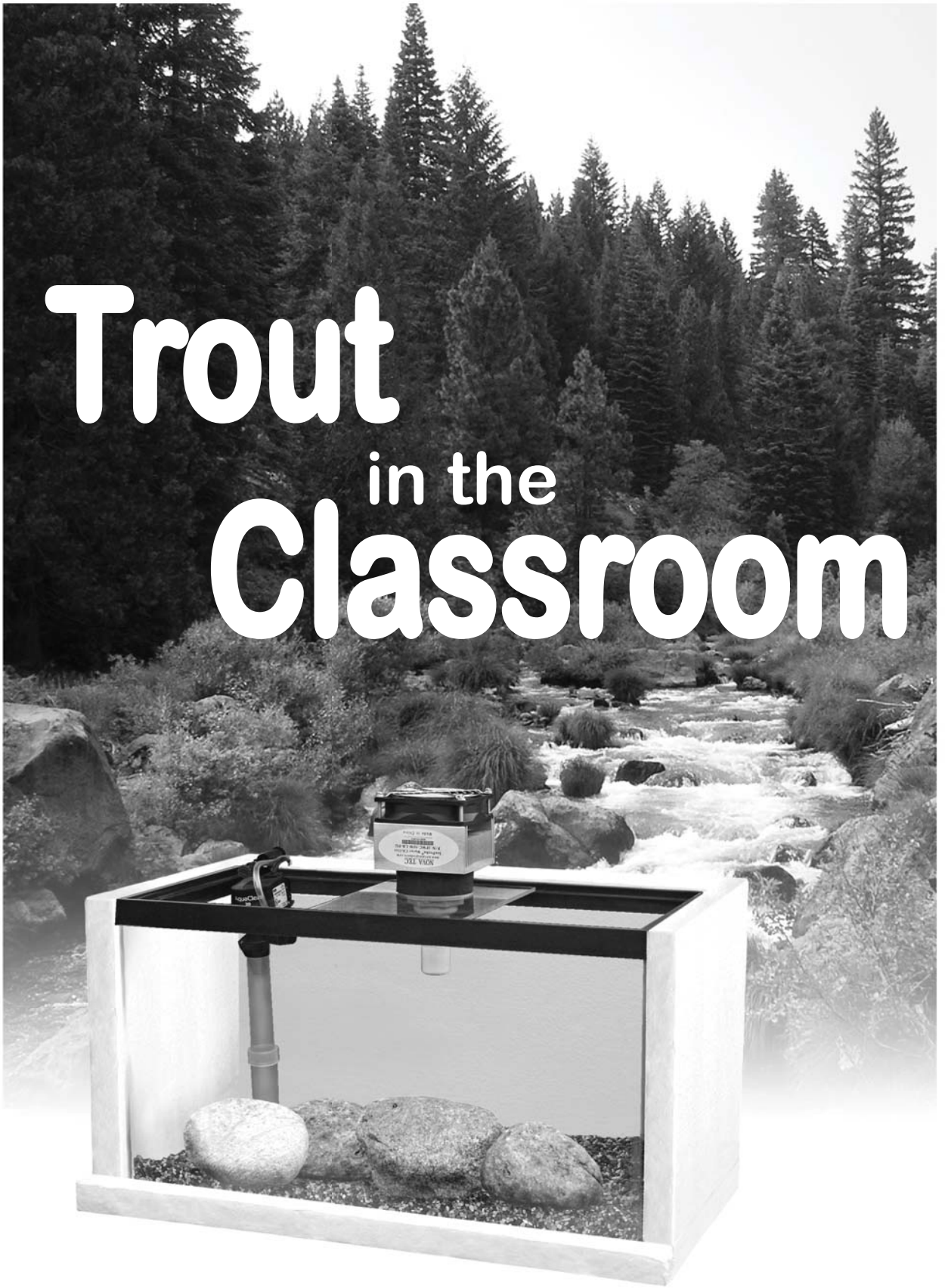

Trout in the Classroom

A TEACHER'S MANUAL FOR HATCHING FISH IN THE CLASSROOM

SPORT FISH RESTORATION

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Special thanks to the following people for their contributions to this guide:

- Amy DiMaggio
- Bob Flasher
- Ed Huff
- Ethan Rotman
- Margaret Hart

With assistance from Mission Peak Fly Anglers

For more information, updates, ideas, and inspiration, visit us at:

Website - www.classroomaquarium.org
Facebook - www.facebook.com/TroutInTheClassroomSF
Blog - http://classroomaquarium.wordpress.com
Ethan.rotman@wildlife.ca.gov

This program receives funding from the Sportfish Restoration Fund
– an excise tax on the sale of motor boat fuel and fishing tackle

Trout *in the* Classroom

Table of Contents

Welcome to the Trout-in-the-Classroom program!

This will be an exciting adventure for you and your students.

This program offers students many learning opportunities and very exciting moments:

- The fun of learning about fish and the habitats they need to survive
- The newness of setting up a fish tank to replicate the natural environment
- The anticipation of the day your fish eggs arrive
- The excitement the day your eggs arrive and the thrill of watching eggs hatch and grow
- Monitoring the fish on a daily basis and having students note the changes in journals
- The bittersweet day you release the fish into the "wild".

The Department of Fish and Wildlife and our partners will provide you with as much support as possible to make this a valuable and fun learning experience for you and your class.

With more than 400 classrooms participating in this program in the Bay Area alone, a dozen fly-fishing clubs providing classroom support, and dozens of other organizations providing support, curriculum, and programs – you will not be alone in this adventure. Let us know what help you need.

As you grow your program, take time to share the results of your work with us so we can include them in our newsletters. You can always post your ideas, questions, and pictures to our FaceBook page.

Take time to explore www.classroomaquarium.org for curriculum, games, lists of books, forms, procedures, new ideas.

Mostly, have fun. Teach well. Try new things.

Thanks for participating in this award-winning program.

Ethan Rotman
Trout in the Classroom Coordinator, SF Bay Area

San Francisco Bay Area
Classroom Aquarium Education Program

Benchmarks for Classes Hatching Trout

Event	Timing (approx)	notes
Training	November thru February, depending on where you are located.	East Bay - Jan Marin/SF - Dec Sonoma - Nov Santa Clara/ Santa Cruz - Jan or Feb
Submit 772	At training or no later than 12/15	In most cases, submit 772 to your sponsor
Meet with sponsor	As soon as possible	
Begin introducing students to habitat	1 month prior to egg delivery	
Clean Aquarium	3 weeks prior to egg delivery	
Set up Aquarium	2 weeks prior to egg delivery	
Receive eggs	Rainbow trout - Late Feb Steelhead - Feb - April	
Fish hatch	3 to 10 days	
Release trout	4 to 6 weeks after hatch	Rainbows - Mid-March
Clean Aquarium for storage	After release	
Return 772 & SFR form	As soon as fish are released	Failure to return 772 makes you ineligible to receive eggs next year

If you have questions, contact your club sponsor or Ethan Rotman, CAEP program coordinator at (707) 944-5501 or ethan.rotman@wildlife.ca.gov

Premise

Trout in the Classroom is a community-based program which allows students to experience first-hand the delicate balance needed for animals to survive in aquatic ecosystems. Using eggs provided by a hatchery, classes set-up and maintain an aquarium for the purpose of observing the development of fish from the eyed-egg stage until they become young fry. Students engage in a course of study which supports the leaning experience across curriculum area. This program is run cooperatively by local schools, fishing clubs, environmental organizations and government agencies.

Objectives

- Provide a positive learning program for classrooms on the value of aquatic ecosystems through the hatching and release of trout.
- Help students learn about their local watershed and how human activities affect the quality of water in local streams, lakes and the bay
- Provide support to teachers to enable them to participate in this learning experience.
- Fulfill the goals and objectives of each partner

Roles of Partners

The following parameters outline the roles partners play in development of a trout in the classroom program.

- ***California Department of Fish and Wildlife***
  - Coordinate program
  - Provide copies of manuals and brochures
  - Provide eggs
  - Authorize release sites and provide copies of permits to qualified teachers
  - Assist in locating possible funding sources for equipment
  - Advertise training and provide resource materials
  - Operate program under guidelines set out in CDFW Operations Manual
- ***Sponsor (Fly-fishing Club or Environmental organization)***
  - Assist at teacher training workshops
  - Provide in-class support to teachers (setting up aquarium, maintaining eggs and fish, troubleshooting problems)
  - Assist class with release of fry
  - Provide financial assistance to school to cover cost of equipment or provide equipment on loan
  - Pick up eggs from CDFW and deliver to schools
  - Assist teacher in completing and returning the Permit form 772.
  - Assist teacher in ensuring all stipulations of the Permit 772 are followed.
  - Complete and return other required paperwork and forms provided by CDFW
- ***Teacher***
  - Attend and participate in a training to become certified
  - Apply for and follow limits of the permit form 772
  - Provide classroom space for aquarium
  - Ensure the eggs and fish are properly cared for and released according to their permit
  - Return permit as stipulated
  - Provide classroom activities related to habitat, fish and conservation to support the classroom activity of hatching the eggs

• Local Park or water district

- Complete and return other required paperwork and forms provided by CDFW
- Co-lead (with other partners) training sessions
- Provide naturalist to assist teachers as able
- Provide educational resources to teachers
- Host workshop

San Francisco Bay Area Sponsors

- Alameda Creek Alliance
- Aquarium of the Bay
- Delta Science Center
- Diablo Valley Fly Fishermen
- East Bay Regional Park District
- Grizzly Peak Fly Fishers
- Golden West Womens Flyfishers
- Lawrence Hall of Science
- Marin Municipal Water District
- Mission Peak Fly Anglers
- Monterey Bay Salmon and Trout Education Program
- Napa Valley Fly Fishers
- North Bay Trout Unlimited
- Northern California Federation of Fly Fishers
- Peninsula Fly Fishers
- Redwood Empire Trout Unlimited
- Shorebird Nature Center
- Sonoma County Water Agency
- The Bay Institute
- Tracy Fly Fishers
- Tri-Valley Fly Fishers

Need Help? Looking for ideas?

