Special Publication No. 99-2

A Guide to Classroom Salmon Egg Incubation in Alaska

by

Fritz Kraus

August 1999

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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A GUIDE TO CLASSROOM SALMON EGG INCUBATION IN ALASKA

by

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The Fishery Data Series was established in 1987 for the publication of technically-oriented results for a single project or group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

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INTRODUCTION

Classroom salmon egg incubation projects have become a popular and valuable educational tool in schools throughout Alaska. Alaskans have a long-standing dependence on their fisheries resources and recognize the need for good fisheries education. Raising salmon in the classroom setting teaches students about salmon development and fosters students' appreciation of the need to protect salmon and their habitat.

This manual is designed as a comprehensive "how to" guide for classroom salmon egg incubation. It is designed so that teachers can turn to the applicable sections to find answers to their questions. The incubation unit described here is not the only one available, and teachers may also develop their own innovative techniques to incubate salmon eggs. This manual will be periodically modified and updated to include the feedback received from teachers.

It is important to realize that school incubation projects should not focus on production, which is a hatchery theme. Use of classroom incubators to enhance existing salmon runs or to establish new runs is not encouraged. In some areas, the removal of even a few fish for brood stock may result in the loss of a major portion of the run. In most cases, release of school fry into anadromous systems away from the donor stock's stream of origin is not permitted, but with proper approval fry may be released into landlocked lakes.

Spring and fall outdoor field activities, combined with classroom salmon development studies during the winter, provide excellent long-term educational opportunities. For example, studies may include aquatic habitat types, macroinvertebrates, water quality analysis, and watershed mapping. Classes may discuss the dependence of the state's commercial, sport, and subsistence fisheries on the continuing health of this vital resource. These biological investigations may also provide the opportunity to incorporate other fields of study, such as chemistry, ecology, math, social studies, economics, and writing. Teachers have already discovered these projects to be educationally rewarding.

A common misconception in school projects is that "more is better." Teachers, in most cases, can accomplish their teaching goals with a few hundred eggs just as well as with 50,000 eggs. The same observable processes are visible; and with fewer eggs, their maintenance is greatly reduced. It is important to emphasize that any incubation project requires work and dedication if it is to succeed. Students should be involved in all aspects of the process appropriate for their age level, and daily and weekly routines should be consistently followed.

Any questions regarding program feasibility or egg availability should be directed to an ADF&G staff biologist prior to the commencement of a project. The program coordinator is Fritz Kraus, ADF&G, STREAM Program, 333 Raspberry Road, Anchorage 99518. Phone: (907) 267-2265.

PERMITTING PROCEDURES

The Alaska Department of Fish and Game (ADF&G) requires instructors wishing to participate in classroom incubation projects to have in their possession the proper permit to transport, incubate, hatch, rear, and release any salmonid eggs or fry. This permit may also allow the holder to perform experiments. The permit required for classroom projects (500 eggs or less, or one spawning pair of fish) is called a Fish Resource Permit (Propagation) for Classroom Incubation Projects. All projects and releases must be approved by the Commissioner of the

Department of Fish and Game. These measures are used to keep track of egg distribution and fry releases throughout the state to insure genetic biodiversity and fish health.

Permit regulations, restrictions, guidelines and effective project periods are listed on the permit when it is issued. Failure to carefully follow and comply with instructions and requests may result in the loss of any future projects. Reporting is required as a condition of any approved Fish Resource Permit. Reporting forms have been developed to help the department obtain basic information and understand potential problems with classroom projects. These report forms will be supplied and should be submitted at the proper times. One report is due at the end of the calendar year (December 31) and the second should be filled out and returned at the end of the school year.

Salmonid eggs may be obtained through an approved remote egg take or from an established hatchery brood stock. Any questions or inquiries regarding egg availability, permit requirements or completion may be made by contacting a local ADF&G biologist.

Examples of the Fish Resource Permit application for Classroom Incubation Projects and the two reporting forms may be found in Appendix A. These forms can be photocopied and used for requesting eggs and reporting.

EQUIPMENT

The recirculating system described here is designed for all phases of egg incubation through early fry emergence. It is not equipped with adequate mechanical filtration to sustain suitable water quality for free-swimming and feeding fish, however additional filtration may be added to this system. The capacity of the system is no greater than about 250 salmonid eggs. All of these components are available through local pet supply stores, with the exception of the refrigeration unit.

A refrigeration unit (chiller) that has been specifically designed for this system is available from:

Ron Coutts, Taylor Refrigeration
6662 Apollo Road
S-2, C-92, RR-6
Vernon, British Columbia VIT 6Y5 Canada

Phone (604) 545-4906

The cost of the chiller (in 1999) was approximately $750.00 U.S. plus tariff (2%) and shipping. The total cost for the entire incubation package will range between $900.00 and $1200.00, depending on equipment suppliers and completeness of package.

This design has been adapted, with a few modifications, from the highly successful "Salmonids in the Classroom" program in Canada (CDFO 1989a, 1989b). A similar design that uses continuously flowing cold water to cool the tank is described in CDFO (no date).

The following list describes the components and materials required to incubate salmonid eggs in the classroom.

