Weekly* found in the appendix under Monitoring Forms.

Notes:

- Depending on your set up it may be easier to add the aerator, filter, and chiller to the tank prior to adding the water.
- MONITOR the tank for proper temperature and water quality for a period of approximately TWO WEEKS prior to receiving salmon eggs.
- *We don't recommend putting gravel in bottom of the tank unless you have a filtration system which requires a substrate (Example: trays at the bottom of the tank).

MONITORING

DAILY

CLEAN EXCESS DEBRIS

Use your siphon to clean your tank daily of any large debris. It is important to remove any uneaten food, egg sacks, dead eggs or fish and other debris which lead to growth of unhealthy bacteria or fungi that can kill healthy eggs and fish.

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. Higher temperatures speed up hatching rates, but also encourage growth of bacteria and fungi that may kill eggs or fry.

The ideal controlled temperature for a classroom tank is 47° - 52° F.

Temperature affects ammonia and oxygen concentrations as well as fish metabolism. A sudden increase or decrease of 3 - 5 degrees within a 15-minute period, even within an acceptable temperature range, can create problems for both eggs and alevins.

Record daily temperatures on the *Monitoring Log – Daily*. This will also assist with predicting hatch rates.

> 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

Count the eggs when they first arrive. Keep a daily record of the number of dead eggs/fish on the Monitoring Log - Daily (see Appendix).

WEEKLY

CLEAN TANK AND REPLACE WATER

- TURN EVERYTHING OFF
  Turn off anything that is plugged in for your tank including chiller, filters or power heads, and air pumps.
- REMOVE ALGAE FROM GLASS AND TANK COMPONENTS
  Wipe the glass in your tank until it is completely clean of algae. This can be done by wrapping a paper towel around your fish net or with a sponge. Tank cleaning sponges with handles can be purchased from the pet store. A toothbrush is good for cleaning corners and small parts of the filter and power heads.

  > Notes:
  > Neoprene gloves are helpful when it is necessary to have your hands in the water for more than a few minutes.

- SIPHON DEBRIS FROM BOTTOM OF TANK
  To create a vacuum in your siphon you can either use method 1: move the siphon head up and down quickly in the water https://www.youtube.com/watch?v=D6Re04cYJcY or method 2: submerge entire siphon under water and place your thumb over the end of the small tube as you

remove it from the water https://www.youtube.com/watch?v=iv8Fk6PztWk. Move your siphon around the bottom of the tank to remove algae, waste and uneaten food. If you accidentally siphon a fish, simply net from bucket and return to tank.

Notes:
You may want to have an extra towel near the bucket and have a student or volunteer help hold the tube in the bucket. It may be helpful to get a turkey baster to remove dead eggs.

- REPLACE WATER – USE STRESS COAT
  Replace the same amount of water as you removed from your tank. Be sure to add Stress Coat to remove chlorine from the water before introducing it into your tank. Also, try to ensure the temperature of the water is within a few degrees of the temperature of your tank. Ice may be needed to accomplish this.

  Notes:
  Once you learn about how much water you will need to replace you can set the replacement water out ahead of time to cool and to mix well with the Stress Coat.

TEST WATER QUALITY – Ammonia, Nitrites & pH

In an established tank levels should be as follows:

Ammonia: 0 ppm (mg/L) | **Nitrite: 0 ppm** (mg/L) | **pH: 7**

Ammonia - NH_3 - Proteins are essential to produce the powerful muscles salmon use for swimming. Animal cells assemble their required proteins from amino acid building blocks found in foods. Ammonia is the result of the biological breakdown of proteins and is present in two forms: ammonium ions (NH_4) and ammonia (NH_3). The latter is highly toxic to fish. Even small amounts can be dangerous. A balance between the two is controlled by pH and the temperature of the water. At higher pH levels (>7) and temperatures, the toxic form increases its concentration.

In nature, ammonia (nitrogen) waste is not a problem. It is simply diluted into the stream where the nitrogen is reabsorbed by aquatic plants and plankton. In a closed aquarium ammonia levels can build up very quickly, resulting in a fish kill. You will most likely notice a difference in nitrogen levels right after the eggs hatch and again when the fish begin feeding.

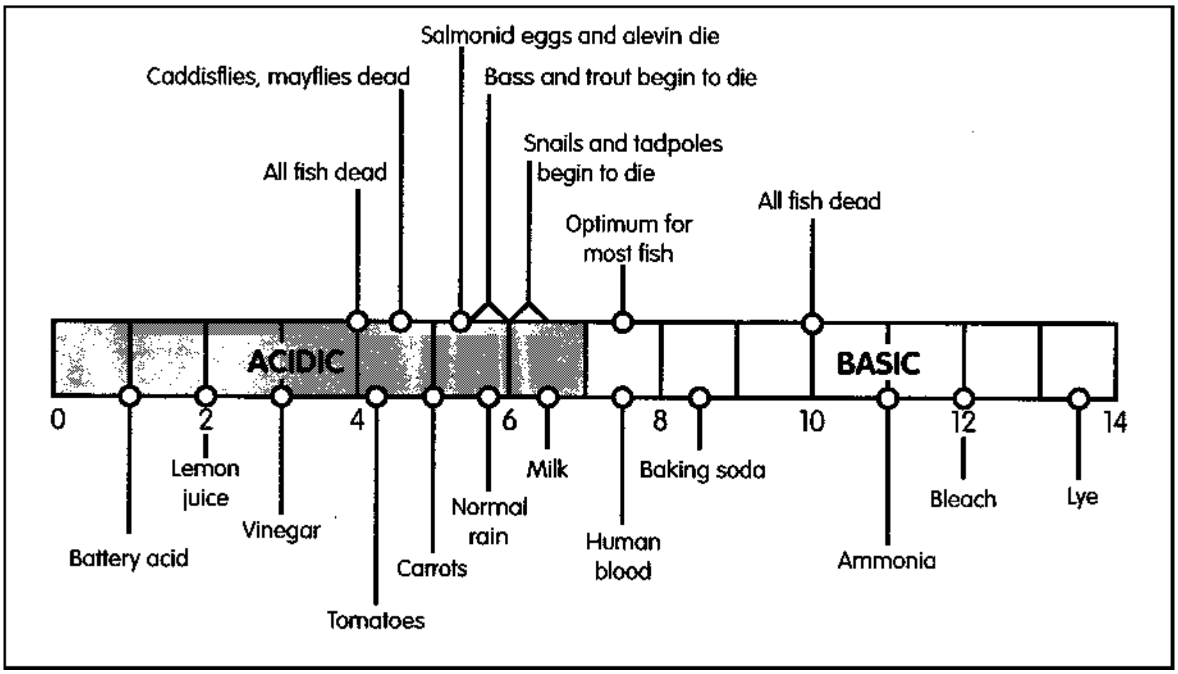
High ammonia levels can kill both eggs and fry. A healthy, actively functioning biological community (bio filter) controls most of the ammonia. The bio filter breaks ammonia down initially into less toxic nitrites, and finally into relatively nontoxic nitrates through a process called nitrification.

