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## Procedure for raising trout in the classroom as part of environmental education

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PROCEDURE FOR RAISING TROUT IN THE CLASSROOM

AS PART OF ENVIRONMENTAL EDUCATION

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A Project  
Presented to the  
Faculty of  
California State University,  
San Bernardino

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Arts  
in  
Education: Environmental Education Option

---

by  
Ronn Chapman

June 1999

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by  
Ronn Chapman  
June 1999

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## ABSTRACT

This curriculum guide enables middle school teachers to teach students about a valuable natural and economic resource: the trout living in our inland waters. By raising trout in the classroom, students learn fish classification, anatomy, life cycles, and habitat range. Students also become aware of the impact of urban planning, development and growth on natural resources.

Through raising and ultimately releasing trout "fingerlings" in the wild, students are introduced to the delicate ecological balance found in an aquatic habitat. A focused study of this ecological balance creates hands-on opportunities for students to understand: a) how hatchery or classroom-raised trout assist replenishment of wild trout populations; b) the effects of human development on the trout's natural habitat; and c) natural and human environmental predation on fish. In addition, students work through potential resolutions. These resolutions include, but are not limited to, protection and restoration of aquatic habitat; appreciation of natural and human-made environments; and awareness and education as tools to help counter environmental problems.

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## INTRODUCTION

It is imperative that young people learn respect for nature and develop environmentally friendly behavior. Becoming hooked on fish should could be one way this might occur. The idea of raising rainbow trout, or other "wild" fish, is to bring the outdoors to the environmentally naive student. Raising live trout in the classroom gives students opportunities to learn about aquatic classification, anatomy, habitat range, environmental urban planning and natural resources. By providing students interaction with their natural environment, raising trout instills a finer appreciation of nature and the natural sciences.

This curriculum was developed after surveying numerous environmental texts for appropriate lessons. Specific classroom lessons include charting trout growth, writing environmental impact stories, and studying aquatic habitats.

This project reflects the recommendations in The Science Framework for California Public Schools Kindergarten Through Grade Twelve (California Department of Education, 1990). These recommendations include instruction in: resource distribution; earth relationships--land, water, wildlife, people, energy; water in the environment;

interdependence in closed environments; and changes in the environment.

As students study living things, they learn about the wonderful variety of life on Earth and the similarities linking us all together. The following curriculum was created to present some of the biological and environmental fundamentals as they apply to fish in general and trout in particular. Its goal is to bring part of our natural world into the seventh and eighth grade classroom to further an appreciation of aquatic life.



## LITERATURE REVIEW

Decreasing fish stocks, coupled with increased coastal utilization, estuarine pollution, and advanced technologies to harvest marine resources demand a society that is knowledgeable about basic concepts of marine resource use and management (Brody, 1996).

This knowledge can be acquired by students participating in the "Trout in the classroom" project, a positive, hands-on, interdisciplinary educational experience. The goal of this aquatic study is to have students acquire ecological sensitivity concerning the environment while learning biological concepts. In planning lessons for students, literature was reviewed concerning environmental education, constructivism, environmental action planning, and assessing student achievement when combining natural science and environmental study.

### Defining Need For Environmental Education

Most authorities defining environmental education include the need for developing within students an educated sensitivity concerning environmental affairs, and the desire for taking action to assure its continued protection (Klein & Merrit, 1994). Hungerford and Volk (1990) defined the

goal of environmental education as achieving and maintaining a dynamic equilibrium between the quality of life and the quality of the environment. These definitions and principles justify educating the citizenry to act in a responsible fashion towards the natural environment. The Second United Nations Educational, Scientific, and Cultural Organization (UNESCO) Conference, held in 1977, developed the following goals and principles: a) environmental education should be a continuous lifelong process; b) environmental curriculum should be interdisciplinary in its approach; and c) environmental learning should occur in a broad array of educational settings (Wilke, 1993).

Environmental instructional goals for improving environmental behavior were developed in the early 1980s. These behavior goals include continually reinforcing the need for environmental awareness and issue sensitivity. This results in individuals who willingly and responsibly participate in environmental maintenance and remediation. Goal success would off-set the severity of environmental degradation and problems associated with human reproductivity.

Hungerford and Volk (1990) reported "environmental

sensitivity" is a function of an individual's contact with the outdoors in a relatively pristine environment either alone or with close personal friends and relatives.

Evidence indicates environmentally sensitive individuals are actively engaged in hunting, fishing, or other outdoor activities. These activities often expose participants to environmental degradation which cause participants to actively seek corrective action. Their search supports programs which involve students in appropriate environmental behavior in the out-of-doors.

#### Defining the Constructivist Learning Theory

Environmental education stresses the need for learning about the natural environment. In these activities, students develop and demonstrate skills through investigation, evaluation, decision making and real life experiences. This is often accomplished with a constructivist approach to learning (Klein and Merritt, 1994).

The constructivist learning theory as defined by Klein and Merritt (1994) directs students to actively acquire knowledge through physical and mental reactions to their personal experiences. This theory asserts that learning is

socially motivated, and knowledge is acquired by interpretations or ideas about the environment.

Clements and Battista (1990, p. 45) supported the use of constructivism by stating, "Knowledge is actively created by the child, not passively received from the environment. Ideas are constructed or made meaningful when children integrate them into their existing structure of knowledge." Thus from the constructive perspective, science becomes less a search for truth, and more a process of making sense of our world. By using a constructivist epistemology as a referent, teachers become more sensitive to children's prior knowledge and the processes by which they make sense of new concepts (Lorsbach & Tobin, 1992, p. 23).

A constructivist lesson consists of four main steps. These are: a) the introduction of a real life problem requiring investigation; b) student centered instruction facilitated by the instructor; c) productive group interaction during the learning process; and d) authentic assessment showing student progress (Klein & Merritt, 1994). These steps fit well in lesson planning when environmental study requires investigation, experimentation, and peer interaction. Students working in small groups are often

invaluable to each other in processing information. Often environmental education is supported with a hierarchical program consistent with developing skills over a period of time. The instructor is required to place emphasis on cognitive and effective development while encouraging positive interaction. During whole group instruction, the instructor's role becomes that of facilitating the learning of new concepts by leading students from the known to the unknown. This includes providing group study and assisting students to develop better listening and communication skills while increasing their comprehension of the topic.

For small group interaction, the instructor assists in the sharing of information and encourages reliance on one another to complete the assignment. The final step, authentic assessment, creates an opportunity for students to display their progress by demonstrating an understanding of the materials through presentation of a written project, an oral report, or portfolio. All of these are represented with learning as an end result (Klein & Merritt, 1994).

#### Defining Cooperative Learning

Cooperative learning is the instructional use of small groups that allow students to work together thus maximizing

their own and each others learning (Johnson & Johnson 1994). Cooperative learning is the productive interaction stage of the constructivist lesson plan. A cooperative learning strategy allows individuals to test the fit of their world experiences with a community of others. This is contrary to competitive learning where students work against each other to achieve a goal that only one or a few students can attain. In competitive situations there is a negative interdependence among students for goal achievements; students perceive that they can obtain their goals if, and only if, the other students in the class fail to obtain their goals (Deutsch, 1962; Johnson & Johnson, 1991).

Cooperative instructional methods make learning active, enjoyable, and realistic. Goal attainment is reached when students perceive that they can reach their learning goals if and only if the other students in the learning group also reach goal attainment. These goals must be realistic. Teachers should all put forth effort to define, direct and assist in goal attainment, but not expect students to reach the same expected goals. Cooperative learning like constructivism is designed to provide the learner with an opportunity to create knowledge and understanding that holds

meaning for the individual learner (Klein & Merritt, 1994). Project and research outcomes would be expected to vary somewhat depending upon the individual student's research and independent research sources. This would give the cooperative learning groups, as a whole, a slightly different and unique result, and the stated outcome of the teacher's lesson plan would vary slightly.

Cooperative learning is also supported by cognitive restructuring and controversy theorists. Controversy theorists believe when students have opposing view points, uncertainty is created, which in turn creates a reconceptualization and an information search resulting in a more refined and thoughtful conclusion. Cognitive restructuring theorists hold that for information to be retained in memory and incorporated into existing cognitive structures, the learner must cognitively rehearse and restructure the input which is often done through explanation to a collaborator (Wittrock, 1990).

#### Defining Action Based Learning

An interaction between basic natural and social science and current environmental concerns is an important part in assisting young people to understand ecological issues

(Brody, 1996). As in the constructivist or cooperative learning approach, the purpose of activity based learning is to assist the student in actively acquiring information through investigation, observation and evaluation of facts presented. According to Newhouse, (1990), knowledge is the basic requirement one must possess in order to understand how to protect the environment. In this instance the environment becomes the educator. Students view their surroundings as a living thing. Only then do they realize how important it is they as individuals contribute to managing a sustainable environment. Student participation is encouraged by allowing students to help determine the nature of the experiences in which they are involved (Hungerford & Volk, 1994). The curriculum is based on a real world which can be seen, touched and smelled.

Action based learning enhances the effective use of cooperative learning. Instructors assign individual responsibilities from within student groups. Students then take their assignments and develop informational bases such as recording or, interpreting data, and making inferences to learn from. Students then compare their inferences with the science curricular framework to recommend a course of



action. Subsequently, the student prepares a report on that investigation.

Environmental action projects also serve as a means to developing student behavior. Activity based projects usually generate sharper interest in students which positively impact student attitudes toward the environment. Participation in action projects allows students to feel they can contribute to preserving or improving their natural environment. This occurs because the students become directly involved with issues or problems. Action projects encourage letter writing campaigns, stream or lake clean up action, and fish planting programs. Newhouse (1990, p 31) concluded that, "The job of the educator is to ensure that everyone has all the tools necessary to make responsible environmental decisions." These tools are practical knowledge developed from real life experiences brought about through direct contact with environmental conditions.