- 29 gallon glass aquarium - serves as the incubator.
- Chiller (coil type) - provides precise and constant water temperature control, adjusted using a thermostat.
- Undergravel filter with undergravel plate, power head, and uplift tubes - circulates and aerates water in the incubator. Use Penguin model 550 or equivalent power head.
- Extension cords - to reach power supply. Use three prong grounded-type only.
- 30 pounds aquarium gravel - for biological filtration (ammonia removal) and some mechanical filtration.
- Rounded stream gravel (1 inch-3 inch range) - have students collect enough to create several gravel clusters on top of the aquarium gravel. If available, false substrate may also be used. This gravel or substrate is where alevins will hide after hatching.
- Styrofoam (1 inch thickness) - enough to cover all sides and top of incubator. The Styrofoam insulates and prevents light from entering the incubator. Attach this to the aquarium with tape, Velcro or glue. Instructors may wish to cover the Styrofoam pieces with contact paper to prevent flaking or breakage.
- Egg basket (optional) - allows easy viewing and removal of eggs at eyed stage. The mesh of the basket should be small enough to hold the eggs, but large enough to allow the alevins to easily exit upon hatching, about 5/8" x 1/4" mesh. Alternatively, eggs may simply be spread throughout tank.
- Egg picker - used to manually remove dead or experimental eggs.
- Four or five 5-gallon buckets with lids - used for water exchanges, shocking and picking of eggs, and for fry transport. The lids are required for fry transport.
- Siphon hose or small submersible pump - for water exchange and water removal. Tubing is required for the pump.
- Gravel Vac siphon - hose with a hollow plastic cylinder on the end for cleaning gravel during water exchanges after feeding commences. May also serve as siphon hose.
- Thermometer - to measure water temperature; preferably in degree Celsius (°C) units.
- Dip net - for egg and fry removal.
- Aquarium air pump - backup air supply in the event of powerhead failure; include airstone and tubing.
- Water quality kits - the most important parameters to measure include dissolved oxygen (O_2), pH, and ammonia (NH_3).
- External water filter (optional) - to increase and sustain rearing capacity.
- Water distiller - may be required in remote areas with turbid water to improve clarity and water quality. Used to make clean water for water exchanges.

- Battery-operated air pump with airstone and tubing - to supply oxygen during fry transport.
- Dechlorination chemical - removes chlorine from chlorinated water supply systems. Not necessary if using unchlorinated well water.
- Several plastic milk or 2 liter soda pop containers - used to contain frozen dechlorinated water for emergency cooling in the event of extended power failure.
- Accumulated Thermal Unit (ATU)/Maintenance/Observation Log - for record and data keeping.
- Curriculum - several salmonid curriculum are available. The "Salmonids in the Classroom" curriculum for the primary grades that was first developed for British Columbia and Yukon Territory schools (CDFO 1989a) has been released in an Alaskan edition (CDFO and STREAM 1995). For further information and obtaining Alaskan materials, contact the Alaska Department of Fish and Game STREAM coordinator at (907) 267-2265.

EQUIPMENT ASSEMBLY

Classroom incubators should be assembled and operating for at least 1 week prior to the arrival of eggs. This allows sufficient time for water temperature adjustment and stabilization.

The incubator should be located in an area away from direct sunlight or heat, on a table, lab top or stand. Plans for the construction of a stand may be found in Figure 1. Chillers may be placed beside or below the tank.

After finding a suitable location for the incubation equipment:

1. Lay the undergravel filter plate on the bottom of the aquarium and insert the uplift tubes in to the left and right ports of the filter plate. Plug any remaining unused uplift tube holes. The uplift tube must be cut to the proper height to properly accept the powerhead unit.
2. Fit the powerhead snugly into the right uplift tube and secure it to the tank. In many instances the powerhead may fit loosely into the uplift tube. Black electrical tape may be wrapped around the powerhead intake tube to insure a tight fit, or a piece of 1-inch (interior diameter) flexible Tygon tubing may be cut and slid over the uplift tube and then the powerhead intake tube fitted securely inside the tubing. If the powerhead has oxygen regulator valves, they should be opened to allow maximum input. If the powerhead is equipped with an oxygen intake air filter, such as the Penguin 550, the air filter material should be removed. Over time these become clogged, resulting in reduced oxygen intake. The secondary aeration (standard aquarium air pump) should be hooked up with tubing and airstone in the uplift tube located on the left side of the tank.
3. Spread the aquarium gravel evenly over the filter plate to a depth of at least 1 inch. Do not remove the uplift tube(s) or allow gravel to get under the filter plate because gravel under the plate may be drawn into the powerhead and damage the unit. At this point, the rounded stream gravel may be placed in several clusters on top of the aquarium gravel, or it may be added after the eggs reach the eyed stage.