Ethan Rotman, Program Coordinator
California Department of Fish and Wildlife
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Website - www.classroomaquarium.org
Facebook - www.facebook.com/TroutInTheClassroomSF
Blog - http://classroomaquarium.wordpress.com

Your Sponsor: _____

Your Coach: _____

Phone: _____ Email: _____

Sometimes there is more than one way to skin a cat(fish)

There are many ways to do things and the beauty of the TIC program is the flexibility in certain parts of the operation. At times, we may present more than one way to accomplish a task – such as how to set up a tank.

If there is a question in your mind, check with your sponsor and follow their advice. Each sponsor may do things slightly differently than others – that is fine.

The only exception to this is your 772 permit – follow the permit to the letter. If you have a question or are interested in seeing if you can make a change, check first with your sponsor and then with CDFW. Remember, the permit is a **legally binding document** and only CDFW is authorized to make changes.

Everything else…follow your sponsor's advice!

A rose by any other name. . .

You may notice this program is called different names in different areas

Classroom Aquarium Education Program (CAEP) is the overall name for all projects that hatch fish in classrooms in California. Local programs may be called:

- Trout-in-the-Classroom
- Steelhead-in-the-Classroom
- Monterey Bay Salmon and Steelhead Education Program (MBSTEP or STEP)

…and many other variations on the same theme.

While the names may be different – there are more similarities between the programs than differences. Each local program is supported by local fly-fishing, educational, and environmental organizations. These groups are the backbone of the program and created the local name.

Yes, they may use a different species of fish, or have a slightly different chiller, or different training program, but they all focus on exposing students to fish and aquatic habitats. They all are working toward hatching fish as a method of developing stewards of our aquatic ecosystems. The strength of the Classroom Aquarium Education Program (CAEP) is in the support of the local, community partners.

HATCHING TROUT OR SALMON IN THE CLASSROOM

Teachers throughout California have been successfully participating in hatching trout or salmon in their classrooms, many with little or no prior aquarium keeping experience. Following these guidelines and the advice of your sponsor will help ensure a successful and rewarding experience for you and your students.

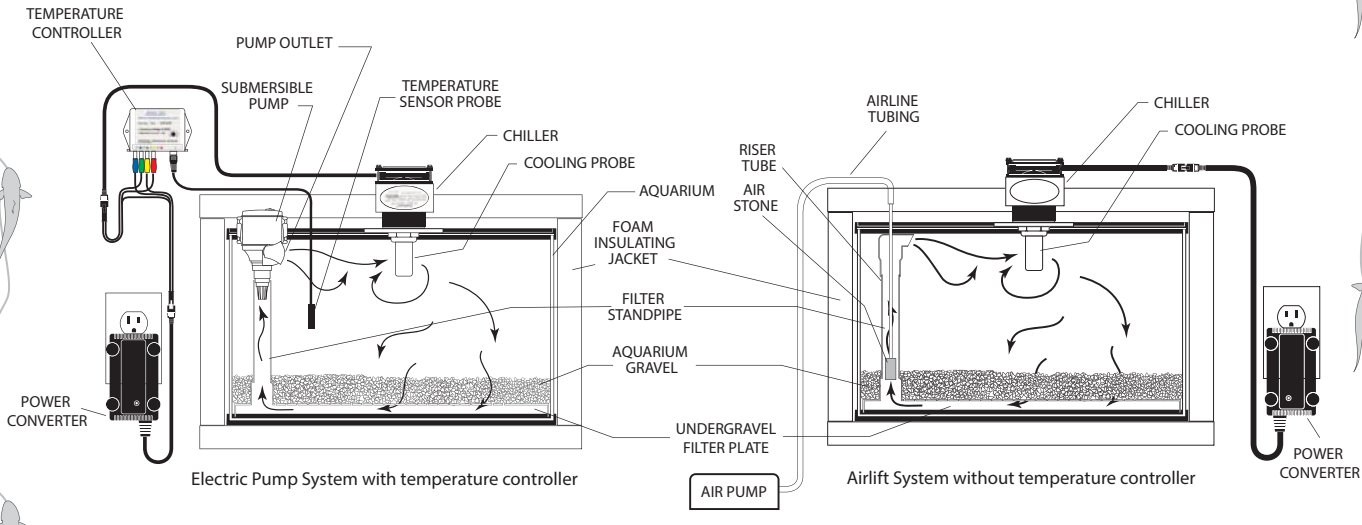
This article is, by definition, general in nature. For specifics that apply to your particular situation, seek input from your sponsor.

THE AQUARIUM

The first step in setting up the new aquarium is to ensure that you are using an electrical outlet that is on 24 hours a day! This is an important first step. The second step is location. Make every attempt to locate the aquarium in an area that is not subject to large temperature fluctuations and away from direct sunlight.

The most common size aquarium is 10 gallons. Other sizes will work but this size has proven to be a good compromise between cost and reliability. It is recommended that you do not use an aquarium smaller than 10 gallons because larger aquariums provide a more stable environment. Aquariums larger than 10 gallons require correspondingly larger chillers and chillers are a significant part of the initial set-up cost.

Trout or salmon fry require cool water so an insulating jacket must be provided to prevent heat loss. The commonly used material is polystyrene foam (Styrofoam) sheets, cut to fit around all 4 sides and the top and bottom of the aquarium. The front panel is generally hinged to allow viewing access and the top is removable to allow for maintenance.



These diagrams illustrate two typical aquarium systems. Your's may vary, so check with your sponsor for the system that best meets your needs.

SUBSTRATE

Although hatchery reared trout or salmon are not placed in gravel, gravel is used in the classroom situation to provide a more natural appearing environment for the students.

When selecting gravel, water worn river gravel is a good choice. It has smooth edges and is generally inert. A good source for this gravel is aquarium shops. Some teachers are experimenting with white gravel. It doesn't look as natural, but it makes the eggs more visible. When washing new gravel be sure to check for foreign objects that may have slipped by the provider's screening system. Small bits of metal like brass cartridge cases are sometimes found mixed in with the gravel. The grain size can vary but generally gravel from around ¼ to 3/8 inch in diameter is preferred. Wash all gravel thoroughly by placing it in a clean, 2.5 to 5 gallon bucket, adding fresh water and agitating. Pour off the loose debris and repeat until the water stays clean.

Several medium (fist sized) stones are often added on top of the gravel for a more natural look. Select stones with a smooth surface. The smooth surface is easier to clean and traps less debris.

If you need to sterilize the gravel here are three methods that have given good results:

1- A bath in a mild chlorine solution. The solution is prepared by adding 1 part household bleach to 10 parts water (1 cup of bleach to 10 cups of water). You should wear protective eyewear and disposable gloves and beware of splashes. Mix the bleach and water in a clean poly bucket. Do not use a bucket that might have any residue from detergent or other cleaning agents. Add the gravel and let soak for at least 30 minutes. Rinse thoroughly in fresh water and, if possible, allow to dry. If there is no time to dry the gravel, fill the aquarium and add a de-clorinator at the suggested dosage.

2- A bath using a solution of vinegar. Distilled white vinegar is commonly available. You should note that this vinegar is approximately 5 to 8 percent acetic acid and has a pH of 2.4. The gravel needs to be thoroughly rinsed when vinegar is used, as any residue could lower the pH in the aquarium. Studies indicate that trout fry do best in water with a pH level of 7.0 to 7.8 (neutral to slightly alkaline).

3- Boiling the gravel, allowing it to cool before use. Place the gravel in a suitable container, cover with water and boil for at least 15 to 20 minutes. (Some sponsors recommend boiling it for an hour.)

If you plan on storing the gravel for an extended period, it must be thoroughly washed and completely dry. Spread the gravel out on a plastic sheet or heat in an oven to speed the drying process. Storing gravel in a porous bag is better than a plastic bag because it allows air to penetrate the gravel keeping it drier and helping to prevent the growth of certain pathogens and anaerobic bacteria. (Anaerobic bacteria are the bacteria that produce hydrogen sulfide, that "rotten egg" smell). Hydrogen sulfide can be toxic to the fish.

FILTRATION/AERATION

There are several systems available to provide circulation, filtration and aeration in the aquarium. The most commonly used system in our program is the under-gravel system. This system operates by drawing water down through the gravel and into a space under the gravel that is provided by the installation of filter plates. The water is then drawn up through filter tubes and back into the aquarium. The lift is provided by either an electric water pump or an airlift system comprised of an air stone and an external air pump. Both perform equally well. Another system that is sometimes used is an external filter with a water pump attached. One of the problems associated with this type of filter/circulator is the possibility of drawing the small fry into the external filter. If you elect to use this type of filter, be sure you provide screening over the intake tubes to prevent the fry from being drawn into the filter. The primary job of all of these systems is to provide circulation for the even distribution of oxygen and temperature. The creation of a natural biological filtration cycle takes longer than the program will be active. The fish will be released before any meaningful populations of nitrifying bacteria are established

CHILLER

Some method must be provided to keep the aquarium cool. There are several systems available and which manufacturer you choose is not as important as ensuring the chiller is capable of meeting the necessary requirements. The chiller must keep your aquarium's temperature around 55˚ F (13˚ C), 24 hours a day. Your sponsor will be able help you choose the best unit for your situation.

WATER

Generally, there are two sources for water: bottled spring water and tap water. Bottled spring water is the most often used water source. It is commonly available in 2.5 gallon containers and can be used as is. Do not use de-ionized or distilled water, as these do not contain elements that are required by your fish.

If you elect to use tap water, it must be treated to remove chemicals that have been added to destroy bacteria. Chlorine has traditionally been used to purify drinking water and is easily removed by aeration and/or the use of de-chlorinators (sodium thiosulfate) available from pet stores. Many public utilities are switching to the use of chloramines. Chloramines are a combination of ammonia and chlorine and are much more stable than chlorine alone. Aeration and/or the use of de-chlorinators are not effective on chloramines. You must use a product intended for use on chloramines. These are available at your local aquarium store.