Nitrite - NO_2 – The first step of nitrification is the process where the oxidation of ammonia produces nitrite. Nitrite can be metabolized by bacteria. These aerobic bacteria oxidize the nitrite to nitrate. Nitrates are far less toxic than ammonia or nitrites. The conversion of nitrite (NO_2) to nitrate (NO_3) is the 2nd step of nitrification. Nitrite levels in a healthy tank should be 0 ppm.

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.

pH Scale



Source: The Stream Scene: Watersheds, Wildlife, and People, Bowers, Patty, et al., Oregon Department of Fish and Wildlife, 1999.

EVALUATE AQUARIUM HEALTH – The Nitrogen Cycle

Whatever filtration system you are using, it is important to establish a nitrogen cycle. This is the process where harmful organic waste is processed by beneficial bacteria. A clean tank will help keep the system in balance and water quality testing will let you know if something is wrong.

For more information read The Nitrogen Cycle (see Appendix) and watch this video: https://www.youtube.com/watch?v=1XC7xT0mIbY.

If the fish are showing signs of stress, mortality is high, or water clarity is cloudy after a tank cleaning and water change, see troubleshooting section of guidebook or contact program coordinator for assistance.

FISH

PREDICTING HATCH RATES – Cumulative Temperature Units

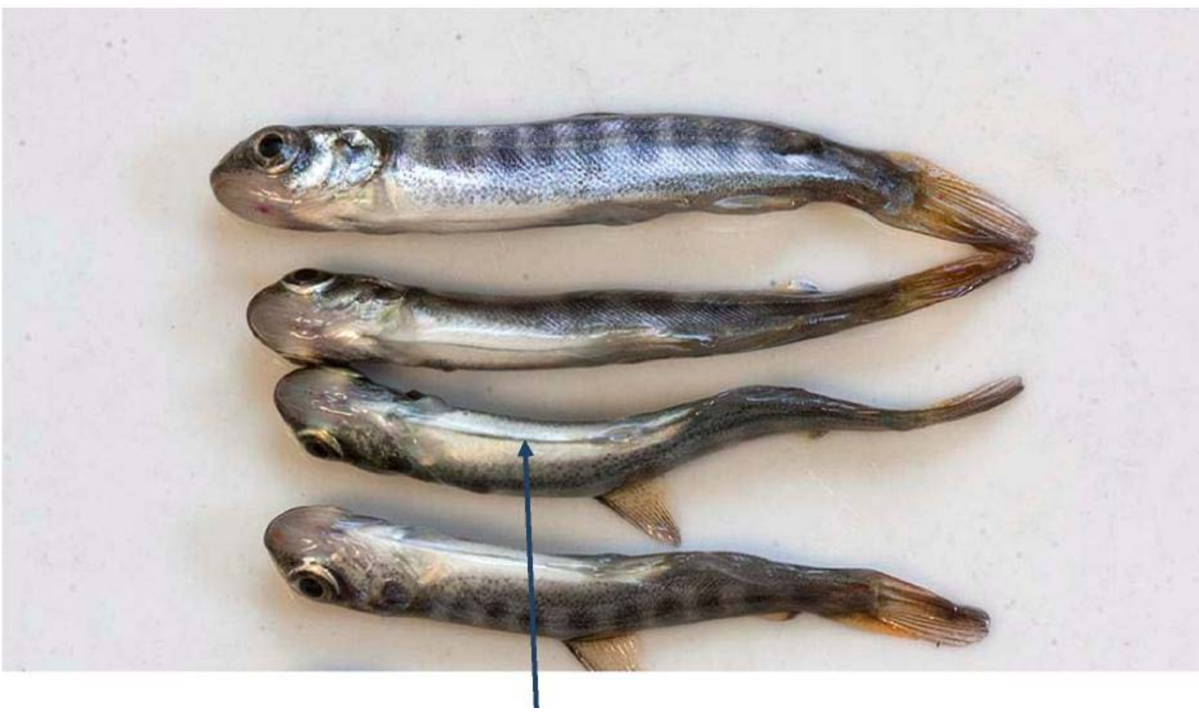
The following table is an APPROXIMATE guideline for development rates. A general rule of thumb is that the COLDER the water, the LONGER it will take to reach the temperature units required for various stages of development. Conversely, the WARMER the water, the FASTER the rate of development — up to 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*.

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. You should not see even a little pink line.



This is the "suture line," where the salmon's yolk sac used to be. **<u>This needs to be almost completely invisible before they are fed.</u>** The full absorption of the yolk sac is known as "buttoning up." These chinook were fed for the first time about A WEEK **AFTER** this picture was taken. The fish will look very skinny at this point, but they are OK!

When the suture lines have disappeared begin "tease feeding" so that the fish will learn to eat and to make sure they have completely buttoned up. To tease feed, 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. It may take a week of tease feeding before the fish eat normally.

Put a daily supply (about 1/4 teaspoon) of size #0 food in a vial or small lid. Use a Popsicle stick to 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.

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.
- At each feeding, observe the fish for 5 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.

AT 4 WEEKS

If you wish, about 4 weeks after the fish begin eating, you can begin feeding size #1 food two-three times daily.

AT 8 WEEKS

If filtration is working well and you have no problem with ammonia or nitrite, you can start feeding size #2 food about 8 weeks after the fish begin eating (the fish should be vigorously free-swimming, not resting at all on the bottom). Keep a close watch on ammonia and nitrite.

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.

Be patient and don't feed your fish before they are all fully buttoned up. If you have buttoned up fish that "fail to thrive," try netting them into a small container where they don't need to compete with more aggressive feeders. Then try hand feeding them size #0 food with an eyedropper or pipette. It takes several weeks for a fish to starve, so be patient and keep trying. In fact, a fish that is not eager to rise to the top of the water may survive better in a natural environment.

RELEASE

KEEP THE WATER COOL & OXYGENATED

Remove water from your tank into a bucket. Net fish and put them into the tank water in your bucket. Start releasing 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.

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.

INTRODUCE CREEK WATER

Explain to the students that fish do not like sudden changes in their water. Direct students to bring a cup of water from the creek and pour it into the bucket to mix with the aquarium water so the fish can begin to get used to creek water.

RELEASE FISH INTO WATER

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.

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 the young fish.

> **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.
>
> If you don't have a count of your fry, tally the fish as they are released and document the total plant number.

REPORT RELEASE INFORMATION

After your release, contact your program coordinator to report how many fish you released, when, and where. Please fill out a PLANT RECORD (see appendix for example) to be sent to WDFW.

Reporting is very important and MUST be done to ensure that your school may participate in the program next year.