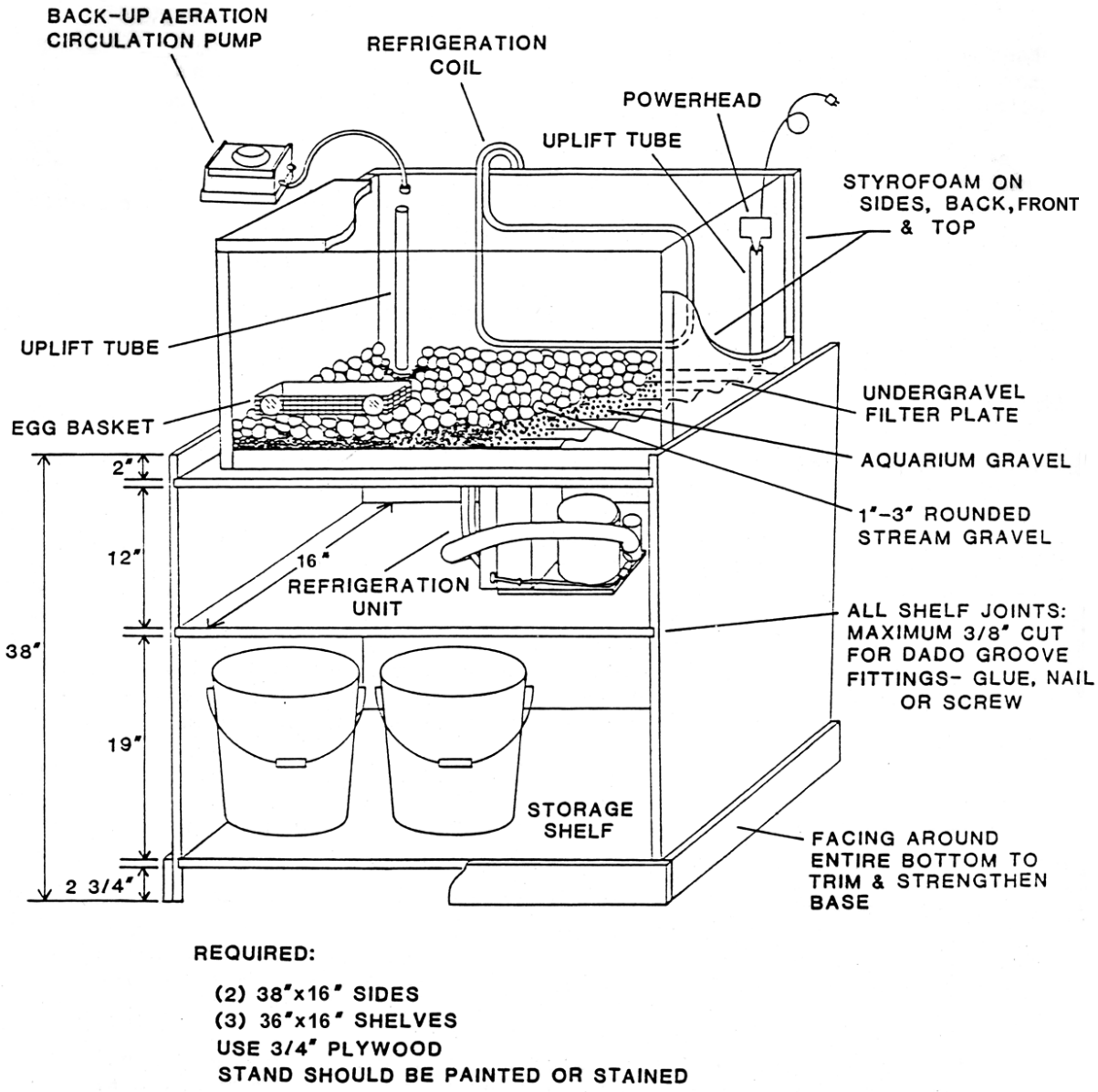

Figure 1.-Incubator components and stand dimensions.

4. Cut, fit and secure the Styrofoam insulation/light barrier to the tank.
    a. Cut the sides the same width and height of the tank.
    b. Add twice the thickness of the Styrofoam to the length for the front and back sections. The height of the front and back panels is the same as the sides. The front panel should be removable for viewing purposes.
    c. Twice the Styrofoam thickness is added to the length and width tank dimensions when cutting the lid. This gives an even fit when the lid is laid on top of the aquarium. The lid will have to be notched to fit properly around the chiller coil and powerhead mount and should also be removable for access and viewing.
    d. Tape, glue or Velcro the panels together and attach to the tank.

    All Styrofoam panels may be covered with contact paper to prevent chipping or flaking. A replaceable porthole may be cut in the vicinity of the egg basket to prevent excessive light from entering the tank when viewing. This feature may be especially helpful for viewing alevin.
5. Position the chiller so that the thermostat is easily accessible, then carefully and gently unwind the coil tubing and fit it over the back of the aquarium on the inside. Don't let the coil touch the back of the tank. Place the temperature probe in the tank near where the eggs will be and not too close to the chiller coil. Many types of chillers have temperature sensors which must remain dry. These are inserted into a dry-well tube that hangs in the back of the tank.
6. Fill the aquarium with cool, dechlorinated water and plug in the refrigeration unit, powerhead, and air pump. Adjust the powerhead so that bubbles are evident (aeration) and verify that the pump is circulating water. Set the thermostat on the chiller to the desired temperature. The chiller may run for 5 to 6 hours before temperatures stabilize, so there is no need to adjust the thermostat during that period. Once the unit has stopped running, make only fine adjustments to the thermostat. The water temperature is generally slightly different than the indicated thermostat temperature. Once eggs are received, NEVER make water temperature adjustments prior to leaving for the day. Water may easily freeze or warm to lethal limits. It is wise to monitor temperature changes closely.
7. If using an egg basket, have this ready before the eggs arrive.

All equipment is now ready and the incubation project may proceed.

CRITICAL ELEMENTS

The developmental processes observed in salmonid eggs are largely controlled by four critical elements, each of which must be considered prior to starting any incubation project. These critical elements are:

1. Temperature - Temperature is probably the most critical factor. Temperature determines the rate of development. All salmonids require cool water for survival. The temperature range for successful salmonid incubation is between 1°C and 12°C. Ranges for rearing salmonid fry should not exceed 15°C. Avoid fluctuations. Egg development is faster at warmer

temperatures and slower at colder temperatures. When making temperature adjustments, do not exceed a 2°C change in a 24 hour period.

2. Dissolved Oxygen (DO) - Fish require oxygen for survival just as humans do. The difference is that fish obtain their oxygen from the water through gills. As oxygen is absorbed, carbon dioxide (CO_2) is expelled. Water loses the capacity to hold oxygen as temperature increases and will hold more at lower temperatures. Dissolved oxygen levels in incubators should not fall below 10 mg/l (ppm).