#### Defining Authentic Assessment

The focus of student assessment centers around measuring student academic performance related to the individuals' understanding of a particular subject. "Student assessment should be rooted in instructional programs not

apart from them, and must benefit students and inform teachers of student achievement." In the case of science, student assessment should support science as an active field of inquiry, full of uncertainty and alternative explanations, and open to student construction (Perone, 1991, p. v).

Decreasing resources, coupled with increased utilization, pollution, and advanced technology demand a society that is knowledgeable about basic science and ecology concepts related to resources and their management. Environmental education assessment guidelines indicate that students must understand how ecological systems work, and this has been the focus of ecological education" (Brody, 1996, p. 21). Correspondingly, Rodger Bybee (1993) asserted ecological awareness must include a concern for the earth, and how the evolution of human values, and natural resource management impacts upon it. Accordingly, this occurs when environmental instruction includes relevant ecological issues, the natural and social science concepts pertaining to them, and clarifies student understanding about them.

Ballantyne and Packer (1996) found assessing learned

skills in environmental education must involve using a range of strategies designed to integrate an individual's environmental knowledge, attitudes / values, and behavior. Their article stated that the application of constructivist learning principles provides a basis for encouraging students to become aware of, challenge inconsistencies in, and make informed decisions regarding commitment to their own or alternative environmental concepts.

## GOALS AND OBJECTIVES

The National Environmental Education Act, passed in 1990, re-emphasized the need to increase the public's understanding of the natural environment while advancing and developing environmental awareness, education and training (Wilke, 1993). The primary goal of this project is relevant to this act: to develop a continuing active link between the classroom and the outdoor environment. Thus, students are afforded an opportunity to expand their knowledge and clarify their values and attitudes related to the environment. Goals of the curriculum include:

1. Enable learners to acquire the knowledge and skills necessary to make ecologically sound decisions.
2. Create awareness of the link between the quality of life and environmental quality.
3. Promote investigation and evaluation of environmental issues.
4. Provide a way for students to make positive environmental contributions.

To accomplish these goals, project emphasis was on the dynamics of the aquatic habitat. Objectives include:

1. Identify the species concept
2. Understand trout breeding procedures.
3. Gain knowledge of aquatic ecosystems.
4. Understand the interdependence between aquatic life and human community development.

## PROJECT DESIGN

Raising trout in the classroom is a multi-disciplinary, action-based project. The goal or action plan of this unit is to raise wild game fish as part of an aquatic environmental study by middle school students. The lesson plans relate the importance of understanding the interdependence of aquatic life and humans. Components of this action plan include working with the Department of Fish and Game and the Southern California Fly Fishing Association. These organizations provided guest speakers and links to school districts actively raising trout in the classroom.

Many of the student hands-on projects were developed based on concepts and/or lessons in Project WILD (1994) and Project WILD Aquatic (1992), both authored by the Regional Environmental Education Council.

Other hands-on lessons were designed based on The California's Salmon and Steelhead Handbook by (1989) Diana Higgins. These lessons include an in-depth study of trout anatomy and aquatic environments. All activities incorporate cooperative hands on learning groups in both indoor and outdoor settings.

The actual raising of trout in the classroom was developed by the southern California based organization "Fly Fishers of Southern California." Their program, "Trout in the Classroom" has been incorporated into classrooms throughout the Pacific Coast of the United States. Each lesson has different objectives according to subject area. Lessons include aquatic life, habitat range, water pollution, and community development effects on wildlife.

In total, this background information was used in two ways. Firstly, instruction on how to set-up an aquarium was developed (Appendix One). Secondly, lessons were developed (Appendix Two).

At the completion of this unit, 350 young rainbow trout fry are released in several local areas. Release points vary so that participating students study different environmental conditions and the impact civilized development has on them. Students completing this unit become better acquainted with various environmental issues affecting aquatic life.

Evaluation for the unit occurs in the form of authentic assessment. This assessment includes students completing trout anatomical species charts, life cycle drawings, and

designing aquatic environments. Students-developed portfolios include project notes, assigned duties, data related to the growth of the young trout, and written summaries associated with observations.



## IMPLICATIONS FOR EDUCATORS

Since many wildlife populations are dwindling, the overall project goal is to make students aware of aquatic resources and the need for their preservation so that our many valued aquatic resources will be enjoyed by all. This project can be implemented into middle school environmental education, science, or social studies curriculums. Unit design introduces environmental appreciation for ecological studies, or when incorporated into life science courses actively explores aquatic biology. Project lessons maybe also adapted for upper elementary grades or secondary introductory studies related to ecology. The objective of this study allows students to gain knowledge about aquatic life, and participate in a environmental action plan which replenishes rainbow trout in local lakes and streams.

This curriculum study includes active learning, hands-on activities, and cooperative learning objectives. Active learning presents concepts that are inductively presented rather than deductively taught. Inductively facilitating an aquatic unit enables students to develop awareness about aquatic resource preservation.

APPENDIX ONE

Aquarium Set-up and Care

## AQUARIUM SET-UP AND CARE

### PROCEDURES ONE

Before beginning procedures to raise the trout, be sure that the California Department of Fish and Game Classroom Aquarium Education Program Authorization Form is correctly filled out. This form must be obtained from the Department of Fish and Game before trout eggs can be obtained from the trout hatchery.

Set up the aquarium and incubator at least three days before the trout eggs arrive. This allows for monitoring and stabilizing water temperature and checking for equipment problems.

#### DISINFECTION PROCEDURE

1. Gather river rocks from local stream bed.
2. Purchase pea gravel from local pet store.
3. Disinfect pea and river gravel if used before. Soak in a disinfectant such as bleach (1:10 solution) for 24 hours or boil for ten minutes.
4. Wash and rinse all aquarium hardware thoroughly.

This includes the sides and floor of the aquarium, under gravel filter, pump tubing, air hoses, and screens placed inside aquarium. Disinfect all aquarium hardware previously used with a Wescodyne solution or by soaking in a 1:10 solution of bleach for 24 hours. Everything used including the aquarium, air pump, thermometer, baster, net, and buckets must be clean.

#### PREPARING AQUARIUM INTERIOR

1. Assemble under gravel filter and uplift tubes.
  - a. Connect sections of the under gravel filter.
  - b. Position air pump / Push hole out of the gravel filter. Punch only one hole in the

filter.

- c. Place the filter in aquarium.
- d. Fit the air pump uplift tube into hole.

#### FILLING AQUARIUM INTERIOR

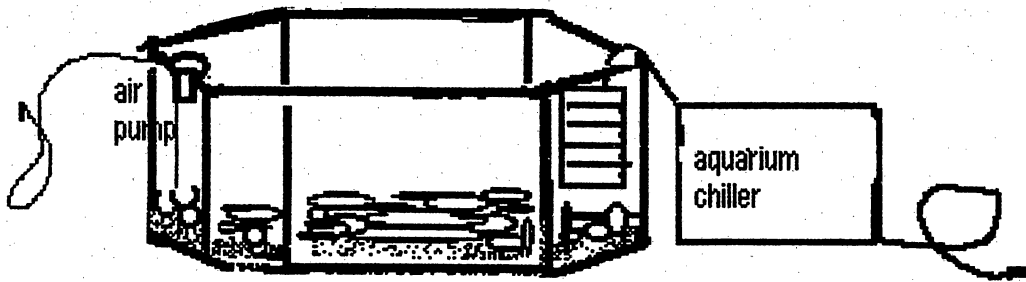
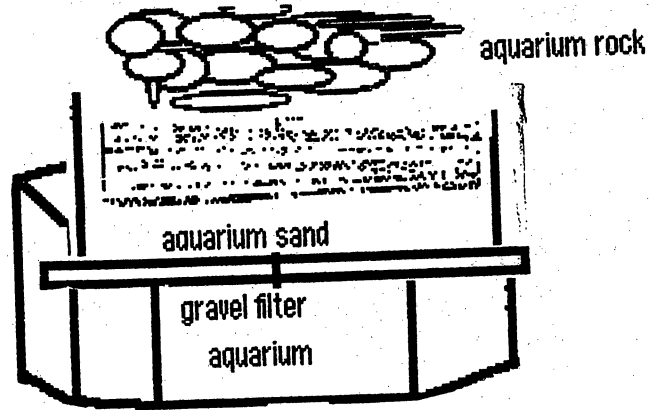
2. Place pea gravel and river gravel in the aquarium.
  - a. Gently pour enough pea gravel to completely cover filter. Any gaps between filter and aquarium wall must be filled with gravel. This prevents small trout from getting such into the filter.
  - b. To make aquarium cleaning easy, place spawning gravel only in front half of aquarium. Leave back half covered only with pea gravel. Small spaces between rocks are reserved for eggs.

#### AQUARIUM SET UP PROCEDURES

3. Fill the tank with water to about two inches from the top.
4. Place the power head pump in the riser and attach to the aquarium. Adjust air flow to accommodate aquarium size.
5. Place aquarium thermometer in the water on the front wall of the aquarium.
6. Install the chiller with the temperature setting between 55-65 degrees Fahrenheit.

See aquarium set-up shown on next page.

# AQUARIUM SET-UP



## AQUARIUM MAINTENANCE

### PROCEDURE TWO

This procedure introduces the activities required for maintaining live trout in the classroom. The focus of study during this time should center around trout life cycles, habitat needs, and how human actions affect aquatic life. The aquarium should be used to demonstrate key elements of stream, pond or river habitat.