APPENDIX

GLOSSARY OF TERMS

SPECIES OF PACIFIC SALMON

MONITORING FORMS & EQUIPMENT MANUALS

- MONITOR LOG – DAILY
- MONTIOR LOG – WEEKLY
- PLANT RECORD (EXAMPLE)
- TRADEWIND CHILLER INSTRUCTIONS
- API TEST KIT INSTRUCTIONS
    - AMMONIA
    - NITRITE
    - pH

EDUCATIONAL RESOURCES

- THE EXTERNAL ANATOMY OF A SALMON
    - LABEL THE EXTERNAL PARTS OF A SALMON
- THE INTERNAL ANATOMY OF A SALMON
    - LABEL THE INTERNAL PARTS OF A SALMON
- LIFE CYCLE FILL IN THE BLANK
- LIFE CYCLE WORD SEARCH
- LIFE CYCLE DISPLAYS/TEACHING MATERIALS
- WASHINGTON NGSS INTEGRATION OPTIONS

LINKS & ACTIVITIES

- SALMON DISSECTION GUIDE: http://www.adfg.alaska.gov/static/education/educators/curricula/pdfs/salmon_dissection_guide.pdf
- NOAA FISHERIES – SALMON ACTIVITIES http://www.westcoast.fisheries.noaa.gov/education/salmon_activities.html
- CAROLINA.COM – SALMON CROSSWORD PUZZLE & BOARD GAME http://www.carolina.com/teacher-resources/Interactive/salmon-life-cycle-activity/tr10854.tr

A

Alevins - hatched salmon still having a large yoke sack for nourishment

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

Ammonia - is a compound with the formula NH_3

Anadromous - migrates from salt to fresh water

Aquatic invasives - a non-native plant or animal deliberately or accidentally introduced into 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 Hatcheries - A place where select fish are spawned, hatched and released

Fry - a recently-hatched fish

H

Habitat - environment in which an organism normally lives

Hardness - a type of water high in mineral content (dissolved calcium and magnesium)

M

Mercury - a silvery white poisonous metallic element, liquid at room temperature

N

Nitrates - a salt of nitric acid with an ion composed of one nitrogen and three oxygen atoms

Nitrite - is either a salt or an ester of nitrous acid

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 as coolants and insulating fluids for transformers and capacitors, PCB production was banned in the 1970s due to the high toxicity of most PCB congeners and mixtures. PCBs are classified as persistent organic pollutants which bioaccumulate in animals.

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

Phosphate - a salt or ester of phosphoric acid

Phosphorus - a highly reactive, poisonous, nonmetallic element occurring naturally in phosphates used in fertilizers

Photoperiod - the relative exposure of an organism to daylight

Plankton - microscopic water born-organisms

Potamodromous - migrates within fresh water

R

Redd - spawning bed

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

Riffles - rocky shoal or sandbar lying just below a waterway

S

Sac fry - young salmon called Alevins

Smoltification - process of becoming physiologically adapted to saltwater and begins its trek to its salt water environment

Spawning - the act of laying eggs

Stocked fish - released by fish hatcheries into the wild

Y

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

CHINOOK or KING, SPRING, TYEE They 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.	
COHO or SILVER They are mature at two to three years and may exceed 30 pounds in weight. Numerically most important to sport fishermen, 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.	
PINK or HUMPBACK They 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.	
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. Closely resembling sockeye, but larger, they have slender caudal peduncle (just ahead of tail) that can be grasped readily, and may have faint grid-like shading on their sides.	
SOCKEYE or RED 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, Sockeye are the prime "red" canned salmon. They are the slimmest and most streamlined of the species with a soft-toothed mouth and prominent glassy eyes.	

Salmon in the Classroom - 2015

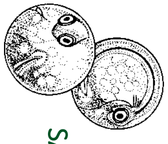
Monitoring Log - Daily

School:

Teacher:

Date	Temperature		Dead Fish		Live Fish		Feeding 1		Feeding 2		Cleaning
	°F	ATU °F	Eggs	Fry	Eggs	Fry	Time	Amount	Time	Amount	syphon, clean glass

Total ______________________



Salmon in the Classroom - 2015

Monitoring Log - Weekly

School:

Teacher:

Date	Water Change quantity	Equipment Check chiller, filter(s), thermometer	Ammonia Test	Nitrite Test	pH Test	Stress Zyme 5 ml per 10 gallons	Stress Coat 5 ml per 10 gallons	Notes

WDFW School Co-Op Plant Record

1 COMPLETE ALL FIELDS

School Name or organization:					
Hatchery that supplied your eggs:		**# of eggs received**		**Species of eggs:**	
Release location:		**# of fish released:**		**Date of release:**	
Teacher/Coordinator:					
Phone Number:		**Email address:**			
Form completed by:		**Signature:** (if sending hard copy)			
Comments:					

2 RETURN THIS FORM:

Send by mail to:
WDFW
ATTN KELLY HENDERSON
600 CAPITOL WAY N
98501-1091

Send by email to:
Kelly.Henderson@dfw.wa.gov

TradeWind Chillers

Installation Instructions for 1/5hp-Compact 1/2hp Drop-In 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. **Do not submerge the Drop-In coil past the section marked by the red sticker (see photo). Doing so will void the warranty on the chiller.**

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). Insert the temperature sensor from the controller all the

way into the supplied acrylic ProbeGuardTM and place the ProbeGuardTM into the sump or aquarium using the suction cup to hold it in place so that the opening of the Probe-GuardTM is well above the water level (see diagram). Use the enclosed piece of cork tape to seal the opening of the Probe-Guard" where the sensor wire is inserted to prevent the ambient outside air from affecting the temperature sensor.

5. **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.

510 Corporate Drive, Suite F Escondido, CA 92029 phone 760-233-8888, fax 760-233-8889
www.tradewindchillers.com

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. A natural mechanism exists that controls ammonia in the aquarium/pond-the biological filter. However, as any natural process, imbalances can occur. So, testing for the presence of toxic ammonia is essential. Ammonia in the aquarium/pond may damage gill membranes, and prevent fish from carrying on normal respiration. High levels of ammonia quickly lead to fish death. Even trace amounts stress fish, suppressing their immune system and increasing the likelihood of disease. Water should be tested for ammonia every other day when the aquarium is first set up, and once a week after the biological filter has been established (in about 4-6 weeks).

Testing Tips

This salicylate-based ammonia tests kit reads the total ammonia level in parts per million (ppm) which are equivalent to milligrams per liter (mg/L) from 0-8.0 ppm (mg/L).

DIRECTIONS

To remove childproof safety cap: With one hand, push red tab left with thumb while unscrewing cap with free hand

1. Fill a 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, holding the dropped bottle upside down in a completely vertical position to assure uniform drops.
3. Add 8 drops from Ammonia Test Solution Bottle #2, holding the dropper bottle upside down in a completely vertical position to assure uniform drops.
4. Cap the test tube and shake vigorously 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 appropriate Ammonia Color Chart (choose either freshwater or saltwater. For ponds, use the freshwater 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 ammonia in the water sample. Rinse the test tube with clean water after use. Note: Do not pour test tube contents back into the aquarium/pond.