3. Water Quality and Supply - Salmonids require cool, clean, uncontaminated water for optimal survival. Test kits are available commercially for testing water quality parameters in the classroom. The most useful classroom incubation test kits include tests for dissolved oxygen (DO), pH, and ammonia (NH_3). The water should not contain high concentrations of heavy metals. Schools with new copper plumbing may experience heavy metal problems due to pipe leaching. In areas experiencing poor, turbid, or inconsistent water quality, it may be possible to improve quality and clarity by using a distiller to prepare tank water. This water must be cooled prior to transferring to the tank during exchanges. Water quality is maintained in closed recirculating systems through once weekly water exchanges during incubation. These exchanges are increased after the fry emerge.

   Most school water sources are chlorinated. Salmonids can not survive with even small quantities of chlorine; therefore, those schools with chlorinated water must dechlorinate water before introduction into the incubator. Sodium thiosulfate (dechlorination chemical) is available at local pet supply stores. Schools having an unchlorinated well water source do not have to contend with this problem.

   Water quality parameters as they pertain to salmonid culture are located in Table 1.

4. Light - Salmonids are quite susceptible to damage and mortality from light throughout the egg and alevin stages. Incubation units should be set up away from direct sunlight and protected from fluorescent lighting.

EGG TRANSPORT

Salmonid eggs may be transported and incubated only with an approved Fish Resource Permit. Eggs may be transported as newly fertilized (green) eggs or at the eyed-egg stage from an established ADF&G hatchery egg source or obtained as green eggs through an approved remote egg take.

Instructors should not attempt to take or transport eggs until they have received instruction on proper technique from a qualified biologist or fish culturist. There are two basic methods used to transport salmonid eggs: water hardened, and dry fertilization.

WATER-HARDENED EGG TRANSPORT

This is the most widely used method in Alaska. Shortly after fertilization and rinsing, eggs are allowed to "harden" for at least 1 hour before they are moved. During this time the soft eggs are absorbing water and increasing slightly in size. The eggs become "hard" and may be chilled with ice to slow initial cell division during transport. It has been found that eggs are not as susceptible

Table 1.-Alaska Department of Fish and Game water quality standards for salmonid culture.

Parameter	Standards
Alkalinity	undetermined
Aluminum	<0.01 mg/liter
Ammonia (un-ionized)	<0.0125 mg/liter
Arsenic	<0.05 mg/liter
Barium	<5.0 mg/liter
Cadmium	<0.0005 mg/liter (<100 mg/l alkalinity)
	<0.005 mg/liter (≥100 mg/l alkalinity)
Carbon Dioxide	<1.0 mg/liter
Chloride	<4.0 mg/liter
Chlorine	<0.003 mg/liter
Chromium	<0.03 mg/liter
Copper	<0.006 mg/liter (<100 mg/l alkalinity)
	<0.03 mg/liter (≥100 mg/l alkalinity)
Dissolved Oxygen	>7.0 mg/liter
Flourine	<0.5 mg/liter
Hydrogen Sulfide	<0.003 mg/liter
Iron	<0.1 mg/liter
Lead	<0.02 mg/liter
Magnesium	<15 mg/liter
Manganese	<0.01 mg/liter
Mercury	<0.0002 mg/liter
Nickel	<0.01 mg/liter
Nitrate (NO_3)	<1.0 mg/liter
Nitrite (NO_2)	<0.1 mg/liter
Nitrogen (N_2)	<110% total gas pressure
	(<103% nitrogen gas)
Petroleum (oil)	<0.001 mg/liter
pH	6.5 - 8.0
Potassium	<5.0 mg/liter
Salinity	< 5.0 parts per thousand
Selenium	<0.01 mg/liter
Silver	<0.003 mg/liter (fresh water)
	<0.0003 mg/liter (salt water)
Zinc	<0.005 mg/liter
Sodium	<75.0 mg/liter
Sulfate (SO_4^{-2})	<50.0 mg/liter
Temperature	0° - 15° C
Total Dissolved Solids	<400 mg/liter
Total Settleable Solids	<80.0 mg/liter (25 JTU)

From: ADF&G 1983

to mechanical shock if transported before they reach the 4-cell stage. After that point the eggs enter a sensitive period where any movement can cause mortality.

Fertilized eggs received from a hatchery may be disinfected for 10 minutes in a 50-100 ppm iodophore solution (use an approved buffered fish egg iodophore, e.g., Betadine). Disinfection is more important when working with large lots of eggs. Surface disinfection of eggs is used as a tool to prevent the growth of fungus and is not necessarily essential for small numbers of classroom eggs.

A brief summary of the transport technique used for water-hardened green eggs is as follows:

Water-hardened eggs are placed in double-lined plastic bags or sealed containers with water. Ziploc bags may also be used. The sealed bags containing the eggs are then placed in a cooler and are surrounded with water. Bags other than the Ziploc type will require rubber bands to seal. A small amount of dechlorinated ice may be floated inside the bags as well as outside. Care must be taken not to contact the eggs in, or through the bag with the ice. Close and secure the cooler lid. The eggs must be handled gently and with extreme care during all phases of transport.

After they arrive at the incubation site, the eggs may have to be acclimated to the incubation water temperature if there is a large difference. Gently place the bags or plastic containers into the incubator to acclimate the eggs. When temperatures are within 2°C the eggs may be poured over the stream gravel or into a basket. With the egg container partially submerged, the eggs should roll out and fall to the desired location.

UNFERTILIZED EGG TRANSPORT

This technique is used widely in Canada and the U.S. Pacific Northwest. It involves the transport of separate sex products (egg and sperm). Fresh unfertilized eggs are placed in a sealable dry plastic container. Sperm or "milt" is expressed into small dry sealable plastic bags (Whirl-pak bags work well). The sperm and eggs must then remain cool and must not contact water directly. Both may be transported in a cooler with ice. Do not let the ice contact the eggs or sperm. The eggs are extremely fragile, so handle them gently. Gametes, especially sperm, should not be exposed to direct sunlight. This may result in decreased viability and fertilization rate.