For those students having a limited background concerning what aquatic habitat consist of, it is suggested one of the following videos be shown to the class:

#### Videos

California's Fish Hatcheries, Enriching Nature's Bounty  
California Department of Fish and Game  
3300 Golden Shoe, Suite 50  
Long Beach, California 90802  
(213) 590 5132

Last Chance for the Pacific Salmon  
Produced by Mike and Patrick Higgins  
Federation of Fly Fishers  
1441 Valencia Place  
Ontario, California 91761  
(909) 930 5800

Where the Trout Are  
Federation of Fly Fishers  
1441 Valencia Place  
Ontario, California 91761  
(909) 930 5800

Before the trout eggs arrive in class, discuss aquatic habitat needs with students. Students should consider the stages of trout development and design an environment that will keep the trout alive while they are held in the classroom aquarium. Each student should draw and label their artificial environment and describe how each component imitates nature.

BACKGROUND: The key ingredients for successfully rearing trout in the classroom are clean cold water and plenty of oxygen. The water temperature must be mechanically regulated by the use of a water chilling device. Have students check this device daily to be sure that the water temperature never gets higher than 60 degrees Fahrenheit.

It is also important trout eggs and young trout alevin are not harmed by light, especially the violet blue range produced by fluorescent bulbs. To avoid possible harm to the eggs or alevin cover the entire outside of the aquarium with sheets of cardboard. A place for viewing the development of the trout can be provided by cutting square viewing windows in the cardboard covering the aquarium. (See illustration) The top or lid of the aquarium should also be covered to prevent unwanted light from entering the aquarium.

#### MATERIALS FOR MAINTAINING AQUARIUM

1. Student Duty Assignment Sheet.
2. An aquarium water filter sized to the aquarium recirculating pump.
3. Air filter.
4. A fish net and turkey baster.
5. Aquarium vacuum.

PROCEDURE: Have students assigned to aquarium maintenance monitor water temperature on a daily basis. They need to be sure water temperature stays between 50-60 degrees Fahrenheit.

Once the trout eggs are placed in the tank, students need to remove aquarium debris from the bottom of the tank. Use the turkey baster to remove unfertile or empty trout eggs from the aquarium. These can be recognized by their milky white color. Removing them prevents fungus from growing in the tank and killing the healthy eggs.

As the young trout alevin emerge from their eggs and mature into trout fry, students much change or drain out half of the water in the aquarium once a week. The aquarium circulating pump and air filters should be replaced every two weeks. Changing the water on a weekly basis recirculates oxygen and eliminates the growth of oxygen-destroying bacteria.

Before refilling the aquarium with fresh water, have students use the aquarium vacuum pump to carefully vacuum the bottom of the aquarium floor to remove decaying matter and dead fish. Be careful not to vacuum up any of the young trout alevin hiding in the rocks. Use the fish net and turkey baster to assist in "sweeping up" any floating debris.

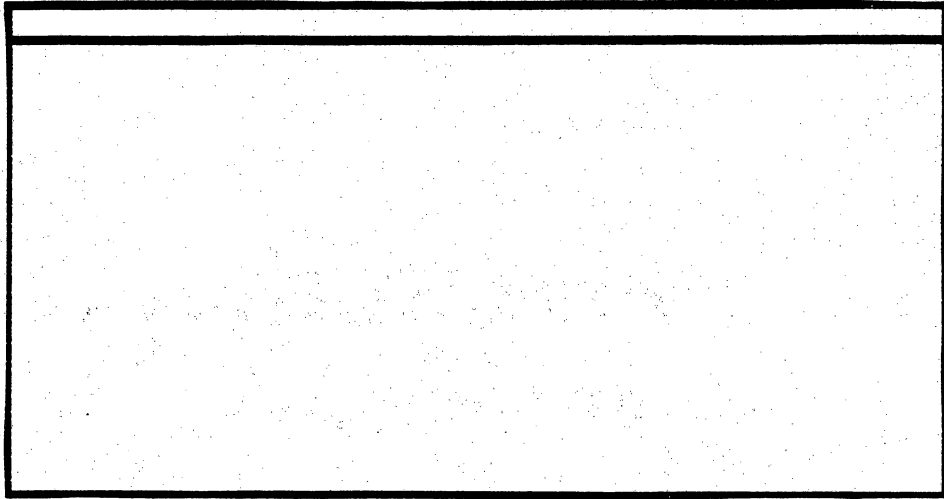
As the alevin mature into fry and their food sac disappears, they will need to be fed. Once students begin to feed the fry, feed no more than once every two hours. Care must be taken not to overfeed since uneaten or decaying food will contaminate the water and kill fish.

EVALUATION: Is based on continued life and growth of young trout.



## TROUT AQUARIUM WORK SHEET

All students should complete the drawing below. They must include the aquarium, air pump, filter grate, gravel chiller, water filter, sand, and anything else needed to keep the trout alive.



## AQUARIUM SET-UP AND MAINTENANCE

### PROCEDURE THREE

After the trout eggs have arrived, students must predict when the eggs will hatch. Their prediction will be based on water temperature and calculating the thermal units it contains.

- MATERIALS:
1. Aquarium thermometer
  2. Calendar
  3. Student Journal

BACKGROUND: Rainbow trout eggs hatch when the embryo inside has accumulated enough thermal energy units, or TUs. Thermal units gathered are based on the daily average water temperature for each degree above freezing (32 degrees F) over a 24-hour period. The closer the water is to 32 degrees Fahrenheit the longer the eggs will take to hatch. The optimum temperature range should be between 40-50 degrees Fahrenheit. Trout eggs kept in water temperature above this range tend to die.

PROCEDURE: Student take aquarium water temperature twice daily. They record temperatures in aquarium journal and estimate when trout eggs will hatch. Expected hatch date is found by adding total thermal units (TUs.) gained daily. Students calculate daily thermal units by subtracting the daily average water temperature from 32 degrees Fahrenheit. The hatch date is estimated by referring to the following chart:

#### Rainbow Trout

Water Temperature F	Approximate number of Days to Hatch	Thermal Units Accumulated
40	80	640
45	48	624
50	31	558
55	24	552
60	19	532

This hatch estimation guide is located in the maintenance portion of the Aquarium Student Maintenance Journal.

Other duties students performed include writing daily journal entries in the student maintenance journal. Journal entries must list the month of the year, the day of the week, and the average hourly temperature of the aquarium. Student observations should include expected hatch date, or cleaning duties and feeding time. The journal will be left next to the aquarium.

## PROCEDURES FOR RELEASING YOUNG TROUT

### PROCEDURE FOUR

Before beginning procedures to release the trout, be sure that the California Department of Fish and Game Classroom Aquarium Education Program Authorization Form is correctly filled out. This form, obtained from the Department of Fish and Game, must accompany students transporting and releasing the young trout.

#### EQUIPMENT REQUIRED:

1. A 10-gallon plastic bucket to transport young trout in.
2. portable battery driven aquarium air pump
3. paper cups
4. thermometer
5. fish dip net
6. ice

**STUDENT PROCEDURES:** In preparing students to take the trout to the release site, be alert for student safety. Advise students in advance to dress for the riparian release site. Students should wear old shoes, shorts or jeans. Students should be briefed on habitat courtesies. These include being made aware riparian areas provide space, shelter and food for associated plant and animal communities. For example, leaf litter and terrestrial insects falling from vegetation into a stream are a source of nourishment for various forms of aquatic life. Discuss ways they can minimize potential damage to habitat. These might include not throwing objects or trash in the water, and removing natural growing or floating vegetation release procedures. Students should also be encouraged to walk lightly along and away from the stream banks to avoid weakening them to the point where they erode into the streams.

#### Steps in preparing trout for release:

1. The 10-gallon plastic transport container the trout are to be carried to the release site in should be filled with non-chlorinated water to

assure water borne disease is not released with the trout.

2. The temperature of the water in the container should be as close to the temperature in the aquarium that the young trout were raised in. The temperature should be between 50 and 60 degrees Fahrenheit. This can be accomplished by placing ice in the container until the water temperature is consistent with water in the aquarium. A thermometer and enough ice should be taken along to assure the proper water temperature is maintained until the release site is reached.
3. The battery driven air pump should be placed secure to the lip of the carrying container, and the attached tube placed in the water. The air pump should be turned on to assure oxygenation of the water.
4. After removing half of the water from the aquarium holding the trout, use the dip net to catch and place the trout in the 10-gallon transport container. To assure trout safety, place no more than 45 trout in the container.
5. During the trip to the release site, make sure the temperature in the transport container stays between 50 and 60 degrees Fahrenheit. Use ice to maintain this temperature as needed.
6. When the release site is reached, students should study the aquatic environment before releasing the baby trout. Lesson six in Appendix Two has suggestions.
7. To begin releasing the baby trout, carefully reduce the water level in the transport container until it is about half full.
8. Next give each student a paper cup and one at a time have them dip the cup into the transport container until their cup contains at least one

baby trout.

9. Then have the student find a quiet eddy in the creek and submerge the entire cup into the water until all the young trout in the cup swim out.
10. Repeat the procedure until all the trout have been released. When the last baby trout has been released, it is important that students begin the clean up procedure. This includes returning any aquatic plant, insect or animal specimens collected for observation, and cleaning up any trash or debris the release team of students may have dropped.

APPENDIX TWO

Trout Lessons

## ACTIVITY ONE

### CREATE A FISH

**OBJECTIVES:** Students will describe adaptations of fish to environments; explain how adaptations help fish survive in their habitat; and interpret the importance of adaptations in animals.

**BACKGROUND:** All organisms are the products of countless adaptations. Most successful habitat adaptations increase the likelihood of survival. With any habitat change, either gradual or catastrophic, species of animals with adaptations most suited to the habitat change are the ones most likely to survive.