PREPARING FOR THE FISH

Because their requirements are similar, the following information will apply to both trout and salmon. In general, they require cool water, high dissolved oxygen levels and a pH of neutral or slightly alkaline.

The aquarium should be set up at least a week or two prior to receiving the eggs to allow things to stabilize and to ensure all of the equipment is working properly. The chiller should be adjusted to provide a constant temperature of between 50˚ - 55˚ F (10˚- 13˚C).Adult wild trout, in contrast, prefer a temperature of between 55˚ - 65˚ F.

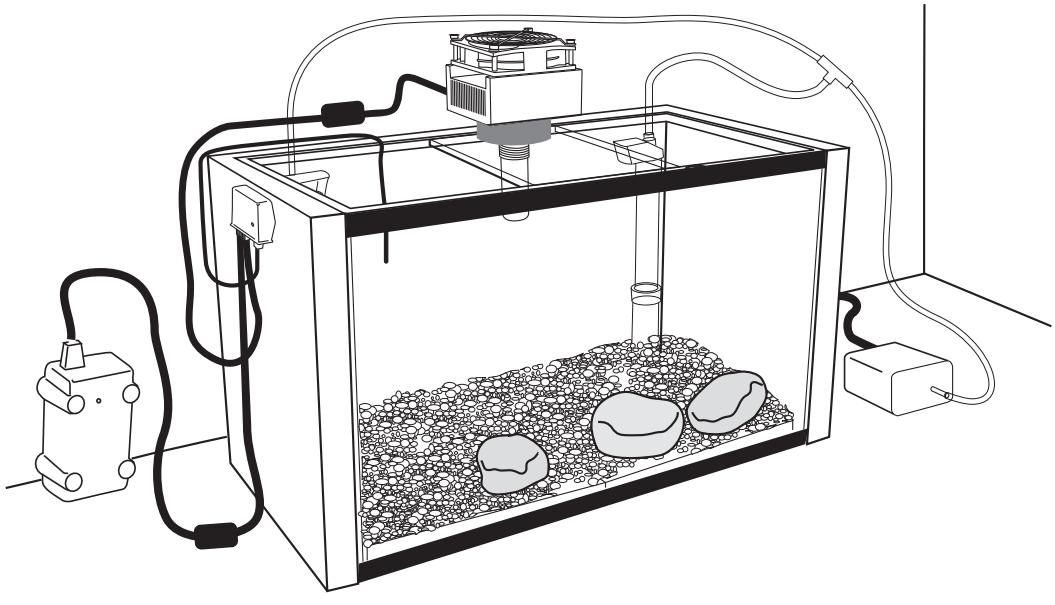
Trout are very sensitive to very low levels of some metals, notably copper and aluminum. Make sure that any objects containing these metals do not come in contact with the water.

We hope you and your students will have an exciting and rewarding experience hatching salmonid eggs. To ensure this, careful and thorough cleaning and drying of your gravel and aquarium, is essential.

How the Classroom Aquarium Imitates Nature

Wild trout have evolved over millennia to thrive and multiply in habitats typified by the western slopes of the Sierra Nevada range in California. This habitat consists of cold, clear, unpolluted and highly oxygenated water with lots of hiding places, gravel areas in which to spawn and a readily available food supply.

To hatch trout eggs in the classroom and raise them to free swimming fry we need only provide some of these requirements. Natural streams are kept cool by receiving water from melting snow or springs. In the classroom aquarium, a chiller or other refrigeration device is used to achieve the same effect. In nature, high oxygen levels are maintained by tumbling the stream water over rocks and waterfalls. In the aquarium, a water pump or air stone provides the circulation that insures a high oxygen level. In nature, clear unpolluted water is maintained by bacteria and other scavengers that reduce the contaminants in the stream and the pH is maintained by the buffering effects of the substrate. In the aquarium, contaminants are kept to a minimum by providing clean water, maintaining a filter system, removing dead eggs and fish and, if needed, making water changes.



Ways to Involve Your Students

Start Now

- Form the habit now of devoting a period of time weekly to Trout in the Classroom.
- Name the time "Nature Ed" or a name that the students decide on with your guidance.
- Talk with staff and other people at your school to see about collaboration opportunities between grades and subject levels.
- Send your sponsor a thank you card for their donation of time and materials.
- Conduct an interest survey of your students and their families – ask questions like: Do you eat fish, have you ever been fishing, have you ever seen a live trout, etc… and gather the results to help you understand the level of prior knowledge and interests of your students.

Introduce Your Students to What Will Be Happening in Their Classroom

- Show the video at www.classroomaquarium.org. Tell students about your inspiring experience at the workshop and let them see the video with teachers, students, and fish in action.
- Show the Intro PowerPoint from the Wild About Trout CD.

Use Journals Actively in the Classroom

- Create a journal with construction paper covers and copied pages from Salmon and Trout Go To School.
- Use a composition book and attach supplementary materials with tape. eg: tape a fish origami or fish print onto a journal page.
- Incorporate fish journaling into existing writer's notebooks.
- Activities to consider:
    - Challenge students to curate their own collection of experiences and discoveries. Create shoebox dioramas that illustrate trout in their habitat
    - Respond to each activity with a short group discussion and written reflection.
    - Observe, draw and describe changes in fish anatomy as they develop.
    - Use observations as a prompt for poetry, exposition, personal narrative writing, etc…
    - Collect scientific data and tie to your math curriculum.

Use the Materials You Received at This Helpful Trout in the Classroom Workshop

- Wild About Trout CD (PowerPoint presentations with narratives for teachers). Use these PowerPoint presentations early and often by trying one of these teacher support ideas, student engagement ideas, or for your own education:
    - **Intro – PowerPoint**
        - Teacher – Use the information to ready yourself for the program and determine the variety of activities you will do with your students.
        - Student – Use the information to understand the process that is about to occur in your classroom
        - Things to consider – Make connections between the entire process and your curriculum. One idea is to include how the ecosystem of the tank is similar to trout habitat in the real world.
    - **Stages – PowerPoint**
        - Teacher – Use the images to create your own neat games, like Go Fish!
        - Student – Compare the life cycle of trout to that of a human
        - Things to Consider – Some students have never seen a fish in its early stages of growth or even thought about how the parts of a fish work

together to help it breathe under water. Think about how your students may have their interests peaked to be more interested in these life stages and functioning systems. eg: Do they like Venn Diagrams or making T-Chart posters?

- **Food – PowerPoint**
  - Teacher – Make connections between other subjects, like math and writing in journals. eg: Estimate how many insects a fry would eat each day. Explain why that number was chosen as an estimate. Can we really be sure of our estimate?
  - Student – What would eating these foods taste like? Do you think the trout can taste them? Do people anywhere eat insects? Why do you think the trout eat these foods?
  - Things to Consider – Don't be afraid to use conjecture in your teaching and say to the students, "I don't know, let's find out together". You can generate lists of questions and work as a team to find the answers, if possible. Not everything has an answer and it is okay to say to your students, "I'm just not sure".
- **Watershed – PowerPoint**
  - Teacher – Think about the concept of topography and how your students understand the speed and flow of water. How could you help them to understand that the steeper the hill, the faster the water travels and therefore the more sediment it will move?
  - Student – What could you use to build a watershed model? What could you use to simulate rain? How would the rain you create travel through the watershed?
  - Things to Consider – This presentation does an excellent job at introducing the concept of how the urban use of concrete can and will impact a watershed: rate of flow, groundwater absorption, pollutant possibilities, mud and clay build up, and more. Perhaps there are simple models or other projects that students can build to show these impacts.
- **Habitat – PowerPoint**
  - Teacher – Nearly every grade level addresses the concept of habitats and ecosystems in one way or another. In showing the numerous species that live within a habitat and what abiotic factors make up those areas, a teacher could go in many directions with this presentation to fit his or her specific science benchmarks and standards.
  - Students – What can help encourage people to be accountable for their actions? What can one person do to help others be more accountable for their actions? When the students know the impacts of behaviors, like littering, what action can they take to educate others to know the impact of their behaviors as well?
  - Things to consider – the Pacific Ocean has a massive floating landfill known as the "Great Pacific Garbage Patch". Litter, plastics, and other debris that float down streams and rivers are contributing to the size and magnitude of this aquatic landfill, which is now larger than the state of Texas. Would your class benefit from seeing the impact of habitat destruction at both a local level as well as on a more global level, like the garbage vortex in the Pacific Ocean?

Read!

- *EggHead* by Jonathan J. Nix. Contact author, illustrate as a class project
- *Lightening's Tale* by Hugh Campbell. Read a chapter at a time to learn about trout needs.
- Check out additional book titles at www.classroomaquarium.org under: More Fun Stuff, or check the titles listed on the "Books on Trout" page in this manual.

Student Tasks and Ideas

- Get the tank ready.
- Record daily temperature and record fluctuations, if any, and journal your thoughts about them.
- Estimate the hatch date of your eggs and buttoning up of the alevin.
- Observe eggs, alevin, fry and journal the findings.
- Use the valuable resources from Trout in the Classroom workshop to help you under stand the needs, habitats, and life cycles of trout.