Fertilization occurs when a small amount of dechlorinated water is added to the mixed eggs and sperm. Water activates the sperm and fertilization is complete within approximately 15-20 seconds. The fertilized eggs are then rinsed with cool dechlorinated water to remove excess sperm, then seeded into the incubator where they water-harden and commence development. Handling after fertilization and potential damage from mechanical shock is greatly reduced when the mixing and sperm activation of the gametes is performed at the incubation location.

DAILY ROUTINE

After eggs are received and seeded into the incubator it will be imperative to follow a few simple procedures to insure that everything proceeds smoothly.

1. Potential problems may be alleviated with early detection. Do a "walk around" inspection of the incubator and associated equipment at least twice daily. Good times to do this are first thing in the morning and just prior to leaving for the day. This simple procedure may prevent

unnecessary mortality of eggs, alevin, or fry. See the "Emergency Procedures" section for information regarding problems.

2. Water temperature should be recorded in a logbook at least once daily, or may be taken twice and averaged. Temperature determines the rate of development of eggs and allows estimation of critical embryonic stages up to fry emergence. It is also a useful tool for planning release dates. Temperature is a good indicator of possible mechanical and biological problems.
3. Record keeping is a vital component of any incubation project and should be taken seriously. It is important to record EVERYTHING that is done or observed. Logs should include such information as species, egg numbers, dates, temperatures, problems, maintenance, water quality, survival/mortality, and all observations (examples: when eggs eye up, hatch, emerge). Records are an excellent source of information for troubleshooting potential problems and for class discussions.

ACCUMULATED THERMAL UNITS

It is possible to monitor development and forecast important egg stages using "thermal units." A thermal unit (TU) is defined as one degree Celsius for a 24-hour period. For example, if salmonid eggs are exposed to a 5°C water temperature for 24 hours they have gained 5 thermal units; one unit for each degree Celsius. Accumulated thermal units (ATUs) are simply the cumulative total of all daily thermal units. Accumulated thermal units are also sometimes referred to as "cumulative temperature units" or "degree days." It is important to record temperatures daily to calculate ATUs. Simply estimate weekend temperatures using averages of Friday and Monday information. See the example below:

Month: October Species: COHO salmon

	Day	Date	Daily Temperature	Accumulated Thermal Units
	Sunday	1		
Received eggs	Monday	2	3.0	3.0
	Tuesday	3	2.5	5.5
	Wednesday	4	3.0	8.5
	Thursday	5	3.5	12.0
	Friday	6	3.0	15.0
	Saturday	7	3.5 [a]	18.5
	Sunday	8	3.5 [a]	22.0
	Monday	9	4.0	26.0

[a] Average of Friday and Monday temperatures

A Fahrenheit/Celsius conversion table is supplied in Table 2. A blank example of an ATU log may be found in Appendix B.

Table 2.- Fahrenheit/Celsius temperature conversion table.

°F	°C
32	0.0
33	0.6
34	1.1
35	1.7
36	2.2
37	2.8
38	3.3
39	3.9
40	4.4
41	5.0
42	5.6
43	6.1
44	6.7
45	7.2
46	7.8
47	8.3
48	8.9
49	9.4
50	10.0
51	10.6
52	11.1
53	11.7
54	12.2

Temperature conversion formulas

$°C = 5/9 (F - 32)$

$°F = (9/5 C) + 32$

For those younger students who are just learning to read thermometers, it may be appropriate to supply pictures of thermometers (one per day) with degree units and have them color in the correct temperature.

NOTE: There is an alternate method to calculate ATUs with the Fahrenheit temperature scale. This technique is used extensively in the Pacific Northwestern United States and defines a thermal unit as each Fahrenheit degree above 32 degrees Fahrenheit for a 24-hour period. For instance, from the former example, 5°C is equivalent to 41°F, so the Fahrenheit thermal units for a 24-hour period would be 41-32 = 9 units. Instructors may wish to incorporate this method along with the Celsius technique to encourage development of additional mathematical skills.

The actual number of ATUs that are required to reach any particular stage of development are "stock specific" (each brood stock is different) but generally fall within the ranges listed in Table 3. Eggs incubated at temperatures below 4°C will require fewer ATUs to reach the above stages. At lower temperatures, eggs experience more development per TU. This is a time-compensation mechanism within the egg. If you were to calculate the days needed for a coho salmon to emerge (700 ATUs) when incubated at 2°C, your calculations would predict that it will take 350, days or almost 1 year; when in fact it takes only approximately 7 months.

It is essential to have an accurate thermometer through the course of the incubation project. If the readings on a thermometer are questionable, it may be calibrated. Simply place the thermometer in a cup containing a slush of water and crushed ice and check the reading. If the thermometer reads 0°C it is properly calibrated. If it does not read 0°C, then a correction factor should be marked on the thermometer to compensate for the difference and to enable the user to calculate the correct temperature.

WEEKLY ROUTINE

It is necessary to exchange some portion of incubator water when using a recirculating system for classroom projects. Water exchanges are done each week to reduce toxic levels of ammonia and other potentially dangerous compounds. The unit described in this guide requires that 50% of the incubator water is replaced with fresh water each week. An effort should be made to not disturb eggs during the water exchange process. If the eggs have been placed in a basket, simply work on the opposite side. It is a good idea to get into the habit of doing water exchanges immediately after receiving eggs, but some instructors have increased egg survivals by not doing water exchanges until the eyed-egg stage or even until the alevin hatch. During the green-egg stage there is a greater risk of egg mortality due to disturbance. Green and eyed eggs also produce less metabolic waste, therefore the water remains relatively free of ammonia.