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/pond, 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 or pond, ammonium and nitrite levels will rise and then fall in the first few weeks, indicating the formation of the biological filter. However, to reduce ammonia levels within the first few weeks us API AMMO LOCK® or PondCare AMMO LOCK® as directed. After AMMO LOCK® 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.

In freshwater aquariums, adding API AMMO-CARB® or AMMO-CHIPS®, or in ponds PondCare AMMO-ROCKS®, to the filter will remove ammonia and improve water quality. In addition, a water change (25% or more) will reduce ammonia. In an emergency, a daily water change may be required over several days. Be sure to use a water conditioner, like STRESS COAT® or AMMO LOCK®, when adding tap water back into the aquarium or pond.

NITRITE (NO_2-) TEST KIT INSTRUCTIONS

Why Test for Nitrite?

Nitrite (NO_2-) is produced in the aquarium/pond by the biological filter. Beneficial bacteria in the biological filter convert ammonia into nitrite. The biological filter then converts nitrite into nitrate (NO_3-). Nitrite in the aquarium /pond is toxic; it will 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. Water should be tested for nitrite every other day when the aquarium/pond is first set up, and once a week after the biological filter has been established (in about 4-6 weeks).

Testing Tips

This test kit reads total nitrite (NO_2-) level in parts per million (ppm) which are equivalent to milligrams per liter (mg/L) from 0-5.0 ppm (mg/L).

DIRECTIONS

To Remove Childproof Safety Cap: With one hand, push red tab left with thumb while unscrewing cap with free hand.

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, holding dropper bottle upside down in a completely vertical position to assure uniformity of drops.
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. Rinse the test tube with clean water after use.

What the Test Results Mean

In new aquariums/ponds the nitrite level will gradually climb to 5 ppm (mg/L) or more. As the biological filter becomes established, nitrite levels will drop to 0 ppm (mg/L). In an established aquarium, the nitrite level should always remain at 0; any level above 0 can harm fish. The presence of nitrite indicates possible over-feeding, too many fish, or inadequate biological filtration.

Reducing Aquarium Nitrite Levels

Add API NITRA-ZORB® to the aquarium filter to remove nitrite from freshwater aquariums. Making partial water changes can also help reduce nitrite, especially if the initial level is very high. Use API STRESS ZYME® to help speed the development of the biological filter. Adding API AQUARIUM SALT® will reduce nitrite toxicity to fish while the biological filter is removing the nitrite.

PH Test Kit Instructions

Why Test pH?

pH is the measure of acidity of water. A pH reading of 7.0 is neutral. A pH higher than 7.0 is alkaline, and a pH lower than 7.0 is acidic. Maintaining the aquarium at the proper pH ensures optimal water quality. The pH should be tested weekly, since natural materials in the aquarium (such as fish waste and uneaten food) can cause pH changes.

Testing Tips

The minimum pH reading for this kit is 6.0 and the maximum is 7.6. Under extreme water conditions, readings below the minimum will read 6.0 and above the maximum will read 7.6. pH adjustments outside the range of this kit will not show any changes until the pH of the aquarium water is within the range of this kit. When keeping livebearers, goldfish, African Cichlids or marine fish and invertebrates use the API HIGH RANGE Ph TEST KIT®.

Directions

1. Fill a clean test tube with 5 ml of water to be tested (to the line on the tube).
2. Add 3 drops of pH Test Solution, holding dropper bottle upside down in a completely vertical position to assure uniformity of drops.
3. Cap the test tube and invert tube several times to mix solution.
4. Read the test results by comparing the color of the solution to the pH Color Card. The tube should be viewed in a well-lit area against the white area of the card. The closest match indicates the pH of the water sample. Rinse the test tube with clean water after use.

Recommended pH Levels

A pH is ideal when keeping a community aquarium containing a variety of tropical fish. Goldfish and livebearers prefer a pH of 7.5. Many Amazonian fish, like angelfish and neon tetras, prefer a pH of 6.5-6.8. Mollies and swordtails thrive at pH 7.2 to 7.5. To raise or lower the pH of a freshwater aquarium, use API pH UP® or pH DOWN®. To automatically adjust pH to a present level, use API PROPER® pH 6.5, 7.0, or 7.5.

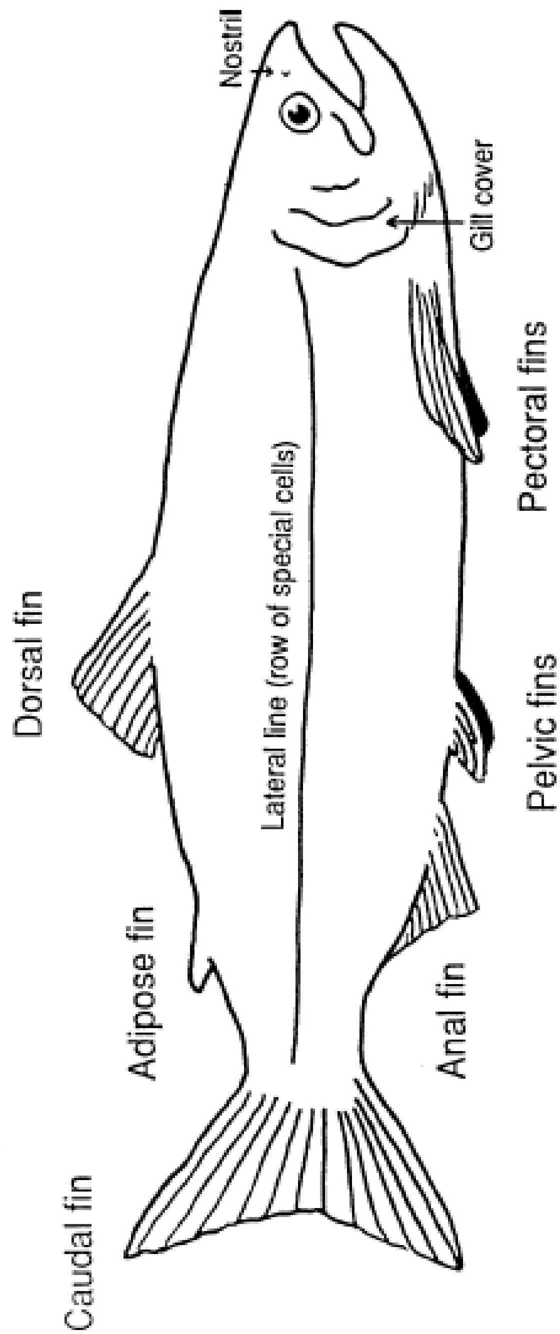
Tank setup tips and instructions for water changes

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, and it is often volunteers or students performing the task.
2. Try to place tank in an area that is easily viewable and something the class and school can take pride in. It can be difficult to place the tank in an area that has good access to water as well a good viewing area, but finding a spot that has qualities of both is beneficial.
3. Using a dolly or wagon to move garbage cans of water is a good idea. Water is heavy and lugging garbage cans full of water is messy. If your tank is far away from a water source, using a dolly/wagon or other wheeled transport for the garbage cans will make water changes much easier.
4. Set up tank completely a week before the eggs will be arriving. Ensure the water temperature is consistently around 50 (+/- 2 degrees) and the nitrite, ph, and ammonia levels are within the desired range.