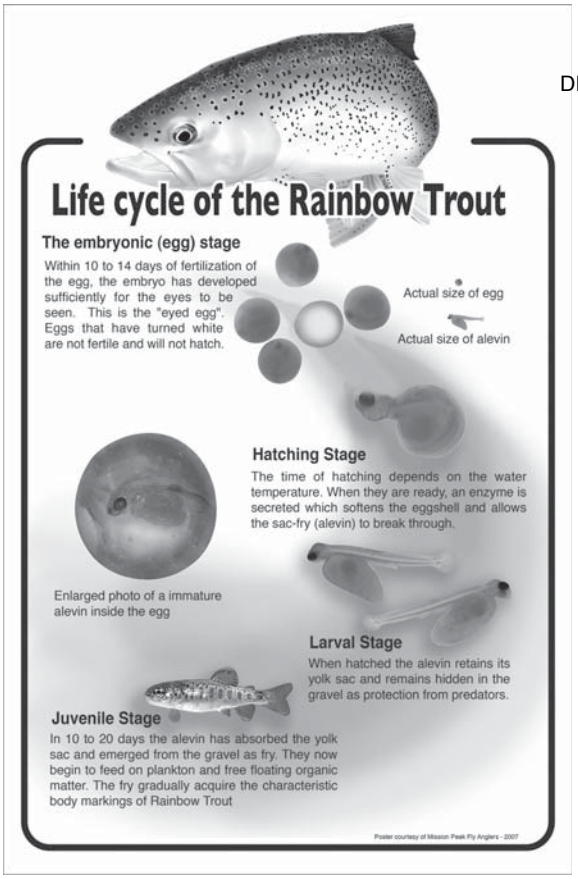
Prepare For Release

- Write Poems and wishes for your fish.
- Ask students for ideas on the best way to safely release the fish.
- Write stories of the fish's journey after release from the perspective of the fish.
- Call your local newspaper and invite them to the release.
- Take lots of photographs of the release and share them!
- Invite families, sponsors, principals, members of your district administration, superintendents, Fish & Wildlife employees, Park supervisors, and other community members that have a vested interest in the health of the lake and watershed at the release location.
- Plan lots of fun games for all of your attendees to see how much fun you have with the Trout in the Classroom curriculum. eg: Oh Trout!, Hooks & Ladders, Protect the Redd, etc.
- Observe the environment of the release site and journal the similarities and differences between it and the tank that was in your classroom.
- Write a thank you card to your sponsor and include a photo from the release.

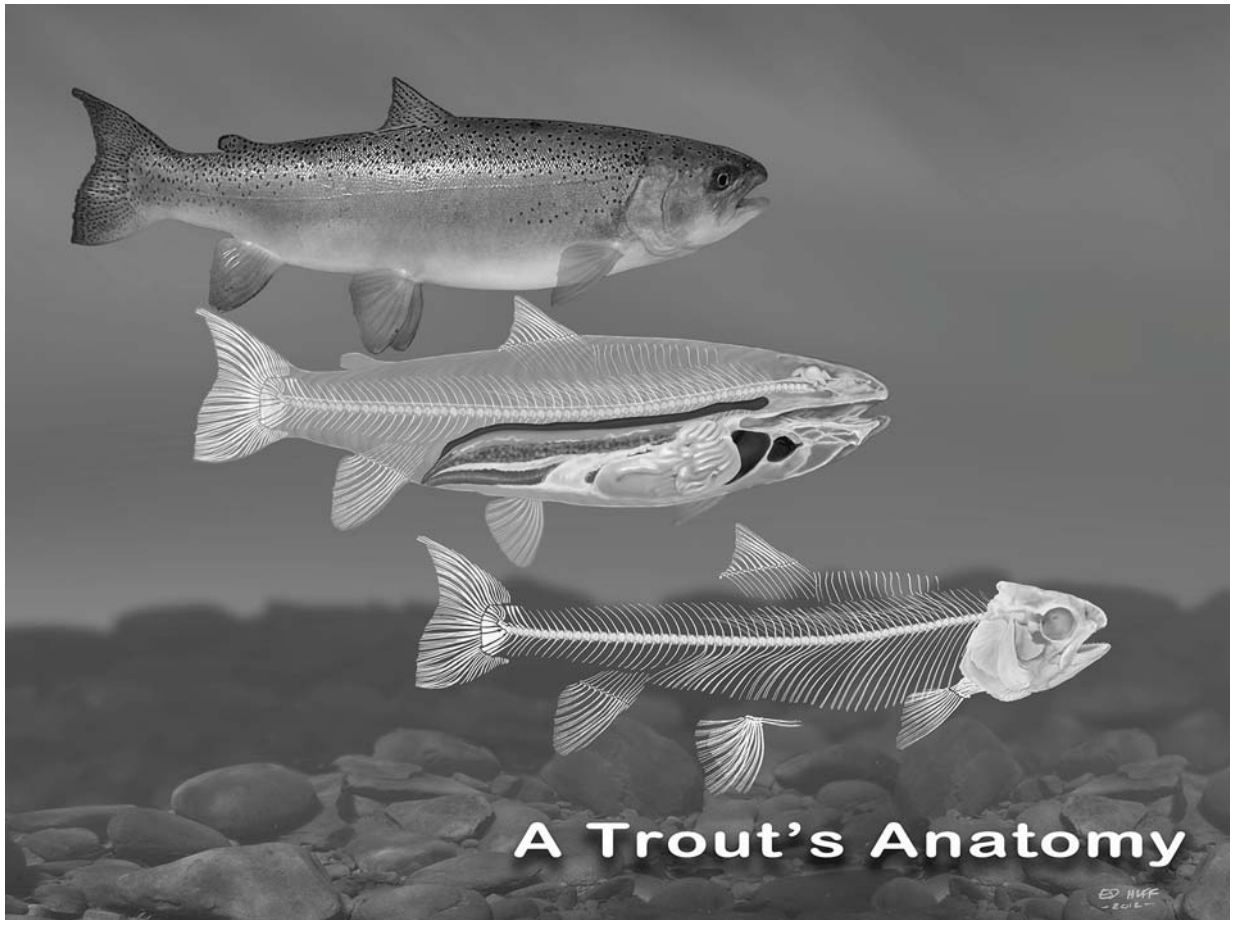
Poster Themes

There are currently four posters available to assist you in discussing trout, their lives and their environment. Each poster has a particular theme: Life Cycle, Anatomy, Diet and Habitat. All of the posters are available as printed posters or can be downloaded from the web. Three of the posters, Anatomy, Diet and Habitat are 18" x 24" and printed on both sides. The front illustrates the theme and the back provides information to help you begin a dialogue relating to the theme. The Life Cycle poster is 11" x 17" and is printed on one side. To download the posters go to www.classroomaquarium.org and select Curriculum Aids.

Spanish translations are also available.

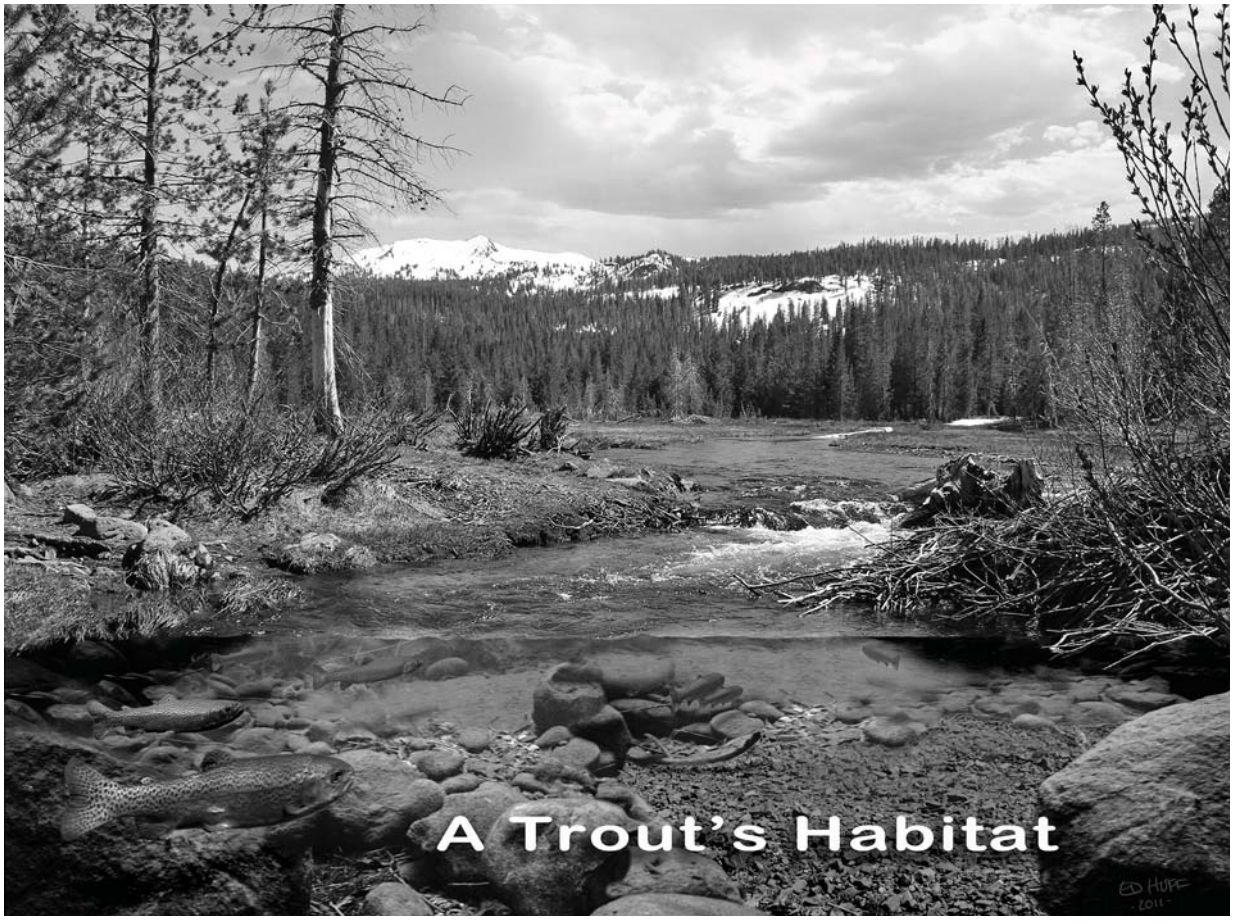


The Life Cycle Poster



The Trout Anatomy Poster

The Trout Diet Poster



The Trout Habitat Poster

Rainbow Trout

Rainbow trout are native to the western slopes of the North American continent. They spend their lives in freshwater lakes, rivers and streams. Adult rainbows spawn in the spring. During this time those adults that live in lakes join their brothers and sisters in rivers and streams and look for smooth flowing water with a suitable gravel substrate on which to spawn. The female creates a shallow depression in the gravel called a redd. She then deposits her eggs in this depression, which is fertilized by the male and subsequently covered with a thin layer of gravel.