In a few species, however, such as the Little Kern Golden Trout, habitat adaptation has been narrowed through extensive hybridization or co-mingling with Rainbow Trout. The habitat range of the Golden Trout has also been adversely affected by habitat infringement of off-road vehicles, road construction, logging, mining, and siltation from overgrazing. As a result, the Little Golden Trout now occurs only in head water streams where rainbow trout were not introduced or where waterfalls block their migration (Pearson, Stevens, & Ostrander, 1991).

In the following activity three to four students, working in cooperative groups, will define the term, "Environmental Adaptation." In the instance of aquatic adaptations, students should consider environmental needs of fish to include water quality, methods of protection from predators, sources of food, and method of reproduction. Students should consider the example of the golden trout as a means of understanding how a micro habitat impacts on the success or failure of adaptation.

**MATERIALS:** The materials for this activity were adapted with permission from the editors of Project WILD Aquatic. The chart proceeding the game cards briefly explains each characteristic students are to use as their group designs a fish and its environment. They should relate each adaptation card to trout or other fish and aquatic animals



they are familiar with.

## COMMON ADAPTATION CHARACTERISTICS

### OF FISH

ADAPTATION	ADVANTAGE	EXAMPLES
<b>Mouth-----</b>		
sucker shaped mouth	feeds on very small plants and animals	sucker, carp
elongate upper jaw	feeds on prey it looks down on	spoonbill, sturgeon
elongate lower jaw	feeds on prey it sees above	barracuda, snook
duckbill jaws	grasps prey	muskellunge, pike
extremely large jaws	surrounds prey	bass, grouper
<b>Body Shape-----</b>		
torpedo shape	fast moving	trout, salmon, tuna
flat belied	bottom feeder	catfish, sucker
vertical disk	feeds above or below	butterfish, bluegill
horizontal disk	bottom dweller	flounder, halibut
hump backed	stable in fast moving water	sockeye salmon, chub, razorback
<b>Coloration-----</b>		
light colored belly	predators have difficulty seeing it from below	most minnows, perch, tuna, mackerel
dark upperside	predators have difficulty seeing it from above	bluegill, crappie
vertical stripes	can hid in vegetation	barracuda, flounder
horizontal stripes	can hid in vegetation	muskellunge, pickerel, bluegill
mottled coloration	can hid in rocks and on bottom	yellow and white bass, snook
		trout, grouper, rockbass, hogsucker
<b>Reproduction-----</b>		
eggs deposited in bottom	hidden from predators	trout, salmon, most minnows
eggs deposited in nests	protected by adults	bass, stickleback
floating eggs	dispersed in high numbers	striped bass
eggs attached to vegetation	stable until hatching	perch, northern pike, carp
live bearer	high survival rate	guppies

The four game cards each group is to use consists of,

1. Mouth shape
2. Body design
3. Coloration
4. Reproduction

The suggested videos supplement document biological or environmental adaptations of trout and salmon in their aquatic habitat.

"Life of a Trout" produced by Trout Unlimited and Scientific Anglers.

"Last Chance for the Pacific Salmon" produced by Michael and Patrick Higgins.

Both of these videos are available from:

Deep Creek Flyfishers  
1441 Valencia Place  
Ontario, CA 91761  
(909) 930 5800

PROCEDURE: Begin by having the entire class watch the video, "Life of a Trout." Upon completion of the video, have students discuss the meaning of the word, adaptation. A simple definition would be, "finding ways to survive within a habitat." To reinforce this concept, students should recall successful/unsuccessful examples of how young trout survive as depicted in the video. Student attention should focus on the importance of the trout's body shape, coloration, feeding behavior and reproduction methods. As the discussion precedes students might also define how humans adapt to where they live. Students should develop examples and categorize them into the following categories:

- a. protective coloration and camouflage.
- b. body shape or form.

- c. mouth type based on feeding behavior.
- d. reproduction/behavior.

Next, divide class into cooperative learning groups of four to five students. Divide the adaptation cards into five groups of four cards representing: a) fish coloration, b) mouth type, c) body shape, and d) reproduction. Have each student group select a card from each group of cards. Then each student is to assemble a fish using the characteristic cards. Fish adaptation cards are found on page 40. Their design should represent the adaptations required for their fish to survive. Students should consider habitat requirements for their fish creation.

LESSON ASSESSMENT: Evaluation is based upon students performing each of the following:

1. Comparing adaptations to actual fish.  
Students in cooperative groups orally name two environmental adaptations in their designed fish and compare designs to actual environmental conditions. Students describe the need for each adaptation to assure survival in habitat.
2. Comparing and Contrasting Environmental Conditions.  
Whole-class presentation. Students orally discuss the most important survival attributes of their fish. Class discussion should include comparing and contrasting survival techniques between fish living in the ocean or in lakes and streams. Students should independently develop charts classifying these differences or similarities between the environments. Instructor directed discussion should provide students time to compare their designs to human or other animal adaptations.

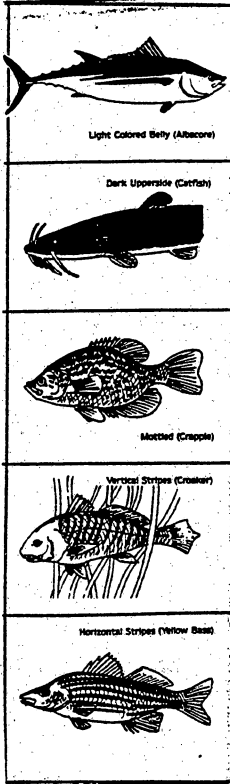
The following lessons found in either Project WILD and Project WILD Aquatic may enhance student understanding of environmental adaptations. The use of these in the curriculum depends on the environmental issue or concept being examined.

Surprise Terrarium, Project WILD, page 118  
Designing a Habitat, Project WILD, page 20  
Migration Head ache, Project WILD, page 94

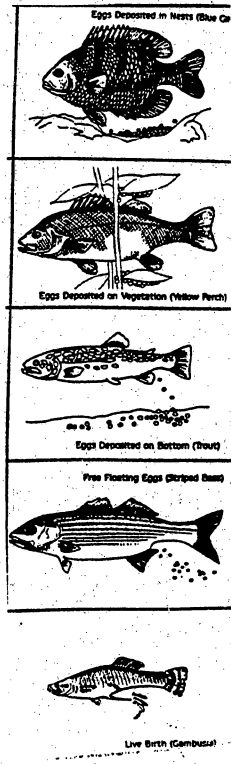
# FISH ADAPTATION CARDS

## MASTER SHEET

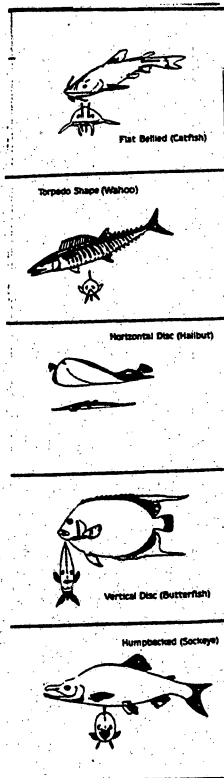
### Coloration



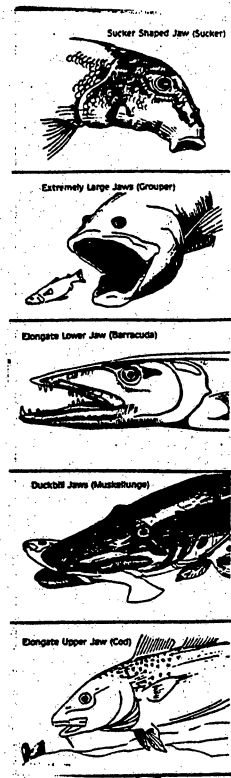
### Reproduction



### Shape



### Mouth



## ACTIVITY TWO

### CLASSIFYING FISH

**OBJECTIVES:** Students will name the genus, family, order and class to which trout belong and list similarities and differences between classes.

**BACKGROUND:** Fish existed long before land vertebrates. Jawless fish, lampreys and hagfish represent ancient lines of fish. Sharks and rays, although ancient in origin, are still very successful today. Their skeletons contain cartilage rather than bone.

Bony fish have experienced tremendous success in recent evolutionary time. Bass are members of one of the most evolved order of bony fish. Their pelvic fins have moved forward, and their pectoral fins have enlarged and moved up on their bodies.

Salmoniforms are a large, diverse order of fish with soft rayed fins and swim bladders that open into the esophagus. These fish, which love cold water, include trout, salmon, char, and white fish. Members of this family are also called salmonids and often swim to the ocean to live out the adult phase of their lives.

When scientists classify animals, very specific names are used to avoid confusion. The name trout is not a scientific name because it does not designate a particular genus or species. The steelhead trout were recently reclassified. They were once part of the genus Salmo, but with new evidence indicating they are more closely related to salmon, they have now been classified into the genus Oncorhynchus.

The genus and species name for the pacific salmon and steelhead trout are listed in the following table.

## Salmon and Steelhead Classification

<u>SPECIES</u>	<u>COMMON NAME</u>
Chinook, <u>Oncorhynchus tshawytsca</u>	King, chinook
Coho, <u>Oncorhynchus kisutch</u>	Silver, Coho
Sockeye, <u>Oncorhynchus, nerka</u>	Red, Sockeye
Chum, <u>Oncorhynchus, keta</u>	Dog, Chum
Pink, <u>Oncorhynchus gorbuscha</u>	Humpback, pink
Rainbow Trout, <u>Oncorhynchus mykiss</u>	of which Steelhead is subspecies gairdneri



Salmon and steelhead are anadromous fish, meaning they begin in fresh water, migrate to sea where they live most of their adult life, and return to fresh water to spawn.