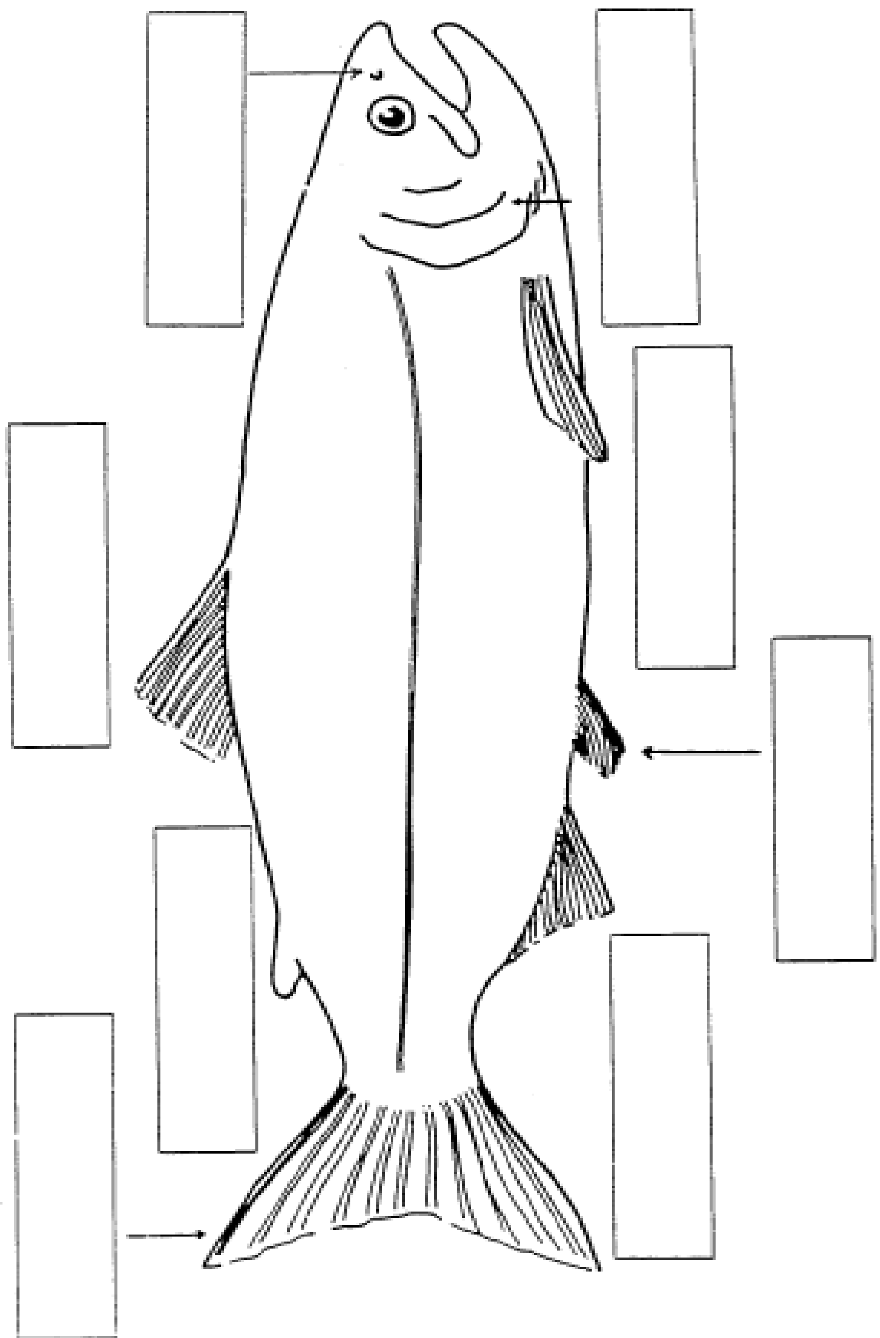
Instructions for water changes

1. Fill two 13-gallon garbage cans about six inches from top (about 10 gal) each to rest and de-chlorinate. It takes at least 24 hours for the tap water to de-chlorinate. Water must be de-chlorinated properly before it is put into the tank.
2. Changing the water is only necessary every 2 weeks or so until the eggs hatch. The eggs do not create as much waste.
3. Once the eggs hatch, water changes will be more frequent-every 1-2 weeks on average. alevin and fry create more waste, which escalates nitrite and ammonia levels.
4. When it is time to change the water, test the tank water for ammonia, nitrites, and ph BEFORE every tank change. Log ph, ammonia, and nitrite levels on the chart provided.
5. Unplug bubblers or filters for your tank before cleaning with the siphon vacuum. Leave the chiller on.
6. Carefully use the siphon and suck up waste and particulates in the gravel, where most of the waste has settled. Be very careful not to disturb the eggs or suck them up into the siphon. After about 1/3 of the tank water is gone, you are done.
7. Add two caps of stress coat to each 13-gal garbage can of de-chlorinated water and mix with your fish net.
8. Add the new water to the tank. It is easier to use a smaller, clean water vessel (coffee can, used ice cream can, etc.) to dump the water in-the garbage cans are heavy.
9. After adding the new water, dump two caps of stress-zyme to the tank. Then fill garbage cans up with water again, allowing them to de-chlorinate until the next water change.
10. Turn bubblers and/or filters back on.