To perform a 50% water exchange:

1. Unplug all electrical devices. This is a safety measure; powerheads will burn up if allowed to go dry. Remove Styrofoam top and front if necessary.
2. Pump or siphon 50% (a line may be marked on the tank) of the incubator water into 5-gallon buckets or into a sink with a drain so the water can be discarded.

Table 3.-Accumulated temperature units (ATUs) required to reach important embryonic developmental stages in commonly cultured salmonids in Alaska.

	ATUs in °C	ATUs in °F
CHINOOK SALMON		
To eyed stage	280	504
To hatch	480-540	864-972
To emergence	900-1000	1620-1800
CHUM SALMON		
To eyed stage	300-350	540-630
To hatch	475-525	855-945
To emergence	900-1000	1620-1800
COHO SALMON		
To eyed stage	220	396
To hatch	400-500	720-900
To emergence	700-800	1260-1440
PINK SALMON		
To eyed stage	350-400	630-720
To hatch	550-650	990-1170
To emergence	900-950	1620-1710
SOCKEYE SALMON		
To eyed stage	230	414
To hatch	500-550	900-990
To emergence	900-1000	1620-1800
ARCTIC CHAR		
To eyed stage	200	360
To hatch	475	855
To emergence	700	1260
RAINBOW TROUT[a]		
To eyed stage	210-240	378-432
To hatch	300-320	540-576
To emergence	500-580	900-1044
STEELHEAD[a]		
To eyed stage	250-270	450-486
To hatch	360	648
To emergence	600	1080

[a] These species are spring spawners. Eggs can not be collected until early spring, so would require accelerated egg development (maximum allowable temperatures) to allow a late spring release. It may not be possible to release these fish while school is still in session. These fish may require rearing, feeding and release after school is out for the summer.

3. Refill the 5-gallon buckets with the appropriate amount of water from a tap that has been allowed to run for several minutes. Running the water for several minutes allows any high concentrations of pipe leachate (copper, lead) to be removed from potential exchange water. Cool the water if necessary to within 2°C of the tank temperature. The new water should be close to the same temperature as the water in the incubator to reduce the chance of temperature shock to the eggs. Water may be cooled using frozen ice containers or by placing buckets full of clean water in cool locations or outside during winter months before performing the water exchange.
4. Add dechlorinator (sodium thiosulfate) to the buckets as directed if water supply is chlorinated. Stir well and allow to stand for a few minutes. If no dechlorination chemical is available, the 5-gallon buckets of water can be stored for at least 24 hours prior to performing the water exchange so that the chlorine can dissipate naturally. The use of dechlorination chemical is recommended rather than letting the water sit. Even if the water sits for 24 hours there is always a risk of adding some chlorine to the tank. The chemical will instantly remove chlorine. Remember, the stored water should be cooled prior to the actual water exchange to reduce the chances of temperature shock.
5. Pump, siphon or pour the fresh, cool, dechlorinated water back into the tank, being careful not to disturb the eggs or gravel. Movement of the gravel may create uneven flow characteristics resulting in the loss of some biological filtration capability. Pockets of disturbed gravel will increase flow through the filter plate and attract large numbers of alevin which could cause mortality due to suffocation. Water may be deflected off the side of the tank or by using a lid from a 5-gallon bucket or by building up a stream gravel cluster in the front corner of the tank opposite from the eggs. Make certain that the chiller coil is covered completely by water for more efficient operation.
6. PLUG IN ALL LIFE SUPPORT SYSTEMS. Replace Styrofoam top and front.
7. Clean up and record the water exchange in your logbook.

This is the most time consuming aspect of the incubation project. Instructors may wish to train groups of students to do this task. Increased survival of eggs and fry will result if regular water exchanges are carried out.

There may be some water loss due to evaporation between water exchanges, especially if water exchanges are not performed until the eyed-egg or alevin stage. Add dechlorinated make-up water as required to keep the tank full. Remember, the added water should be close to the same temperature as the water in the tank. If the incubator is covered, evaporation is greatly reduced.

Immediately after the eggs hatch, a few extra 50% water exchanges may be required. Some foaming may result during a rapid hatch as albumen and other egg products are released and circulated throughout the tank. Excess foam on the surface can be skimmed off between exchanges. Water will eventually clear and foam will disappear as water quality returns to normal following additional exchanges. An increase in weekly water exchanges (2-3 per week) may be required after feeding commences.

Water quality analysis should be performed once a week if test kits are available. Include all water quality test information with the incubation records.

EQUIPMENT MAINTENANCE

Maintenance is minimal when using the equipment described in this manual. The life support systems (chiller and powerhead) should be checked occasionally and cleaned when necessary.

The chiller has what appears to be a radiator on it. This is actually a condenser, which converts liquid refrigerant back to its gaseous form through removal of latent heat. Dust should be blown out of the fins when a buildup is noticed. Cooling efficiency is reduced when the fins are coated with dust because of decreased air contact.

The powerhead may be removed and taken apart occasionally and inspected for algal or slime growth. Simply unplug and remove the unit during a water exchange and rinse it off with tap water. If a mild detergent is required to clean the powerhead, be certain to rinse it thoroughly before returning it to the tank.

EMERGENCY PROCEDURES

The equipment described in this manual is generally trouble and maintenance free, however, it is always possible to experience mechanical difficulty. It is best to be prepared for some type of failure. The following information will help instructors troubleshoot problems with the chiller and powerhead.