**MATERIAL:** For each student, a copy of the Phylum Chordata Classification chart, the Classifying Fish Worksheet one, and the Stream Trout and Salmon Identification Chart.

**PROCEDURE:** Each student receives a copy of the Phylum Chordata Classification chart, the Classifying Fish Worksheet one, and the Stream Trout and Salmon Dwelling Identification Chart. Review chart and pictures of salmon with students. Explain that the chart only contains a complete classification for salmon and steelhead. It does not contain all scientific classifications of fish families or other aquatic life forms.

Using the enclosed stream dwelling trout and salmon identification chart students are to describe the different family characteristics between trout and salmon. Have students note that these fish are all related so distinguishing characteristics, such as size and locations of spots on body and color of skin, are part of the pictorial classification process.

Explain that the term species is part of a genus, or a common grouping, which is part of a larger family. Compare and contrast the use of scientific classification and common names for students so that they understand the difference.

**EVALUATION:** Upon completion of discussion, students will be able to classify basic groups of fish according to skeletal composition. Students will also be able to recognize different fish found in the Salmoniform family. Students will be able to demonstrate a basic understanding of the classification process used in science.

**ADDITIONAL LESSONS:** Good Buddies found on page 104 in Project Wild.

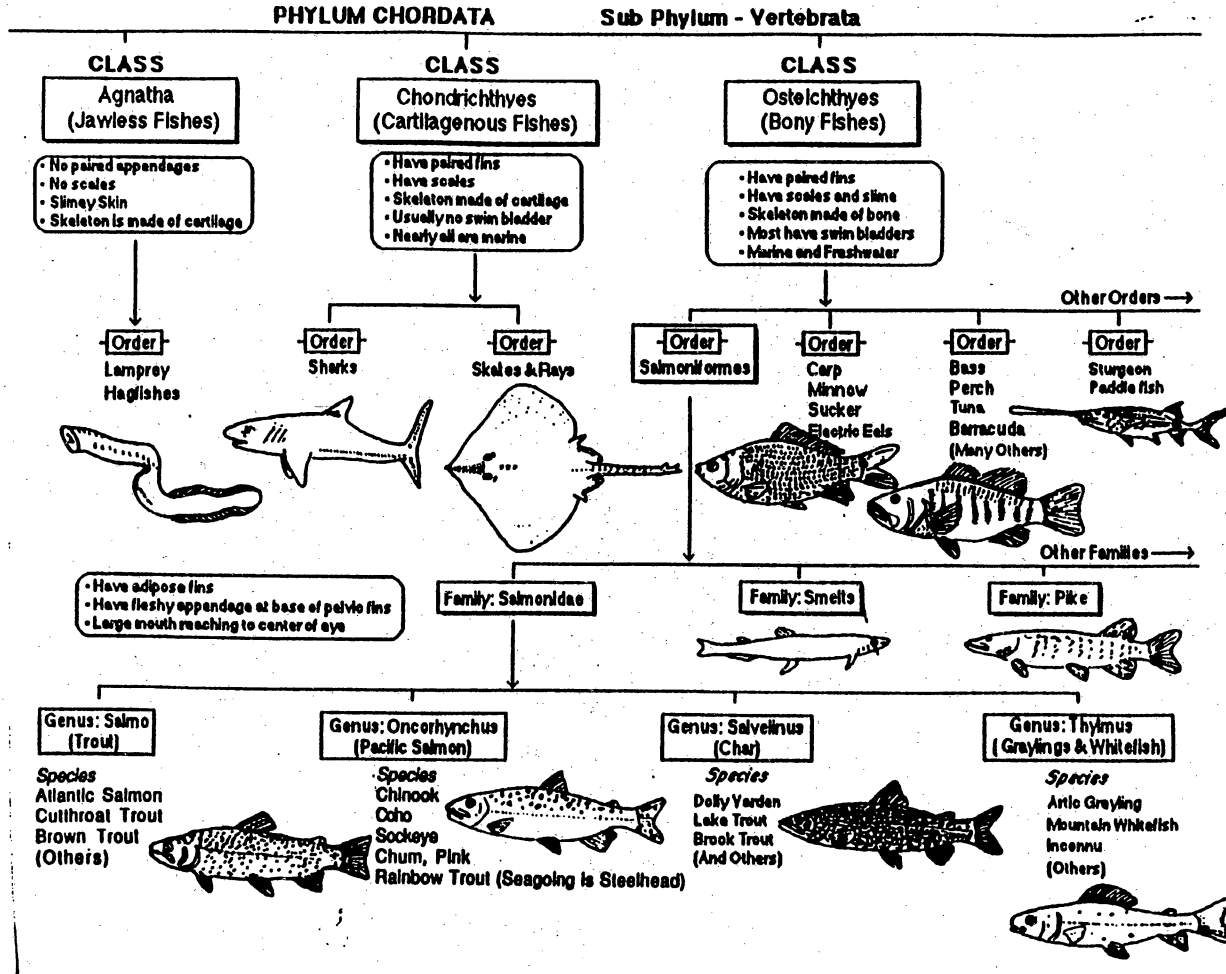
## CLASSIFYING FISH

### WORK SHEET ONE

Please use Phylum Chordata Classification Sheet, and a copy of the Salmon and Trout Identification Chart to complete.

1. Salmon and Rainbow trout belong to the genus \_\_\_\_\_
2. A cutthroat trout belongs to the genus \_\_\_\_\_
3. All salmon and trout are in the \_\_\_\_\_ family.
4. The other two genera in this family are the \_\_\_\_\_  
and the \_\_\_\_\_.
5. The class of bony fish is called \_\_\_\_\_
6. How do jawless fish differ from cartilaginous and bony fish?  
a. \_\_\_\_\_ b. \_\_\_\_\_
7. List two ways that fish in the class Chondrichthyes are  
Different from those in the class Osteichthyes.  
a. \_\_\_\_\_ b. \_\_\_\_\_
8. What two things do fish in the Chondrichthyes and the  
Osteichthyes family have in common?  
a. \_\_\_\_\_ b. \_\_\_\_\_

# Physium Chordata Classification Chart



## Trout and Salmon

### Identification Chart

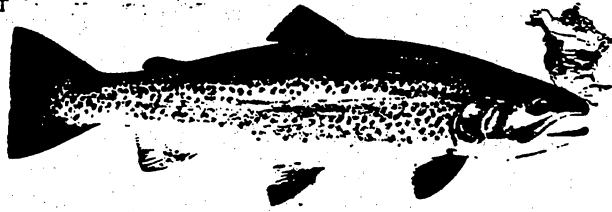
While there are several sub-species of this fish, these are the three main species.

#### Rainbow Trout *Oncorhynchus mykiss*

##### *Trout and Atlantic Salmon*

##### COMMON RAINBOW TROUT

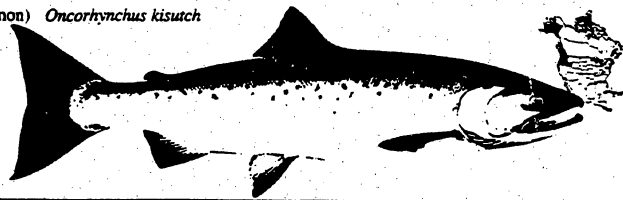
All rainbows have radiating rows of black spots on tail, black spots on back and sides, and no teeth on tongue. Common rainbows have pinkish horizontal band and pinkish gill cover with some black spots. World record: 27 lbs., 3 oz.; Ganaraska River, Ontario; 1984.



#### Coho Salmon *Oncorhynchus kisutch*

##### COHO SALMON (silver salmon) *Oncorhynchus kisutch*

Resembles chinook, but tail with small black spots on upper lobe only. Teeth set in whitish to grayish gums. Anal fin considerably shorter than that of chinook, usually with 12 to 15 rays. World record: 31 lbs.; Cowichan Bay, British Columbia; 1973.

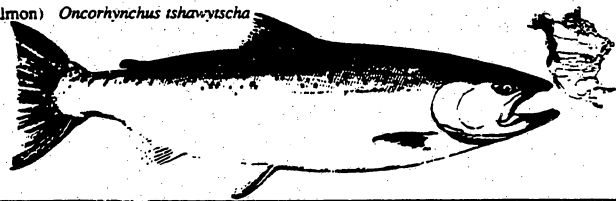


#### Chinook Salmon *Oncorhynchus tshawytscha*

##### *Pacific Salmon*

##### CHINOOK SALMON (king salmon) *Oncorhynchus tshawytscha*

Sides silvery; upper sides, back, and both lobes of tail peppered with small black spots. Teeth set in blackish gums. Anal fin, usually with 15 to 19 rays, is longer than that of other Pacific salmon. World record: 97 lbs., 4 oz.; Kenai River, Alaska; 1985.



## ACTIVITY THREE

### DISSECTION OF YOUNG TROUT

**OBJECTIVE:** Students examine the anatomy of trout to learn about fish adaptation to their environment.

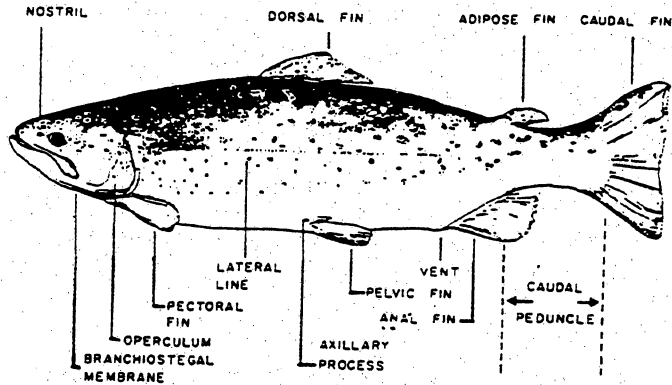
**METHOD:** Students observe trout anatomy and adaptation by dissecting trout furnished by the California Department of Fish and Game. This agency is located in Sacramento, CA. and is reached by calling 916-445-3531. Computer dissection labs are available from Sargent-Welch of Skokie, IL, 1-800-727-4358. These labs simulate dissection processes for students unwilling to participate in an actual trout dissection process.