The eggs develop, protected by the gravel, and hatch into baby trout called alevin. The alevin come out of the egg with their yolk sac attached. They stay in the protective gravel until the yolk sac is absorbed, then emerge from the gravel as free swimming fry.

The fry begin feeding on microorganisms found in the stream. The fry generally occupy areas of the stream that have slower currents and offer protection from predators such as otters, loons, egrets and raccoons. As the fry mature they move into other, more productive feeding lanes or migrate back into the lake. They are carnivores and subsist mainly on aquatic and terrestrial insects as well as other fish smaller than themselves.

When the trout mature, somewhere around 2 years of age, they begin to spawn and the cycle begins anew.

Salmon and Steelhead

Salmon and steelhead (which are simply an anadromous form of rainbow trout) live as adults in the open Pacific Ocean. At 2 to 3 years of age the surviving adults of both of these species migrate up the freshwater stream or river of their birth to spawn. Like rainbow trout, they look for smooth flowing water with a suitable gravel substrate on which they deposit their eggs. They often travel many miles upstream from the ocean looking for a suitable location and are able to overcome major obstacles such as waterfalls and rapids in order to reach their goal. However, they are often unable to pass man made barriers such as dams and as a result, entire populations can be wiped out.

After locating a suitable site, the female, using her tail, creates a shallow depression in the gravel called a redd. She deposits her eggs and the male fertilizes them in the same manner as rainbow trout. The eggs are covered and left to develop. After spawning all salmon expire, their decomposing carcasses providing nutrients for the stream and surrounding biomass. Most of the steelhead survive and return to the ocean. Steelhead return to their birth river in the following years and spawn again, usually 2 or 3 times.

When the eggs hatch the young fish called alevins emerge carrying their yolk sac. Their development is similar to the rainbow trout. After about a year in freshwater, both salmon and steelhead begin a life quite different from rainbow trout. They migrate into the sea. The young of both salmon and steelhead move downstream to the mouth of their river where they become smolts. During this stage they acclimatize themselves to saltwater for a life in the ocean. When they are ready they move into the open ocean to mature. After 2 or more years both salmon and steelhead return to the river of their birth to spawn and the cycle begins again.

Internal Organs

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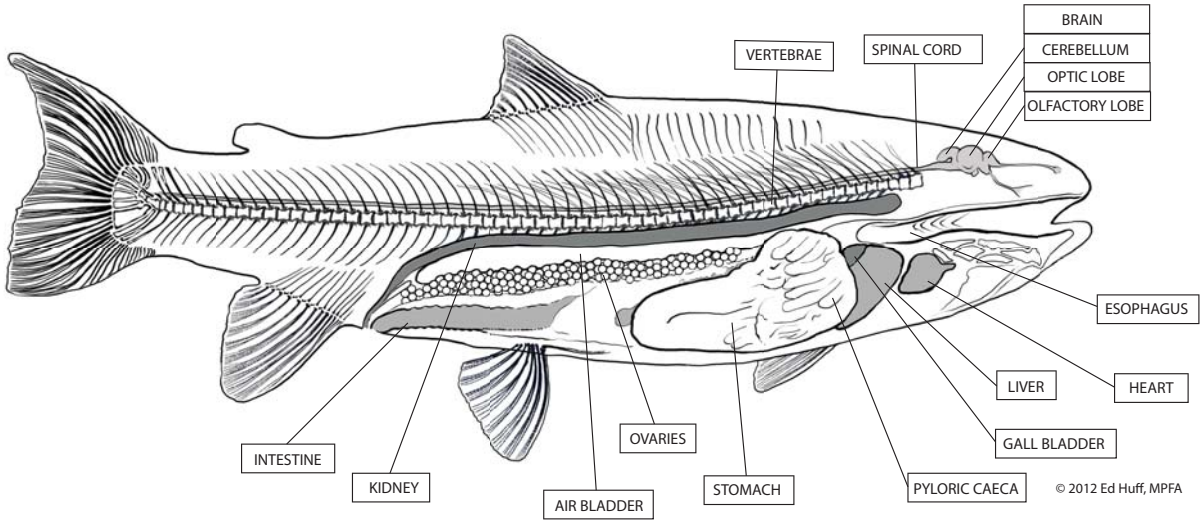
of the

RAINBOW TROUT

Oncorhyncus mykiss



Trout, like all animals have anatomical features that enable them to breathe, eat, see, move and reproduce. However, because trout are adapted for an aquatic environment there are some significant differences between trout and humans.

The gills, although not shown on this illustration, are located alongside the trout's skull and are covered by bony plates called the operculum (o•PUHR•kye•lem). Water, taken in through the trout's mouth, passes over the gills and back into the surrounding water through openings under the operculum. A fish's gills are used to extract oxygen from water. The gill filaments are held in place by the gill arch. Bony projections called gill rakers extend in front of the gills and help guide food and foreign objects away from the delicate gill filaments. The water the trout lives in contains dissolved oxygen. The gill filaments are charged with blood near their surface, which allows the exchange of this dissolved oxygen. Our atmosphere contains 21% oxygen or about 210 parts per thousand (ppt), a trout's water only contains about 8 parts per million (ppm). A trout's gills must be very efficient to extract enough oxygen to support the fish's metabolism. They can extract up to 85% of the oxygen from water that comes in contact with their gill filaments.

The brain has three major divisions: the olfactory lobe is located in the front and is used for smell and taste, the large optic lobe is used for sight and the cerebellum in the rear coordinates and regulates muscle activity. The spinal cord exits the rear of the brain and passes through the vertebrae, which gives it protection. The olfactory lobes are located inside the nostrils of the fish and are connected to the brain by olfactory nerves. Although not shown in this illustration, the lateral line is a network of sensory canals that extend from the brain down the body to the tail and appear as a series of small openings aligned along the spinal cord. In each of these canals lies a sensitive receptor called a neuromast. These neuromasts provide the fish with important information about water movement which in turn allow the fish to detect moving prey or predators.

The heart is a muscular two-chambered organ (humans have four chambers) that is primarily responsible for circulating blood throughout the fish's body. The heart is situated at the base of the throat and lies in the pericardial cavity that is completely separated from the

body cavity. In humans, the blood is pumped through the lungs, oxygenated and returned to the heart which in turn circulates the oxygen rich blood throughout the body. In trout, blood enters a chamber in the heart called the atrium and passes through a valve into the ventricle which forces the blood out and into the capillary networks of the gills. After the gas exchange in the gills, the oxygenated blood passes on to the capillary network throughout the body of the fish.

The stomach is a dilated, U-shaped section of the digestive tract located between the esophagus and the intestine. The fingerlike structures that extend from the stomach are called pyloric caeca. (pi-lorik see-ka) These caeca secrete the digestive enzymes required to digest some food. The digestive process begins in the stomach. The trout's stomach can easily extend to allow the fish to swallow large prey whole. The remainder of the digestion and food absorption processes take place in the intestine.

The liver acts as an accessory digestive organ. The liver secretes bile through a duct into the gall bladder. The liver also detoxifies heavy metals, drugs and pesticides to which the animal may be exposed.

The gall bladder is a small amber yellow to green sac attached to the liver. The gall bladder stores and discharges bile into the stomach. Bile aids in the digestion of fats.

The kidney lies along the ventral surface of the spine. The kidney is the main filter of the body and its primary function is to maintain the internal salt/water balance of the fish. In fish, the kidney plays only a minor role in the elimination of waste products like ammonia. In combination with the spleen, the kidney also produces white and red blood cells.

The spleen plays important parts in both the function of the red blood cells and the fishes' immune system. It removes old red blood cells, holds a blood reserve and recycles iron. The white blood cells of the spleen also synthesize antibodies.

The gas (swim) bladder is responsible for maintaining the fish's equilibrium in its environment. The fish does this by changing the amount of air in the bladder, raising and lowering its position in the water column.

The ovaries are the female trout's reproductive organs and produce eggs and sex hormones. A typical mature rainbow trout can produce from 1,000 to 8,000 eggs each season.