CHILLER FAILURE

The most obvious sign of a chiller problem will be elevated incubator temperatures. Chillers generally deliver a constant temperature with little fluctuation. If water temperature is steadily increasing, be sure to check:

1. Is the unit plugged in? Did someone simply forget to plug unit back in after a water exchange?
2. If plugged in, is there a tripped breaker somewhere? Plug another electrical appliance into the outlet and see if it works.
3. If (1) and (2) check out, reduce the temperature setting on the thermostat. If this fails to trigger the chiller, something is defective. Have the emergency frozen water containers ready to submerge in the tank while a contingency plan can be formulated.
4. If the chiller runs constantly without interruption, feel the coil. If it is not cool, the freon has probably leaked out. Have the emergency cooling containers ready. If the coil is cool something may be wrong with the thermostat or sensor. Unplug the unit if the tank water is freezing. Some freezing around the coil may occur at low temperature settings. This is normal, and may remain for the duration of the incubation project.

POWERHEAD FAILURE

A problem may exist with the powerhead if there is no apparent water movement (pumping and circulation) and/or no bubbles (aeration). First check (1) and (2) above. If these check out and the unit is doing nothing, it is most likely defective. If the pump is circulating but not aerating, check for an air line blockage in the venturi tube (if applicable). Remove the tube and blow into it. If it is blocked, blowing into the tube will clear it out. If the pump is not circulating, is it underwater? Is it air locked in some fashion? Sometimes it is necessary to take the powerhead apart and clean the magnet and impeller assembly inside the unit. The easiest solution in the

event of a powerhead failure is to have a backup powerhead or a standard air pump and airstone available.

HOLIDAYS

Most schools have extended holidays during December and spring break. These periods need not be a major concern as far as incubation projects are concerned. Equipment described in this manual is generally trouble and maintenance free and should continue to function properly without attention. It is a well known fact, however, that any mechanical device is susceptible to failure; so it is a good idea to check incubators during vacation. If the instructor is not available, another responsible person with access to the school should be asked to keep an eye on operations, daily if possible.

Emergency phone numbers should be written down and available in the event a problem is detected.

Power outages always seem to occur during holidays. Frozen water containers should be available to keep temperatures below lethal limits until electricity is restored, especially in the case of an extended outage. All electrical equipment is self starting once the power returns.

Water quality will not be a problem if a water exchange is done prior to leaving and immediately upon return.

EGG STAGES

REQUIREMENTS:

- Cool, clean, clear, uncontaminated, dechlorinated water.
- Water temperatures not exceeding 12°C. Avoid fluctuations.
- Dissolved oxygen levels of at least 10 mg/l (ppm).
- Sufficient water circulation to provide steady flow of oxygen-rich water through and around eggs.
- No physical shock or disturbance during the green-egg stage.
- Little or no exposure to direct sunlight or fluorescent light.

GREEN EGGS

Newly fertilized eggs are also referred to as green eggs. This name applies until eyes become visible in the egg. Green eggs are extremely sensitive to any physical shock or movement. If the eggs are disturbed, it is very likely they will die. Dead or unfertilized eggs will turn white, but should not be removed from the incubator if they are close to healthy eggs. More damage may result to healthy eggs if they are disturbed prior to the end of the sensitive period.

It may be frustrating for students to not see any visible signs of development in their eggs. Instructors should reassure them that development is occurring and that it simply takes time. At this point it may be worth discussing the incubation time required in local streams to help students develop an appreciation for what wild eggs are experiencing. Some eggs may be sacrificed for observation under a dissection microscope, to demonstrate that development is occurring.

EYED EGGS

When the small, black pigmented eyes of the fish become evident in the egg, they are termed "eyed" eggs. Eggs reaching this stage have overcome the sensitive period. Although less prone to damage from movement and handling, they are still delicate and should be handled with extreme care. When a "strong eye" develops, the dead eggs may be removed. A strong eye is simply a well-defined, deep black eye.

REMOVING DEAD EGGS

Dead, unfertilized, or fungus-coated eggs are removed in large production hatcheries at the eyed stage. The process by which these eggs are removed is referred to as "shocking and picking" the eggs. The dead eggs turn white and, if not removed, are a source of fungal growth. Fungus can be a destructive factor in small lots of school eggs. Healthy eggs can be attacked by the spreading fungus and killed. Eggs incubated in recirculating systems (such as a classroom incubator) should not be chemically treated for fungus (formalin or malachite green would be the usual chemical of choice). These treatments would result in the destruction of ammonia eating bacteria that are found on the aquarium gravel, consequently destroying the biological filtration component of the system.

It is possible to shock and pick eggs in the classroom setting and, although not required, it provides students with some hands-on experience and a chance to actually touch a salmonid egg.

The procedure for shocking and picking eggs is as follows:

1. Remove all the eggs by siphon, dip net or pouring from the egg basket into a 5-gallon bucket that is approximately half-full of water that is the same temperature as the incubator water. The water may be taken from the incubator so that the eggs will not experience a temperature change.
2. Gently pour the eggs into another 5-gallon bucket. This bucket need not contain as much water. Repeat by pouring eggs back into the original bucket. Pour eggs from a height between 1 and 2 feet.
3. Return the eggs to the incubator for at least 24 hours. Any dead or unfertilized eggs which are not already white will turn white during this period.
4. Remove the eggs from the incubator as previously described in (1) above and remove the white eggs. It is possible to fabricate egg pickers or use a suction bulb device with a tube large enough for eggs to fit. Plans for egg pickers may be found in Figure 2.
5. Count the dead eggs and discard. Count the live eggs and return them to the incubator. NOTE: If gravel or false substrate has not yet been added, do so before replacing the eggs. The alevin will require this after they hatch.