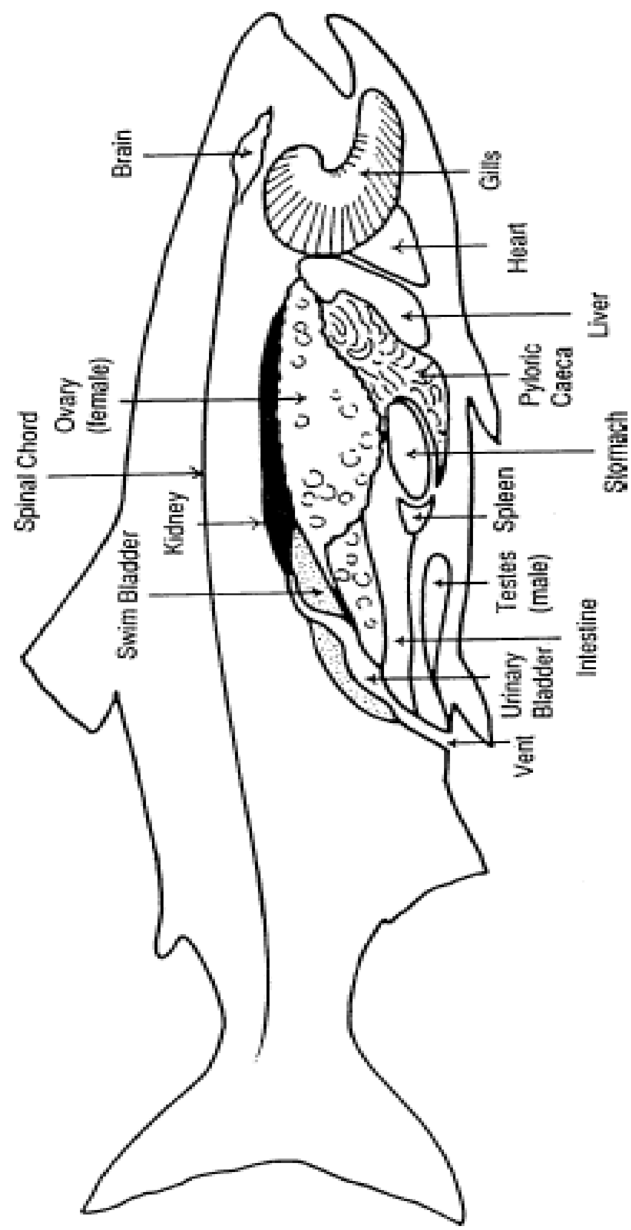
The external anatomy of a salmon



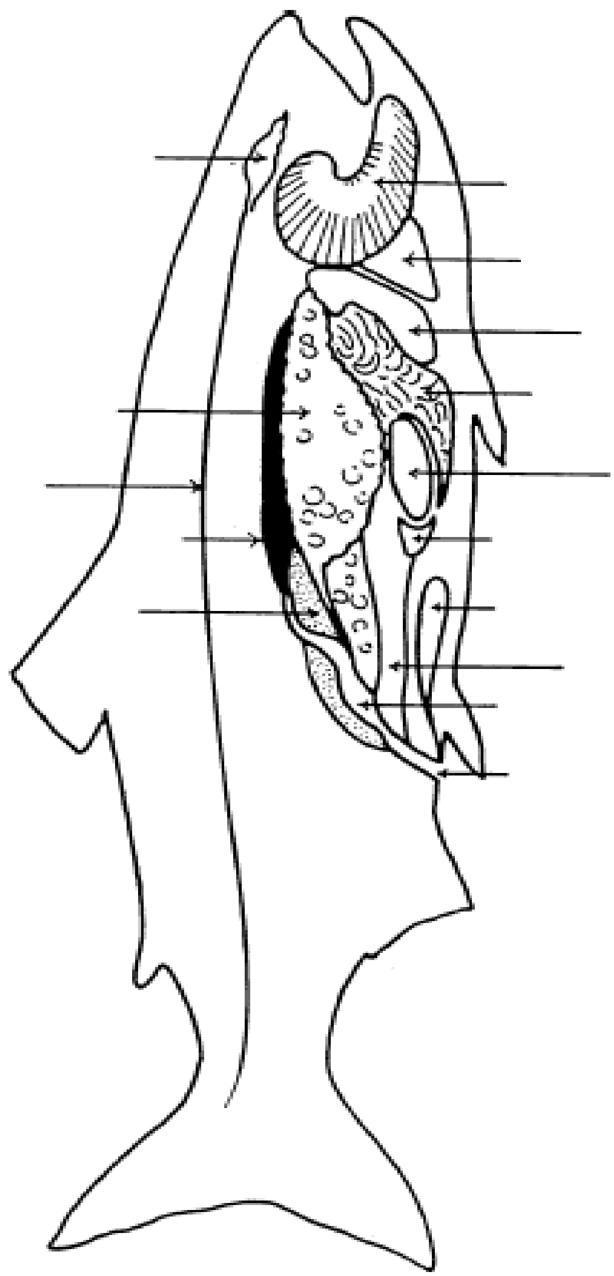
Label the parts of a salmon



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.

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
L	R	N	W	R	B	E	A	D	P	Y	Z	I	Q	H	C

Find these words related to the Salmon Life Cycle:

adult

alevin

chinook

chum

coho

estuary

freshwater

fry

gravel

ocean

parr

pink

red

river

roe

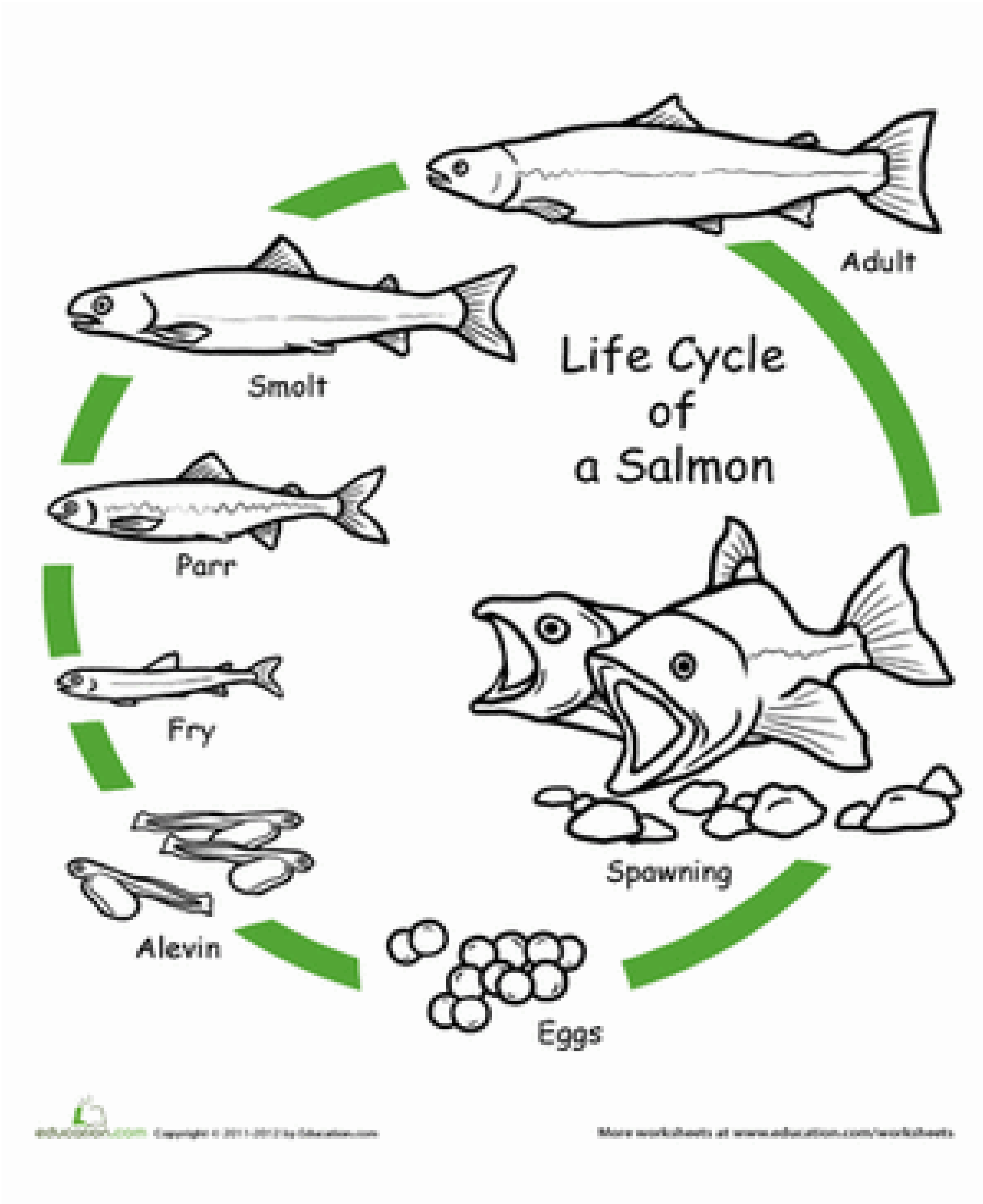
saltwater

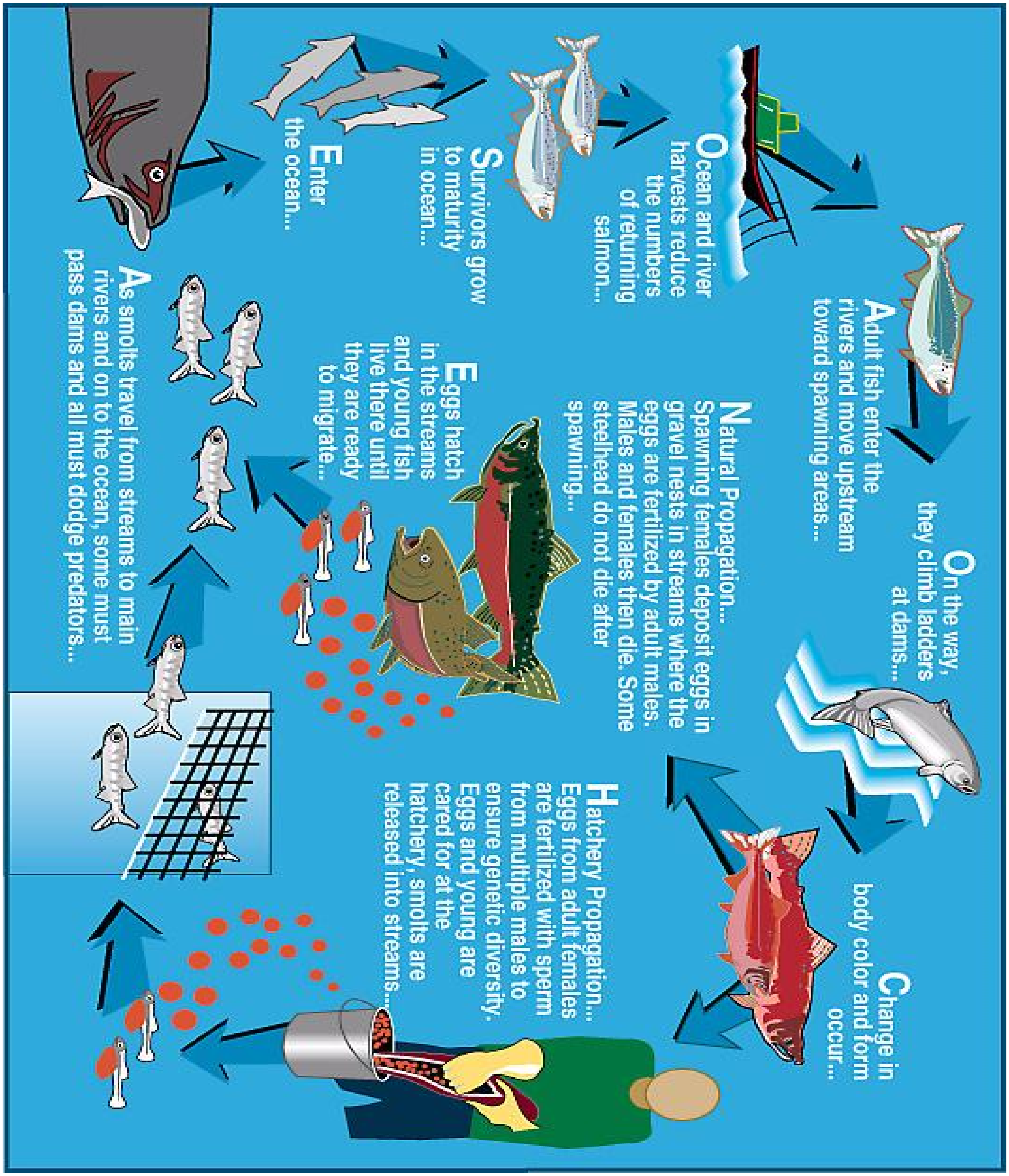
smolt

sockeye

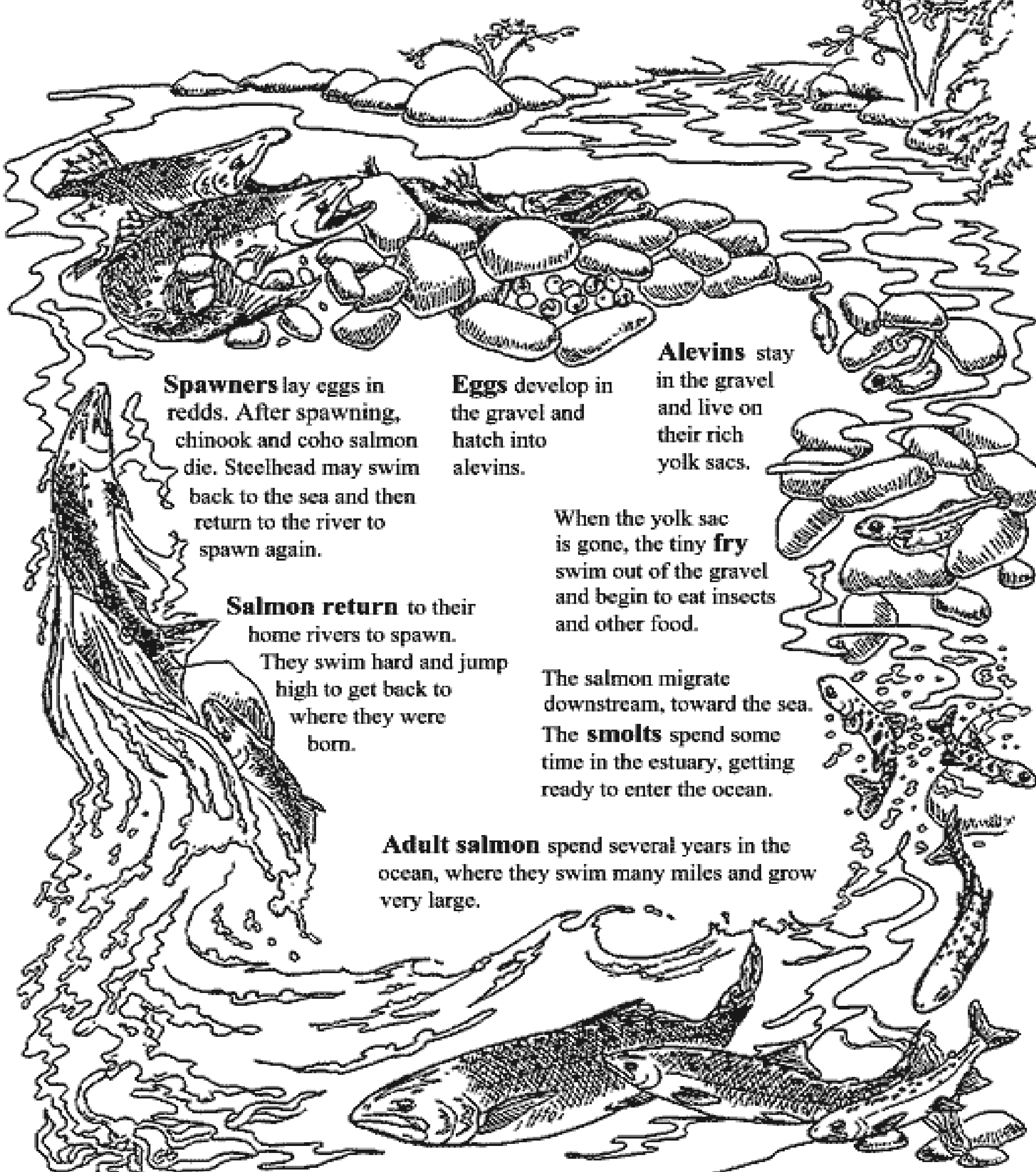
spawner

stream

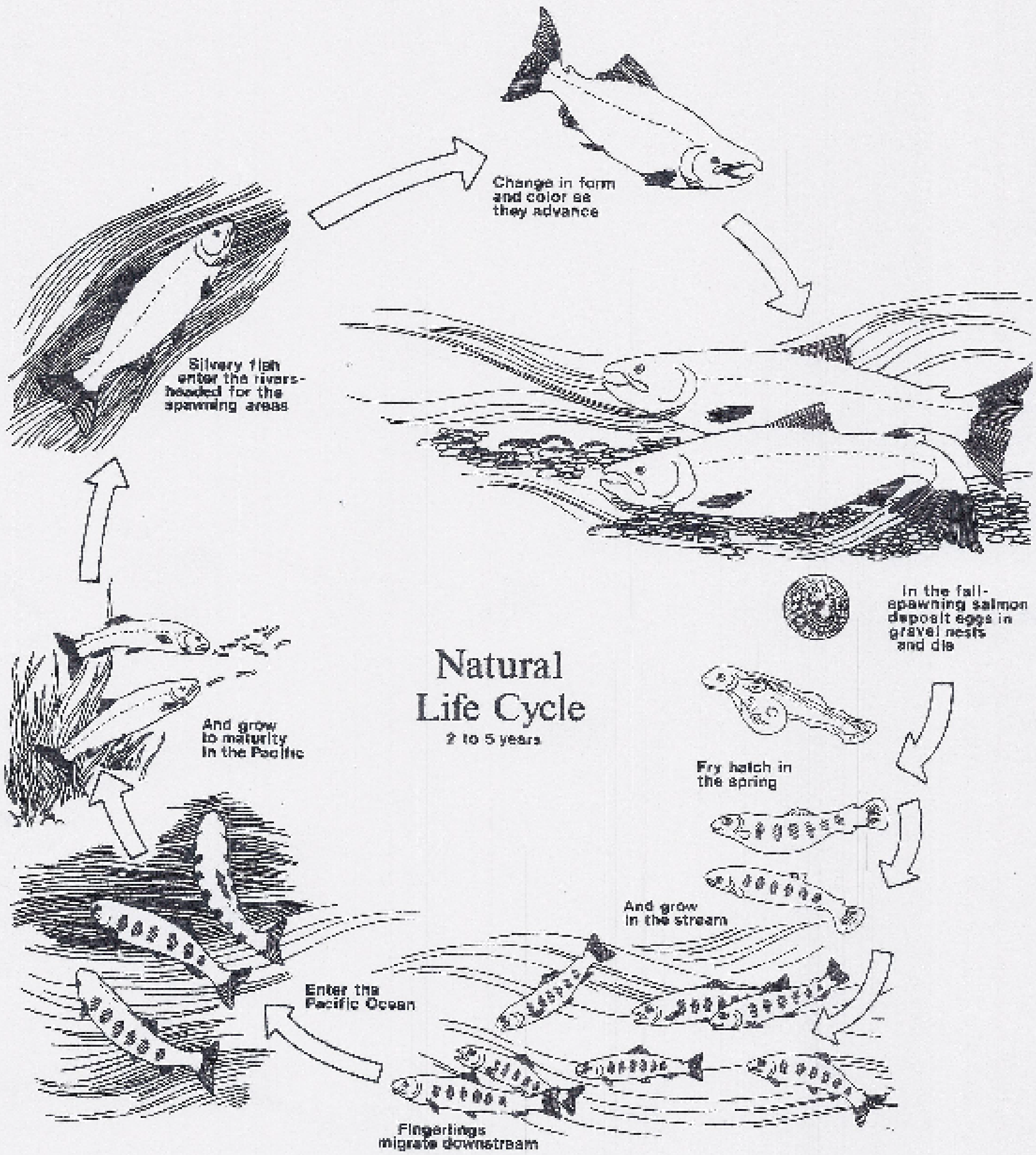

Life Cycle of a Salmon
Adult
Smolt
Parr
Fry
Alevin
Eggs
Spawning


Adult fish enter the rivers and move upstream toward spawning areas...
On the way, they climb ladders at dams...
Change in body color and form occur...
Natural Propagation... Spawning females deposit eggs in gravel nests in streams where the eggs are fertilized by adult males. Males and females then die. Some steelhead do not die after spawning...
Hatchery Propagation... Eggs from adult females are fertilized with sperm from multiple males to ensure genetic diversity. Eggs and young are cared for at the hatchery, smolts are released into streams...
Eggs hatch in the streams and young fish live there until they are ready to migrate...
As smolts travel from streams to main rivers and on to the ocean, some must pass dams and all must dodge predators...
Enter the ocean...
Survivors grow to maturity in ocean...
Ocean and river harvests reduce the numbers of returning salmon...

SALMON AND STEELHEAD LIFE CYCLE



From *Salmon & Trout Go To School* by D. Higgins — Illustration by Gary Bloomfield — CDFG 1996



Length of life cycle varies with species and conditions

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).]