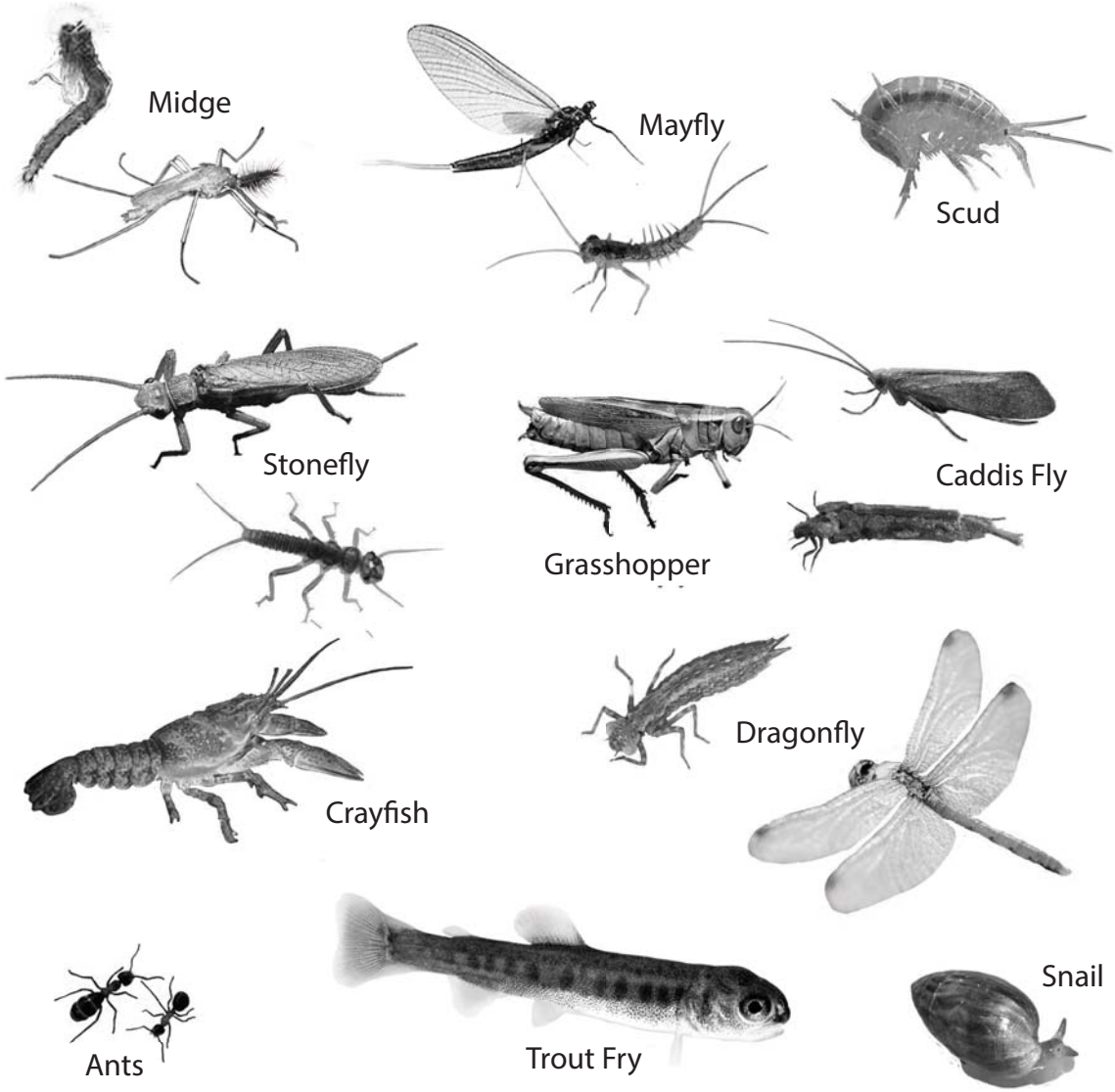
The skeleton of a trout gives structure, provides protection and anchors the muscles

A Trout's Diet

A trout will eat just about any organism that will fit in its mouth. They are generally carnivorous (meaning they eat other animals, rather than plants). The Fry (fish the size classroom trout are when released), eat microscopic organisms called zooplankton and phytoplankton. Zooplankton are very small animals usually the size of a pin head or smaller. Phytoplankton are microscopic plants. As trout grow, the size of their prey increases as well. Adult trout will eat all manner of insects, both aquatic (those that live in the water) and terrestrial (those that live on land). They also eat crustaceans such as crayfish and scuds (aquatic arthropods); mollusks (clams and snails) and small fishes including other trout.

Trout in streams occupy a space called a "holding lie". This is a position in the stream that gives them access to any animal unlucky enough to be swept up in the current and carried into the path of the hungry trout. The prime positions (those that provide the best feeding opportunities) are occupied by the dominant trout. This hierarchy is maintained by threats and displays and rarely results in actual combat.

Just a few f the many animals a trout might eat...



The Trout's Habitat - A High Sierra Stream

The environment in which an animal or plant lives is called a habitat. A Habitat is a combination of all of the living and non-living parts of an environment. Within a habitat are many complex relationships and interdependencies. If one part is affected, many other parts will be affected.

All living things depend on the sun for energy to live and grow. Plants change sunlight to the food energy they need. Animals get food energy by eating plants or eating animals that eat plants. Food chains represent this flow of energy and show all living things are connected by what they eat.

Clouds bring the rain and snow that keep the creek flowing and healthy. Water is life to the entire ecosystem, including us. "The water in every cell of our bodies has already flowed down every stream and slept in every sea." (Fredrick Lehrman)

Snow-capped mountains store a "reservoir" of frozen water after the winter season ends. This provides a constant source of cold water as the snow melts during the summer months.

Healthy forests help shade the creek, keeping the water cool and providing a healthy habitat for trout. The leaves dropped into the creek provide food for aquatic invertebrates, which in turn are food for trout.

Clear, cold water is needed for a healthy trout habitat. Muddy water could smother trout eggs and destroy many of the aquatic invertebrates trout feed upon. The lower visibility also makes it harder for the trout to find food.

The dead trees in the illustration are not "wasted". They will provide homes for wildlife such as woodpeckers who make their nests in cavities they carve in the dead trees. Eagles and hawks break off the smaller branches to build their nests. Ultimately they will fall and decompose, contributing to the soil and nurturing young trees, bushes and grasses.

Fallen tree limbs and twigs in the creek provide hiding places for trout where predators like egrets, bears and river otters can't reach them. The branches also slow the stream flow immediately downstream, providing a more restful habitat. Submerged branches also provide a home for many animals the trout feed on.

Creekbank vegetation provides food and cover for mammals, birds, amphibians and insects. Insects that fall into the creek from these plants can become trout food. The root systems from these creekside plants hold the stream bank in place, helping prevent erosion, keeping the stream clear and providing a good environment in which the trout can reproduce.

Rocks in the creekbed, if they are just the right size, provide successful nesting habitat for trout. The size of the rocks is reduced by freezing and thawing and by the tumbling action of the moving water. Rocks that are too large can't be moved to form the redd (the trout's spawning bed). Rocks that are too small prevent enough oxygen from reaching the eggs and alevin.

When trout grow old and die or are eaten by predators, their bodies fertilize the forest, helping it grow. Aquatic invertebrates like insect larva, snails, and worms, feed on the decaying trout. The invertebrates are then eaten in turn by the baby trout.

Books on Trout - *A student Reading List*

This list is a compilation of available books regarding trout that may be useful in the classroom or for educators. This reference is provided as a service to parents and educators, and is in no way meant to endorse any authors or books contained herein.

Picture Books and Easy Chapter Books

Campbell, Hugh. Lightning's Tale: The Story of a Wild Trout. Portland, Oregon: Frank Amato Publications, 1994.

Ciardi, John. *The Hopeful Trout and Other Limericks.* Illustrated by Susan Meddaugh. Boston: Houghton Mifflin Company, 1989.

Clark, Joan. *Thomasina and the Trout Tree.* Illustrated by Ingeborg Hiscox. Plattsburgh, New York: Tundra Books, 1971.

Cole, Harold. *A Few Thoughts on Trout*. Illustrated by Betty Christensen. New York: Julian Messner, 1986.

Cole, Joanna. *The Magic School Bus at the Waterworks.* Illustrated by Bruce Degen. New York: Scholastic, Inc., 1986.

Hertz, Ole. *Tobias Catches Trout*. Translation by Tobi Tobias. Minneapolis, Minnesota: Carolrhoda Books, Inc., 1984.

Lucas, K. H. *Fly-Fishing with Trout-tail: A Child's Journey*. Trout-Tail LLC, 2002.

Moisa, Ralph, Jr. *Little Fish*. Logan, Iowa: Perfection Learning Corporation, 1997.

Norman, Howard. *Who-Paddled-Backward-With-Trout.* Art by Ed Young. Boston: Joy Street Books, 1987.

Sayre, April Pulley. *Trout, Trout, Trout! (A Fish Chant)*. Illustrated by Trip Park . New York: Scholastic Inc., 2004.

Sloat, Teri. *There Was an Old Lady Who Swallowed a Trout!* Illustrated by Reynold Ruffins. New York: Henry Hold and Company, 1998.

Turnage, Sheila. *Trout the Magnificent.* Illustrated by Janet Stevens. San Diego: Harcourt Brace Jovanovich, Publishers: 1984.

Chapter Books and Young Adult Fiction

Conly, Jane Leslie. *Trout Summer.* New York: Scholastic, Inc., 1995.

George, Jean Craighead. *The Case of the Missing Cutthroats.* Originally published as Hook a Fish, Catch a Mountain, 1975. New York: Harper Trophy, 1999.

Hyde, Dayton O. *The Major, the Poacher, and the Wonderful One-Trout River*.Honesdale, Pennsylvania: Boyds Mills Press, 1985.

Weddle, Linda Massey. *T.J. and the Big Trout River Vandals*. Schaumburg, Illinois: Regular Baptist Press, 1991.

Nonfiction and Reference Books for Children

Burk, Sandy. *Let the River Run Silver Again!* Blacksburg, Virginia: The McDonald and Woodward Publishing Company, 2005.

Burg, Ann E. *E is for Empire: A New York State Alphabet*. Illustrated by Maureen K.Brookfield. Chelsea, Michigan: Sleeping Bear Press, 2003.

Cole, Joanna. *A Fish Hatches.* New York: HaperCollins, 1978.

Pyers, Greg. *Why Am I a Fish?* Chicago, Illinois: Raintree, 2006.

Winner, Cherie. *Trout.* Minneapolis, Minnesota: Carolrhoda Books, Inc., 1998.

Reference Books

Behnke, Robert J. Trout and Salmon of North America. Illustrated by Joseph R. Tomelleri. New York: The Free Press, 2002.

Caduto, Michael J. *Pond and Brook: A Guide to Nature in Freshwater Environments*. Hanover, New Hampshire: University Press of New England , 1985.

Martin, Patricia A. Fink. *Rivers and Streams*. New York: Franklin Watts, 1999.

Prosek, James. *Go Fish: A Fishing Journal.* New York: Stewart, Tabori & Chang, 2000.

- *Trout: An Illustrated History*. New York: Alfred A. Knopf, 1997.
- *Trout of the World*. New York: Stewart, Tabori & Chang, 2003.