**BACKGROUND:** Trout are, as all fish are, adapted specially to their environment. Their breathing is based on oxygen availability and water temperature. Externally, trout bodies are, as are most fish, streamlined and tapered. Like all fish, they must swim and glide, or hold position through the water with little resistance. The following anatomical descriptors may be used in the classroom to explain environmental trout adaptations.

**Skin and Scales:** The skin is actually two layers thick. The outer, epidermis, contains mucus glands and pigment cells. The dermis or inner layer contains nerves, blood vessels and connective cells. The scales grow from and are embedded in the dermis. Each scale lies in a pocket of dermis, with only a small portion visible. Overlapping like shingles the scales point to the tail in order to reduce friction with the water. Scales grow as the fish do.

**Teeth:** Teeth are present in the bones along the margins of the upper and lower jaw and on portions of the roof of the mouth. They are also located on the tongue.

**Fins:** All fins except the adipose are made of tough membrane supported by bony fin rays.



**Exterior Trout Body.**  
**Taken from Trout Biology**  
**by W. Willers.**

- A. Caudal fin or tail fin is responsible for propelling fish forward. This fin assures the fish stays upright.
- B. Anal fin helps fish propel forward, balance and steer.
- C. Adipose fin is a small fleshy fin whose function is not know. It is thought to help balance anal fin.
- D. Dorsal fin helps the fish stay up right and swim on course.
- E. Pelvic and Pectoral fins are paired fins which are important for maneuvering, turning, braking and balancing.

The Nervous System: The brain, spinal column, and all the nerves make up the nervous system. The brain is encased in the skull just above and behind the eyes (nerve opitals). The spinal cord is encased in a bony arch of the vertebral column.

Eyes: Trout have excellent eyesight and see both near and far simultaneously. The large pupils allow most available light to be admitted. Since the pupil does not adjust much to light, that might explain why trout ten to avoid brightly lit areas.

Nostrils and Olfactory Lobes: The sense of smell is extremely well developed in trout. Incoming water is guided into the olfactory sac, where small receptors are located.

Ears: Trout have no external ear opening, but do hear quite well. Within the inner ear are chambers which contain tiny bone called ear bones. These move about the chamber as the fish swims. This allows the fish to know its position.

LATERAL LINE. This mucous filled canal located under the skin runs the length of the fish. Connected by short nerve endings to the outside, the lateral line is sensitive to low frequency vibrations. Such vibrations caused by the movement of animals or other fish in the water are thus

felt.

Internal Systems: Since water contains less oxygen than air, fish have evolved very efficient methods for extracting what is available. Gills are a specialized system for respiration, taking in oxygen and eliminating waste.

MATERIALS: One medium sized trout supplied by Department of Fish and Game for every four students. One pair of gloves for each student. Dissecting scissors or nail clippers, tweezers or flexible knife; newspaper or dissection pan, paper towels, trout anatomy work sheet.

PROCEDURE: Cooperative groups of four students each or formed. Teacher directs how and when students touch or cut into the fish. Students are guided by teacher in filling out trout work sheet.

1. Students examine trout skin, and determine need for scales.
2. Examine skin color pattern. Class should discuss reasons for trout body being dark on top and light on the bottom.
3. Look at the lateral line along the side trout, and determine possible environmental applications.
4. Measure the overall size of the fish. Ask what can be determined about the placement of the fins.
5. Have students note the size of the trout's eyes. Call attention to large pupils and eyeballs. Have students rotate eyeball in the eye socket with their fingers. Ask students what such a large eye indicates about the vision for this animal.
6. Now examine the face of the trout and locate the nostrils. Find the large olfactory lobes leading to the brain. Have students speculate why the sense of sight and smell are so important to the trout.



7. Have the students open the mouth and examine the area surrounding the teeth and gums. Allow student to feel the teeth along the gum margins, and roof top of trout's mouth, and on top of tongue. Have student open mouth as far as possible. Ask why or under what conditions opening the mouth so wide would be necessary.

Explain that trout also use mouth for breathing, and in low oxygen conditions fish actively pump water over gills by opening and closing mouth as far as possible.

8. Now, examine the gill arches by looking down the trout's mouth. Using a tooth pick to probe and separate the arches and explore how they are arranged.
1. Now have students place their trout on its side and examine the bony section of the gill covering known as the operculum. Now have each student group cut the operculum away at its base so the gills are exposed.
  - a. Remove the gills by cutting away the lower and upper attachments of the arch. Have students look at large surface area of gill filament and thin tissue composition which allows blood vessels to come into contact with oxygen in water.
  - b. Now carefully cut the fish open using scissors or a scalpel. This cut should be made from the anal fin to the bottom of the gill plate. Before going further, students should observe how the internal organs fit together.
  - c. Locate the swim bladder. It is located in the upper body cavity just below the kidney. This is the organ which gives buoyancy to the fish.
  - d. Investigate the digestive track by starting

in the mouth and following the route food takes when eaten by the fish. A student from each team should place a probe in the mouth and through the esophagus to show the beginning of the route. Then, follow the course the food goes using a probe. Digestion begins in the cardiac or first part of the stomach. Notice that the stomach tends to grow larger at the bend just below the cardiac area. This portion is known as the pyloric ceca.

- e. After the pyloric ceca, are the intestines which like the stomach take nutrients from the food. Explain that blood vessels located within the intestines are used for nutrient exchange. Have the students trace the path of the intestines to the anal opening where waste products are eliminated.
- f. Place the fish on its back in order to find the kidneys, which are located just under the backbone. They run the entire length of the body cavity, and serve to filter metabolic waste from the blood.
- g. Next have students examine the liver and spleen. The spleen is found by lifting the stomach. It is reddish in color and assists in the manufacture of blood. The liver, located in front of the stomach assists with digestion.
- h. The trout's heart can be observed by slightly moving the liver to the side. The individual chambers of the heart should be easy to see. The gills, liver, and heart are located close together in order to filter or provide both the proper blood pressure or oxygen content to the trout.
- i. Finally have the students cut part of the trout's skin away from its body. This will

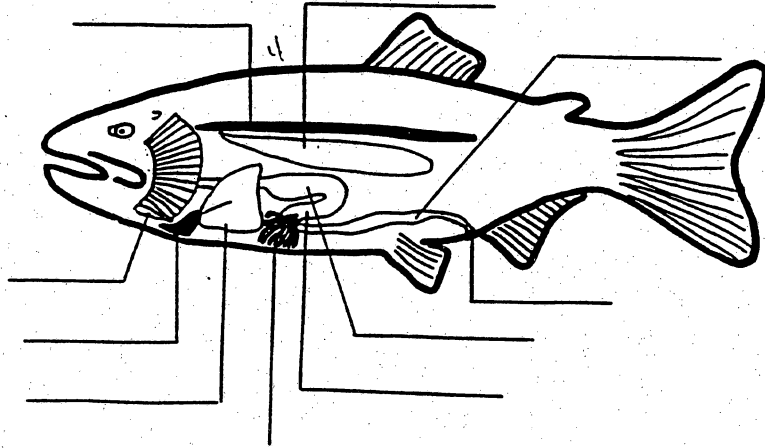
expose the bone and muscle of the fish. The fleshy part of this mass is the eatable part of the trout.

After the dissection portion of the lesson, students clean up the work area and properly dispose of the remains of the trout.

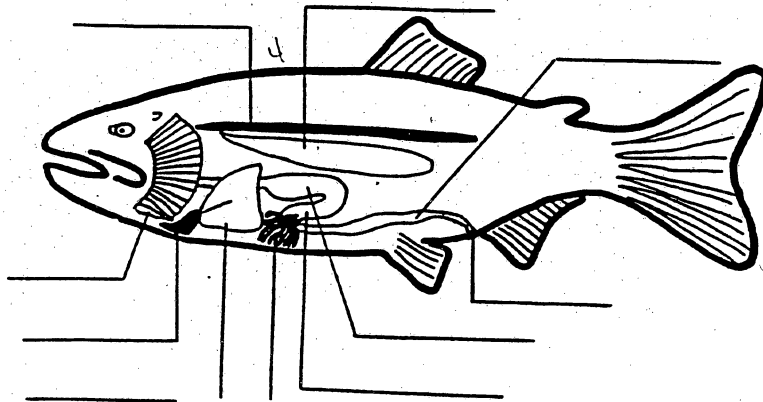
LESSON ASSESSMENT: Student assessment is based on correctly filling out the trout internal and external anatomy charts. See following two sheets. Students are also expected to write a short paragraph explaining the location and use of trout external and internal anatomy.

Trout Anatomy Work and Answer Sheets

Trout Anatomy Worksheet



Trout Anatomy Answer Sheet



PLEASE LABEL THE FOLLOWING:

GILLS  
KIDNEY  
SWIM BLADDER  
PYLORIC STOMACH  
INTESTINES

HEART  
LIVER  
CARDIAC STOMACH  
PYLORIC CECA  
VENT

Taken from California Salmon and Steelhead Handbook.

## ACTIVITY FOUR

### LIFE CYCLE

**OBJECTIVE:** Students correctly assemble stages of trout's life cycle.

**BACKGROUND:** Life Cycle. The following is an outline describing the life cycle of trout. Students should review each stage and then working in small groups design a trout life cycle chart and discussion paper.

1. **Eggs:** The female trout digs a depression in the sandy soil that is 6 to 24 inches deep, depending on the species. She then deposits the eggs and the male fertilizes them. By fanning her tail, she then buries the eggs with gravel to protect them. For the first few weeks the eggs are extremely fragile, and can be killed by a shifting of the stream bed brought on by flooding. As the young trout's eyes develop, the eggs become less sensitive to impacts. The trout eggs are very sensitive to light and require cool water circulation in order to have oxygen and carry away waste products. Water circulation is also important because it prevents stream bed siltation which may smother eggs.
2. **Alevin stage:** After hatching, the tiny fish, known as alevin, remain hidden in the gravel bed. This is a useful survival instinct for the small and helpless trout. A trout alevin is easily recognized by the egg sac attached to its stomach. All nutrients needed for the first week are supplied in the large egg sac. The prominent viteline running through the egg sac absorbs oxygen. Eventually the alevin must struggle up through the gravel. If spaces are plugged with silt, or the depth of the gravel has increased, the young fish may be trapped and die. Only about ten percent of the young trout survive past this stage.
3. **Fry stage:** The small fry become most active at night to avoid predation. The small fish gulp air from the surface filling their swim bladders so they can

maintain the correct orientation in the water. They are so tiny many animals will eat them. They must have plenty of places to hide. Dark marking on the sides of these young trout help them blend with their environment. Many fisheries scientists believe that imprinting, the process of developing survival instincts, occurs in this stage of the trout. During this developmental phase, the young trout learn to eat small insects that live or fall into the water.

4. Adult stage: During the early years of adulthood, trout feed mainly on immature forms of aquatic life and adult insects. They also eat small crustaceans, mollusks and earthworms. As they grow larger, they eat both insects and tiny fish. Very large trout will also eat small frogs and mice. The rate of growth of adults depends not only on diet, but the fertility and size of the stream or lake. Generally, trout feeding mainly on insects grow more slowly than those eating small fish because insect feeding consumes more energy for the nutrients obtained.

**MATERIALS:** Life cycle overview. Trout life cycle work sheet, glue, scissors. The video, Life of a Trout or Last Chance for the Pacific Salmon maybe used to supplement the classroom background discussion.

**PROCEDURE:** During class discussion, the instructor defines life cycle as the life chain from birth through death to life again. After distributing the life cycle work sheet, have students cut out pictures depicting these stages. Challenge students to arrange pictures the proper order. Remind students that since they are describing a life cycle, pictures need to be assembled in a circle. Allow them to make any changes to their poster after they have checked their work against the life cycle reference sheet. They may then glue pictures in proper order.

**LESSON ASSESSMENT:** This will be the successful completion of the life cycle chart. After completing the chart, students are expected to write a short story describing the stages of the trout life cycle. The paragraph should be written so that environmental conditions and hazards are mentioned.

These might include the trout's need for abundant aquatic insects and clean running water.

## ACTIVITY FIVE

### NET EFFECT

**OBJECTIVE:** Students working in cooperative groups simulate the commercial use of fishing technology to catch "fish." Students then tabulate and interpret the possible effects of changes in fishing technology on fish populations.

**BACKGROUND:** This activity focuses on changes affecting the fishing technology. Humans have been engaged in fish-gathering since prehistoric times. Methods of catching fish probably began with humans wading into wetlands at the edge of large, shallow lakes. There, using bare hands and clubs, they began the first uses of fish as a human food source. Methods of fishing like spearing, and catching fish on hooks or trapping them in baskets, were then used in streams, rivers, and dams. Eventually, large nets were used which enabled fishing to be used in economic ventures rather than only small family subsistence.

As netting fish increased, the net changed in size, design and effectiveness. Currently, there are nets available for catching different fish species in different situations. Gill nets hold the fish by the gills; purse seines trap the fish in a large circular target area; and drift nets large monstrous affairs, trap anything swimming by. Nets have all improved the catch rate of fishing. An illustration of these nets follows. Along with the use of nets came the need to put them in waters rich with fish.

Evidence of boats and rafts being used in fishing goes back to the stone age. The first revolution in boat design came when fishing boats shifted from dugouts to sailing vessels. The technology of sails did much to allow people fishing to extend both the distance they could travel looking for fish and the amount of fish brought back. With the revolution created by steam engines and later diesel-driven fishing fleets, fishing vessels were able to go rapidly to any spot in the oceanic world.

The combination of better nets and the longer range and faster maneuverability of steam and diesel ships have made



it possible to catch larger and larger amounts of desired aquatic life. It appears these modern fishing technologies have introduced new aquatic problems negatively impacting on marine life such as species discrimination, over harvesting, and marine habitat destruction. These negative technological elements often jeopardize fishing range and aquatic population(s).

Technological changes in sport fishing and commercial fishing ships have brought about a considerable change in other support fishing gear. In each instance, fish now may be located using radio and sonar technology. Commercial fisheries routinely use spotter aircraft, computerized navigational equipment, at-sea fish processing, and other sophisticated tools.

Currently, for many fish species, besides being over-fished, the single most critical issue is their habitat loss. In many cases breeding grounds are being lost to pollution from various sources including recreational use, shoreline development, municipal and industrial waste, and offshore drilling. These factors, coupled with overfishing, are contributing to the devastating loss of both fresh and salt water aquatic life.

Today, many commercial fishers are reporting fewer and fewer fish in traditional fishing sites. Non-commercial or sports fisherman are also reporting similar concerns in some places. These concerns have lead countries to extend territorial fishing limits and the need to develop more stringent regulations for both freshwater and marine situations.

**MATERIALS:** Mesh netting materials and 12 oz. plastic drinking cuts. Mesh netting material can be made from onion bags, potato bags, fruit bags, or cloth. Each group should also have a four inch wide aquarium fish net, Netting materials should be cut to be about four inches by six inches in size. Have enough nets so that each group of four students has at least two nets made of different materials, with net mesh size varying from course to fine. Each group must also have an aquarium fish net. Each student team also requires a 12 oz. cup, which serves as the fishing fleet. A

variety of dried beans or grains will represent the fish harvested from the catching area. For example, lima beans, pinto beans, red beans, lentils, and rice could all be assigned names that represent fish to be caught. Each fishing group should be assigned a fishing area containing a minimum of 200 fish. Writing materials in the form of fishing journals will be used to record and report different catch sizes and types. A stop watch for timing fishing time.

Before starting this activity, hold a class briefing about the following fishing topics and procedures.

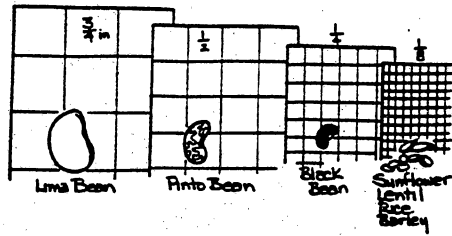
1. Discuss how different ways fish can be caught.
2. How does commercial fishing differ from recreational fishing?

Place the following questions on the board. Have students write answers in their note books or journals.

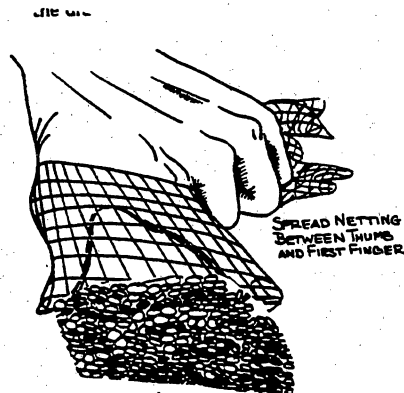
1. List as many ways you can think of to catch fish.
2. How have you observed people catching fish?
3. If you fish, how do you catch fish?
4. Could lots of fish be caught using only rods or poles? What would you do to catch large quantities of fish at one time?
5. Should limits to the way fish are caught be considered?

## NET AND FISHING GROUND ILLUSTRATION

### 1. Various recommended net sizes.



### 2. One handed net sweep in fishing grounds.



### 3. Two handed sweep in fishing grounds..



Class discussion is concluded when students have answered the questions and can summarize the impact on fish that different fishing techniques have.

PROCEDURE: Students conduct a simulation exploring the effects of technology on fishing. They will be fishing in either the ocean or a lake. The ocean or lake will be prepared by mixing all the beans and grains together. The mixture is equally placed into "fishing grounds" tables for each group. The beans and grains represents a fish species. A chart identifying each fish species should be posted in the classroom. For example, the species chart could list: lima beans as salmon; pinto beans as bass; red beans as trout; and rice as perch or sunfish. While the fish named above basically represent freshwater fish, beans and grains used could also be listed after varieties of fish found in the ocean. Now have the students divide into groups of four, and each group go to the fishing grounds where fish are located. The beans and grains should then be spread out on the table.

Start the activity by explaining that each group of four students represents a commercial fishing enterprise. Their goal is to determine the best way to catch the most in 30 seconds. They begin by selecting one person to pick up as many fish as possible in the time limit using only the thumb and forefinger (to simulate the hook). They are to put each "fish" into the boat. At the end of the time period for fishing, count the number of fish caught.

Next the group is to fish using only one hand and one net. They must hold the net so the distance between their thumb and first finger is the catching area. They are to make one pass, or scop, through the fishing grounds. See illustration. Once the pass has been made students should count the number of "fish" caught. Record the number of fish on the enclosed chart. Now have the students use both hands and the net to scoop up fish. They are to only make one pass through the "fishing grounds." Repeat the fish count. Now explain that their fishing techniques will be improved by incorporating the aquarium fish "net sweep." This actually represents the shift from hand powered boats and cast nets to trawlers and fleets of fishing boats. Have

the students note the species netted. Inquire how more fish could be caught in nets.