Stolz, Judith and Judith Schell, eds. *Trout.* Part of The Wildlife Series. Stackpole Books, 1991.

Nonfiction for Adults

Carrol, David M. *Trout Reflections: A Natural History of the Trout and Its World*. New York: St. Martin 's Press, 1993.

Louv, Richard. *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. Chapel Hill , North Carolina : Algonquin Books of Chapel Hill , 2005.

Prosek, James. *Early Love and Brook Trout*. New York: The Lyons Press, 2000.

This list was compiled by Trout Unlimited.

Applying for a 772 Permit

The permit to transport and rear fish (Form 772) is an integral part of the program and is a legally binding document. Please review the conditions of the permit.
Teachers must file an application each year. The permit will be issued to you when you receive the eggs and must be completed and returned to CDFW after releasing your fish (or after the last fish dies).
The permit is to remain with the eggs/fish at all times and must be posted on or near your aquarium. The permit must accompany the eggs/fish during transport.

To be eligible to apply for a permit, you must:

1) Have successfully completed a qualifying workshop within the past 3 years.

or

2) Received a permit within the past 3 years and complied with all terms of your permit.

To apply for a permit:

1) Download the most recent form from www.classroomaquarium.org
2) Complete the form. You can find a list of acceptable release sites for your area at www.classroomaquarium.org and in this packet
3) Return the application to your sponsor or to CDFW by December 15th or at your training workshop (whichever is later)

After releasing your fish or after your last fish dies, complete the bottom section of the permit and return it to your sponsor or to CDFW within 3 days. Failure to do this will make you ineligible to receive a permit the following year.

You are expected to comply with ALL aspects of your permit. No changes can be made without the express WRITTEN approval of CDFW.

DRAFT DOCUMENT 12-2013

California Department of Fish and Wildlife
Authorization to Transport and Rear Eggs and Fish for Classroom Aquarium Education Projects

Pursuant to Fish and Game Code Sections 6400, 711.7, 1802 and 2081(a)
Each aquarium must have an individual approved authorization form
Please see page 2 for additional information and conditions for this authorization form

Application – Request for Eggs

Applicant name:_____
E-mail:_____
School Name: _____
School mailing address:_____
City: _____ Zip:_____
School physical address (if different than mailing):_____
City:_____ Zip:_____
School Phone:_____ School Fax:_____
Cell or Alternate Phone:_____
Sponsor Organization:_____
Your sponsor contact:_____ Sponsor phone #(s):_____
Sponsor contact email address:_____
I have discussed this year's project with the above sponsor contact: ❑ Yes ❑ No
Species requested: ❑Rainbow Trout ❑Chinook Salmon ❑Steelhead Trout ❑Other (specify) _____
Size of aquarium to be used: _____ gallons
Month and year the eggs are wanted: _____ (if known)
Proposed release location: Water body_____ Site _____e.g. Kings River, Winton Park
Alternate release location: Water body_____ Site _____ (optional)
Alternate release location: Water body_____ Site _____ (optional)

I have read and agree to the conditions on page 2 of this application
Applicant's signature:_____ ***Date:***_____

For CDFW Use Application Approval

❑ The above application is approved
❑ Application approved as amended:_____
_____
Egg delivery date:_____
Fish must be released before:_____
CDFW Approving Signature: _____
CDFW Printed Name and Title:_____
Date approved:_____

# of eggs _____
☐ CHIN - _____
☐ COHO - _____
☐ CT - _____
☐ KOK - _____
☐ RT - _____
☐ SH - _____
☐ Other _____

Release summary

This summary section must be filled out and <u>this permit must be returned</u> to the CDFW coordinator serving your county <u>immediately following release of fish</u>, see page 2 for address

Date fish were released:_____ Or date last fish died:_____
Release location: Water body_____ Site _____
Number of fry released:_____ Grade level(s) of students involved:_____
Total number of students involved in class:_____ on field trip:_____
Permittee's signature: _____Date:_____

For CDFW Use

Additional Information: _____
_____

Applicant – CDFW certified teacher or person responsible for the rearing of the fish or lead person if several people are participating.
Sponsor Organization – Provider of assistance to the applicant (e.g. fly fishing club, non-profit organization)
Application – This 772 form is an application when first obtained by participant, a request for eggs.
Permit – Once this 772 application is approved by CDFW it becomes a permit for possessing eggs and fish and for the placing of those fish into waters of the State, at those authorized locations.

The following are the conditions of the permit:

1. Only the applicant on this form is authorized to acquire and incubate the eggs or fish.
2. No eggs or fish acquired may be possessed, transferred, released or otherwise disposed of except as authorized by this form. Fish shall be released only at the location(s) authorized on the front of this form.
3. This permit shall remain with the egg or fish at all times. The permit must be posted in a visible location on or next to the incubation unit and accompany the eggs and fish during transport.
4. Non-chlorinated drinking water or de-chlorinated tap water should be used in aquarium. Do not use distilled water.
5. All eggs and fish shall remain the property of the State and decisions on final disposition remain solely with CDFW.
6. Do NOT release deformed or diseased fish, please contact CDFW coordinator for instructions.
7. The summary section of this permit shall be filled out and the permit returned upon release of fish or after the last fish dies.
8. Volunteer hours shall also be sent in with permit, volunteer reporting sheets are available at website listed below.

The following require CDFW approval:

1. Using chemicals, drugs or medication on the fish or eggs.
2. Using stream or lake water in aquarium.
3. Changing the release location or any changes after application is approved.
4. Holding fish beyond the approved release date.

www.dfg.ca.gov/caep OR www.classroomaquarium.org

	Location the aquarium will operate:	Contact the CDFW CAEP Coordinator:		Mail to CDFW Regional Office:	
	Del Norte, Humboldt, Lassen, Mendocino, Modoc, Shasta, Siskiyou, Tehama and Trinity counties	(707) 725-1058		CDFW, Northern Region Attn: CAEP 1455 Sandy Prairie Ct, Suite J Fortuna, CA 95540	
	Alpine, Amador, Butte, Calaveras, Colusa, El Dorado, Glenn, Lake, Nevada, Placer, Plumas, Sacramento, San Joaquin, Sierra, Sutter, Yolo and Yuba counties	Joe Ferreira (916) 358-1644 joe.ferreira@wildlife.ca.gov		CDFW, North Central Region Attn: CAEP 1701 Nimbus Road Rancho Cordova, CA 95670	
	Alameda, Contra Costa, Marin, Napa, Sacramento, San Mateo, Santa Clara, Santa Cruz, San Francisco, San Joaquin, Solano, Sonoma, and Yolo counties	Ethan Rotman (415) 999-5924 ethan.rotman@wildlife.ca.gov		CDFW, Bay Delta Region Attn: CAEP 7329 Silverado Trail Napa, CA 94558	
	Fresno, Kern, Kings, Madera, Mariposa, Merced, Monterey, San Benito, San Luis Obispo, Stanislaus, Tulare and Tuolumne counties	**For Salmon:** Gail Davis (209) 853-2533 ext. 8# gail.davis@wildlife.ca.gov	**For Trout:** Cheryl Moxley (559) 243-4017 ext. 253 cheryl.moxley@wildlife.ca.gov OR r4salclass@wildlife.ca.gov	**For Salmon:** CDFW La Grange Field Office Attn: SIC PO Box 10 La Grange, CA 95329	**For Trout:** CDFW Attn: SIC 1234 E. Shaw Avenue Fresno, CA 93710
	Los Angeles, Orange, San Diego, Santa Barbara and Ventura counties	Dwayne Maxwell (562) 342-7152 Dwayne.maxwell@wildlife.ca.gov		CDFW, South Coast Region Attn: CAEP 4665 Lampson Ave., Suite C Los Alamitos, CA 90720	
	Imperial, Inyo, Mono, Riverside and San Bernardino counties.	Jeff Brandt Phone: (909) 987-7161 Fax: (909) 481-2945 jeff.brandt@wildlife.ca.gov		CDFW, Inland Deserts Region Attn: CAEP 3602 Inland Empire Blvd., Suite C-220 Ontario, CA 91764	

Classroom Aquarium Education Program

Approved Release sites for rainbow trout, steelhead trout from Warm Springs Hatchery, and steelhead from the San Lorenzo River System

This list is current as of 9/13 and is subject to change.
Please check www.classroomaquarium.org for updates.

Releasing Rainbow Trout

With appropriate authorization, rainbow trout fry may be released into:	***Trout may NOT be released into:***

• Alameda County
  • Lake Elizabeth
  • Lake Temescal
  • Lakeshore Park
  • Quarry Lakes
  • Shadow Cliffs Reservoir
• Contra Costa County
  • Contra Loma Reservoir
  • Lafayette Reservoir
  • Heather Farms Pond
  • Hidden Valley Lakes
  • Lake Refugio
  • San Pablo Reservoir
• Marin County
  • Bon Tempe Reservoir
  • Lake Lagunitas
  • Phoenix Lake
  • Scottsdale Pond
• Napa County
  • Lake Hennessey
• San Francisco County
  • Lake Merced (all)
• Sonoma County
  • Lake Ralphine
• Solano County
  • Lake Chabot
• Santa Clara County
  • Campbell Perc Ponds
  • Lake Cunningham
  • Sandy Wool Lake
  • Spring Valley Pond
• Santa Cruz County
  • Pinto Lake
	• Cottonwood Lake
	• Lake Chabot (Alameda County)
	• Del Valle Reservoir
	• Don Castro Reservoir
	• Hilltop Lake
	• Lake Anza
	• Lake Merritt and channel
	• Sprig Lake
	• Stafford Lake
	• Vasona Lake
	• Any body of water not specified on your Form 772

Approved Waters For Release of Steelhead obtained from Warm Springs Hatchery

12/11

With appropriate authorization, steelhead trout fry obtained from Warm Springs Hatchery may only be released into the following bodies of water:

Mendocino County	Sonoma County	Other Approved Waters
Gibson Creek	Atascadero Creek (W. of Jonive Creek along the Bodega Hwy, lower section is too warm in summer.)	Hobson Creek
Feliz Creek	Big Sulphur Creek	Felta Creek
Orr Creek	Brush Creek	Porter Creek
Russian River	Dry Creek	Green Valley Creek
Dooley Creek	Dutch Bill Creek	Smith Creek
	Fife Creek	Willow Creek
	Foss Creek (Ed Gauer Ranch (trib. Stream)	
	Mark West Creek	
	Matanzas Creek (Doyle Park)	
	Mill Creek (1 mile upstream from Felta Creek)	
	Oakmont Creek	
	Porter Creek	
	Santa Rosa Creek (good place is near the confluence of Brush Creek)	
	Santa Rosa Creek, upper	
	Sausal Creek	
	Sweetwater Creek	

TEACHERS: You may use the following language on your 772 application under proposed release site:
"Russian River or approved tributary as listed on the CDFW website"

Approved Waters For Release of Steelhead obtained from Monterey Bay Salmon and Trout Education Program

12/11

With appropriate authorization, steelhead trout fry obtained from Monterey Bay Salmon and Trout Education Program may only be released into:

The San Lorenzo River at or above Henry Cowell State Park

Branciforte Creek by De Laveaga Park Area

Fish may only be released in accordance with all the terms and conditions of your approved form 772. If you have questions, please contact Ethan Rotman at (415) 892-0460 or erotman@dfg.ca.gov

Classroom Aquarium Education Program (CAEP)
and
Aquatic Project WILD correlation of activities

The following matrix will assist educators in connecting classroom lessons from Aquatic Project WILD and the Classroom Aquarium Education Program (CAEP) experience for effective student learning about their local environment and the natural world.

Aquatic WILD activities correlate well with the Content Standards adopted by California in the early 2000s, and also with the new Common Core and Next Generation Science Standards. They can be used to provide learning activities that foster an awareness and understanding of the natural world and to create an attitude of caring for the environment. Experiences inside and outside the classroom provide educational opportunities that engage students in the discovery of the world around them Aquatic WILD activities prepare students by creating pathways for meaningful hands-on experiences, and the Aquatic WILD K-12 Curriculum and Activity Guide provides educators with a tool for both teaching and assessing student understanding and assimilation of information.

The following matrix was developed by California Department of Fish and Wildlife staff to show some correlations between Aquatic WILD activities and some of the topics addressed in the Classroom Aquarium Education Program.

For other connections, please see the Aquatic WILD Guide appendices, including:

- **Grade Level Index (pages 320-321 in the 2013 Aquatic WILD Guide)**
- **Skills Index (pages 322-323 in the 2013 Aquatic WILD Guide)**
- **Topic Index (pages 324 and 325 in the 2013 Aquatic WILD Guide)**

Glossary

Alevin: A newly hatched salmon or trout with a yolk sac attached to its stomach. The alevin hide between the gravel in the streambed, sustained by the nutrition in the yolk sack.

Anadromous fish: Fish that spend the greater share of their lives in salt water but are born in and migrate back to fresh water to reproduce.

Aquarium: A tank of water in which eggs can be hatched and fish can live, if the proper conditions are maintained.

Aquatic: Growing, living in or frequenting water. There are aquatic plants and animals.

Cascade: Falling water, not impressive enough to be called a waterfall and too big to be called a riffle. Cascades mix more oxygen into the water, as it tumbles over the rocks, which makes a healthier habitat for trout.

Catadromous fish: Fish species that begin their life in the ocean, then live most of their lives in fresh water, returning to the ocean to spawn. The opposite of anadromous. One example is eels.

Catch limit: The number of fish that a person can legally catch in one day. This is to protect species from becoming depleted or endangered. The limit it determined by biologists in the California Department of Fish & Wildlife.

Cobbles: Stream rocks that are 2-10 inches in diameter, the smallest almost the size of a tennis ball and the largest just bigger than a softball. Your aquarium probably has cobbles on top of the gravel.

Confluence: The place where two streams come together. Trout, salmon and steelhead often rest at these water intersections, as the water is usually fresher and colder than that in the main stream.

Dissolved oxygen: Molecules of oxygen gas that are dissolved in water. Trout need water high in oxygen to remain healthy. They can filter out 95% of the oxygen as water passes over their gills, which is way more efficient than our lungs.

Ecology: The study of the relation of organisms to and interactions of organisms with their environment. Every organism, whether plant or animal, needs a healthy environment to live in. We need a healthy environment too.

Erosion: The process by which water, wind and temperature break down rock and soil into small loose particles that can be swept away by rain or streams. Too much erosion can harm trout streams by covering redds and smothering the eggs.

Estuary: The area where the river meets the ocean and its fresh water mixes with the salt water of the sea. Most species of fish depend on healthy estuaries for food and cover when young.

Eyed eggs: Eyes are one of the first features that are visible in eggs. The eyes show as big dark spots in the egg. Eggs lacking these eyes have not been fertilized and will not hatch.

Fish ladder: A series of ascending pools of water constructed to enable salmon or steelhead to swim upstream around a dam. The fish leap from one pool to the next until they can get over the dam and swim to the spawning area.

Food chain: The transfer of food energy from the source in plants through a series of animals. The base of almost all food chains is plants. These are eaten by herbivores, which are in turn eaten by carnivores. The energy created by photosynthesis in plants is thus transferred up the food chain to sustain many other species of animals.

Fry: Small young fish that have recently hatched and have "buttoned up." Buttoning up is what happens when alevin run out of nutrition in their yolk sac and have to come out of the gravel to catch food. At this point, they no longer look like they have potbellies.

Gills: Organs on both sides of a fish's head that take oxygen from the water as it passes over them. Trout have gills instead of lungs.

Gravel: Very small rocks that are between 1/10 – 2 inches in diameter. They are smaller than cobbles and boulders, and form gravel bars along creek banks where aquatic plants can grow.

Hatchery: A place where fish are spawned and eggs are hatched. The fry are raised until they are at least 7 inches long, and then released into streams and lakes. Hatcheries are an attempt to make up for the destruction of trout and salmon streams by dams. Most trout hatcheries are operated by the California Department of Fish & Wildlife.

Habitat: The place where an organism lives. Healthy habitats provide enough food, water, shelter and space to support a variety of plant and animal life.

Imprinting: The scent memory of a salmon or trout's birth stream that enables the fish to return to the same stream after 2-3 years in the ocean. The fish memorize the scent of their stream as they swim backwards on their migration toward the sea from their place of birth.

Glossary - pg 2

Incubate: Keeping eggs at the optimum temperature and supplied with enough oxygen so they will hatch and grow. Keeping your aquarium at the optimum temperature is essential for a successful hatch.

Lateral lines: A special line of cells on each side of a fish's body that help it sense motion and magnetic fields. The lateral lines in small fish tell it when something is coming its way, even before the fish sees it.

License: This is a permit issued by the Department of Fish & Wildlife that allows someone to hunt or fish. Fees for these permits help protect important habitat and pay the salaries of the people who determine how many of each species can be taken. Hunting or fishing without a license is a crime. The 772 permit, that goes everywhere with your eggs and fry, is also a license. It allows you to hatch the eggs of wild native animals in your classroom.

Life cycle: The stages of an organism's life. For trout and salmon, this would begin with an egg, and then develop into an alevin, then a fry, then an adult which will lay eggs to begin the process all over again.

Migration: Moving from one place to another, usually far away. Salmon and steelhead move out to sea and then back to the river where they were born. Lake trout don't migrate.

Mucous: A slippery liquid that covers the body of a trout or salmon, helping protect it from disease.

Parr marks: Curved marks on the sides of fish fry that help these fish hide from predators by making them look more like their surroundings.

Plunge pools: Deep pools in streams that are made when water falls over a rock or log and scours out a hole. These holes have colder water and are a favorite habitat for trout.

Pollution: Harmful substances that can contaminate soil, water or atmosphere. Trout are very sensitive to pollution. So are many of the aquatic insect larva they eat.

Predator: An animal that eats other animals. Trout and salmon are examples. So are the animals like bears, raccoons, osprey and eagles that eat trout and salmon.

Redd: The "nest" made in the gravel of a streambed by a female trout or salmon. She then lays her eggs in the nest and covers them back up with the gravel to protect them while they are hatching. And she does all of this nest building with her tail.

Riffle: A place in a stream where the water flows quickly over rocks. These areas help aerate the water, but are shallow and expose small fish to predation.

Run: When a group of salmon or steelhead return to their birth river to spawn, they do it at the same time and this is called a run. It's a coordinated migration that takes place at a specific time of the year.

Scales: Small, overlapping, fingernail-like skin of fish. This tough skin helps control the amount of water that can leak into and out of a fish, and doesn't wrinkle like our skin would if we spent our life underwater.

School: A group of fish studying together Monday through Friday. It can also mean a group of fish that swim together for protection.

Sediment: Very fine particles of rock and soil that wash into streams. Too much sediment can clog up gravel beds and smother the eggs. Sediment comes from erosion caused by logging, roads, grazing and landslides.

Silt: Even finer particles of eroded topsoil than sediment, that cause the same problems.

Smolt: A salmon or steelhead that has outgrown its parr marks and whose body is transforming from a freshwater to a saltwater- adapted organism. This takes place in an estuary where fresh and salt water mix.

Spawn: When a female fish lays eggs and a male fish fertilizes them as they float down into the redd. Steelhead can swim back and forth from the ocean several times during their lifetime to spawn, but salmon just do it once and then die. Their bodies are eaten by aquatic insects, mollusks and crustaceans, which are then eaten by the baby fish when they hatch.

Yolk sac: The pouch of food that is connected to the stomach of fish that have just hatched. This food pouch allows the fish to hide in the gravel until they are larger and ready to catch their own food.