Now let students have a fine mesh net, less than 1/4 inch. The net size should be about four inches by six inches. Have all the fish "caught" so far returned to the sea or lake. Using the fine mesh net, have students sweep the fishing area. Now, instruct students to tabulate all the fish caught.

Have the students construct a bar graph in their fishing journal. The graph should show all fish caught and the different type of technique and net used.

Announce to the students that all the fish, beans through rice, are of the same species. No fish smaller than the red bean may be caught or kept. Any small fish caught will cost them a point. Have one or two students act as regulatory agency for monitoring fishing practices. This agency is to allow each fishing group ten seconds to get rid of all undersized fish after each netting. Have the two member regulatory agency go to each group and check for undersized fish.

Allow the commercial fishers again to use the fine mesh net and make a catch. They should empty the net onto the table and one by one return the undersized fish to the ocean or lake. At the end of ten seconds the regulatory representative will come by and count the undersized fish that are still left and assess a fine of one point for each one left.

Ask the students to provide a written discussion as to whether or not the undersized fish should be returned to the lake or ocean. If yes, why, and if no, why not? What are the other options?

Allow the students to fish using the larger mesh nets. Ask them if there is an advantage in letting the smaller fish get through the net instead of having to return them by hand. Explain how dolphins and sea turtles are often caught in nets. Discuss with students what happens to the netted sea turtles and dolphins because they are too large to

escape. Inform the students that the turtles and dolphins often die needlessly. Tell them efforts are being made to design, and to enforce, the use of nets and other fishing equipment that reduce the loss of dolphins and sea turtles under these conditions.

**EVALUATION:** Students compare and contrast "catching techniques" by writing a brief summary related to each fishing method used. The summary should include data gathered during the simulation to rank the effectiveness of each technique and how each new technological change may have affected fish populations. The discussion of each method should also include possible impacts on fish habitats as well. Identify some potential trade off related to changes in fishing technologies. Determine how to create or use fishing techniques that minimize any potential long term negative consequences on healthy fish populations and aquatic environments.

**ADDITIONAL ACTIVITIES** may include:

1. Have a fish biologist or representative from the California Fish and Game Department visit the classroom. Have the biologist discuss the role of aquaculture, freshwater, and mariculture and marine farming. Find out how this emerging field affects commercial fishing.
2. Have a representative from the fly fishers come in and demonstrate fresh water fishing techniques.
3. Students can experience Bass Sports fishing using the TROPHY BASS computer program available from: Sierra On-Line International Direct Sales, P.O. Box 53210 Bellevue, WA 90015-3210.

## ACTIVITY SIX

### RIPARIAN ZONE VISIT

**OBJECTIVE:** Students will identify different organisms that live in riparian ecosystems and evaluate potential positive and negative effects from changes in riparian habitats. They will increase their appreciation for the variety of life found along and in the banks of creeks, streams, ponds, rivers and lakes.

**BACKGROUND:** On the day(s) the young trout try are released, students will explore riparian areas to find a variety of aquatic life. These might include constructed streams, natural creeks or lakes. The students should understand trout biologists examine several release sites to monitor and predict what is occurring within the natural environment.

Explain to students that a riparian area consists of insect and animal life found on the edges of water courses like creeks, streams, or lakes. These zones range in width from narrow ribbons in desert and mountain settings to wide bands on the plains and lowlands.

Riparian areas provide space, shelter and food for associated plant and animal communities. For example, leaf litter and terrestrial insects falling from vegetation into a stream are a source of nourishment for some forms of aquatic life. Vegetation also provides shade from the sun for aquatic plants and animals or land dwelling creatures taking subsistence from the water's edge. Riparian areas are also transportation corridors or highways for animals that depend on water bodies for food and shelter. The riparian plant community, especially shrubs and trees, provides shelter and food for animals as large as deer. Trees and marshy areas provide shelter for nesting birds, and the banks provide homes for burrowing animals. Often the presence or absence of certain organisms reveals much about water quality. Water rich with a wide variety of aquatic creatures is usually healthy, whereas water with just a few different species usually indicates less healthy conditions.

Riparian zones also serve as a buffer between the land and the water. Rainfall occurring on the land most often flows downhill. Water is usually cleansed as it flows through the riparian zone. The banks of the riparian areas store water during periods of high flow such as rainstorms or snow melt, and release this water to the stream during low flow times. Where riparian vegetation is present, the stream banks are strengthened and bank erosion is prevented.

**MATERIALS:** nets, collection containers, paper cups, petri dishes, white collection trays.

**PROCEDURE:** After discussing riparian life and before arriving at the trout fry release site have students brainstorm what they expect to find hovering above, or swimming through the water. Have them write or sketch various forms of aquatic life.

In planning for the trip to the release site, be alert to the safety of the students. Advise students in advance to dress for the setting. They should wear old shoes, shorts or jeans. Alert students to ways to minimize potential damage to existing aquatic habitat. Encourage students to walk lightly along the stream bank to avoid damage to insect environments, and to remove foreign debris such as paper or trash which pollute the creek or stream. Make sure students take care in collecting specimen techniques, and return all wildlife collected to its habitat unharmed.

Once at the release site, select a spot to release the young fry where student impact will be minimal. Students should examine both the water surface and the depths. Ask them to be alert for differing micro-habitats near and under rocks and in eddies. Place animals captured in collection water-filled vials and in white trays for observation and drawings. Keep collected animals or insects under observation in shady areas.

Have students identify and draw animals observed in natural setting or in collection containers. Make sure they record in some manner the actual location where the animal was found. Once the observation is complete, have the specimens returned to their natural habitat by allowing them



to escape the container holding them. While still at the release site, have students discuss their observations. Introduce the concept of bio-diversity. The teacher-directed discussion should include comparing or contrasting different samples of insect or plant life found in and near the water.

**LESSON ASSESSMENT:** Students will either draw a picture or write a paragraph describing an insect or animal niche observed. They will also be asked to list two things that have a positive effect on the habitat they visited.

**EXTENSIONS:** Contact one of the below organizations and have a representative accompany the group during the riparian zone visit. Representatives of these organizations are happy to serve as riparian tour guides and can contribute a great deal to the learning experience.

Deep Creek Fly Fishers: Trout in the classroom  
c/o Otto Instruments  
1441 Valencia Place  
Ontario, CA 91761  
(909) 930 5800

Department of Fish and Game  
Region Five  
330 Golden Shore Suite 50  
Long Beach, CA 90802  
(310) 590 5870

Fly Fishers Club, Deep Creek  
Quail Valley Middle School  
Phelan, CA 92392  
(760) 949 4888 or (760) 868 2623

## ACTIVITY SEVEN

### CREATING AQUATIC HABITAT

**OBJECTIVE:** Students will identify the components of habitat essential for fish or other aquatic animals to survive.

**BACKGROUND:** Trout must have cold, non-polluted running water to survive and grow. Often snow melt from mountain peaks and rainfall feed their stream and lake habitats. Shade from trees and their roots provide hiding places for aquatic life, or soil stability around the stream. Often fallen leaves nurture breeding grounds for insects which in turn provide food for trouts.

In commercial aquaria, water is a uniquely sensitive part of the habitat and must meet specific requirements for different aquatic life forms. Slight changes in salinity, pH factors, amount of dissolved oxygen, and the presence of a wide range of pollutants often spell disaster for certain aquatic organisms. Therefore, to successfully house wildlife in aquaria, careful attention must be paid to the range of conditions each life form can tolerate. For example, some fish require moving water or currents while others prefer almost static conditions. Some prefer deep water and others seek shallow, rocky bottoms. These variations are remarkable when considering designing habitats for microorganisms in pond water compared to the mammoth habitats for sharks.

In the growing practice of agriculture (cultivation of fresh water organisms) or mariculture (cultivating oceanic organisms), the habitat design must assure the animals' comfort. Created conditions must be as similar to those found in the natural habitat as possible. Much research is devoted to creating artificial environments meeting the physical needs of aquatic wildlife to assure their survival under all conditions of captivity.

**MATERIALS:** Three by five inch cards with various aquatic wildlife names on them. These could include trout, salmon, tuna, shark, goldfish, carp, sturgeon, fresh water or sea bass and perch, Siamese fighting fish, frog, lobster,

crayfish, oyster water strider, diving beetle, and eel. Other names such as penguin, sea otter, beaver, killer whale, and alligator may be added. Art supplies of writing materials, paper mache, modeling clay, gallon jars, string, cardboard, small cardboard boxes.

PROCEDURE: Divide class into teams of four. Have each group select an aquatic wildlife card. Each group must design an artificial habitat in which their animal would successfully live. In order to accomplish this, each team must conduct computer internet or library research to obtain reference materials on the natural habitat requirements for their animal. It is suggested when the computer internet is used, the instructor control the number of addresses made available to the students. This can be accomplished by either "book marking" certain aquatic sites, or providing an approved research internet list. When the research is complete, each student team is to design and build an environmental model or aquarium containing habitat suitable for their animal's survival. A scale size of one inch equals five feet works well. For insect life, the model maybe life size.

LESSON ASSESSMENT: Students will be able to compare and contrast different aquatic environments. Student reports, written and oral, should include a description of the basic biological needs and habitat of their animals. These will summarize components such as food, shelter and space. Student models should show how their design meet the needs of their animals.

EXTENSIONS: Visit a fish hatchery managed by the California Department of Fish and Game. For additional information, write or call the California Department of Fish and Game Conservation Education Branch, 1416 Ninth Street, Room 1236-8, Sacramento, CA 95814; Phone (916) 445-3531.

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