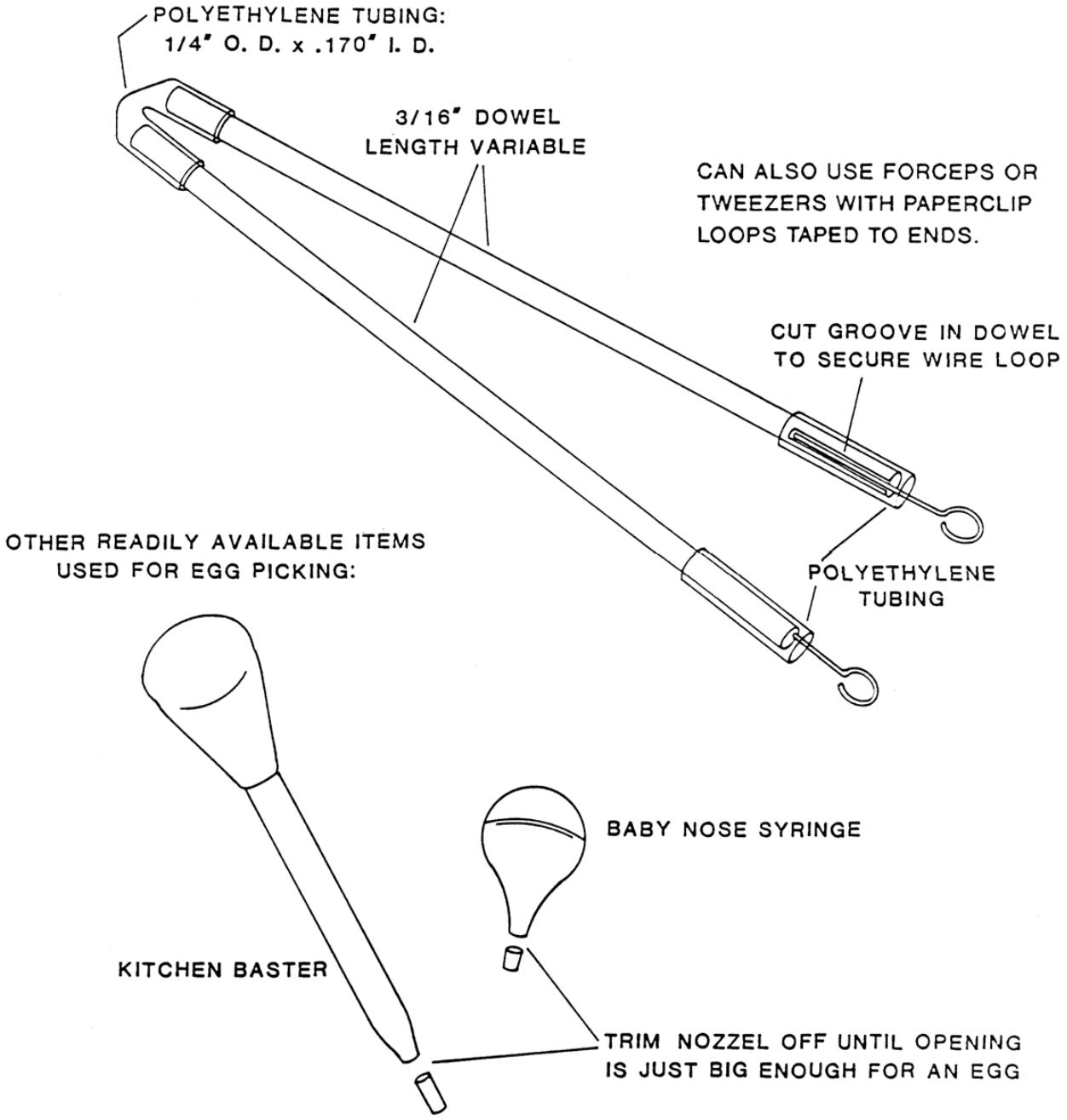

Figure 2.-Egg pickers.

6. Calculate percent survival to eyed stage with the following formula:

   Actual % Survival = Number of Live Eggs / (Number of Live eggs + dead eggs)

   Remember to include the number of other eggs that may have been removed previously. Survival rates may also be calculated for eyed to hatch (alevin) stages, and hatch to emergence (fry), as well as green to hatch and green to emergence.

ALEVIN STAGE

REQUIREMENTS:

- Cool, clean, clear, uncontaminated, dechlorinated water.
- Water temperatures not exceeding 12°C. Avoid fluctuations.
- Dissolved oxygen levels of at least 10 mg/l (ppm).
- Sufficient water circulation to provide a steady flow of oxygen-rich water to alevin.
- Suitable substrate for cover and support.
- No handling.
- Little or no exposure to direct sunlight or fluorescent light.

In many instances this is the most exciting and intriguing phase of early salmonid development that students witness. The egg, which has laid motionless in the basket or gravel for months, finally comes to life and hatches as a new salmonid is born. This newly hatched fish is called a "yolk-sac fry" or, more appropriately, "alevin." Unfortunately, the excitement is sometimes short lived as alevins are negatively phototactic. They are genetically programmed to burrow into the gravel to escape light and predators. It is in the substrate where the alevin grow as they consume their yolk sac. Alevins are extremely delicate and should not be disturbed or removed from the tank as there is a high risk of rupturing the yolk sac. If alevin become difficult to observe, it is possible to gently lift gravel or substrate off the bottom to find pockets of these elusive fish, but be careful when replacing the moved material! Placing clusters of gravel throughout the tank instead of a solid layer of gravel will increase alevin visibility. If these awkward swimmers are seen swimming in the water column, remove the lid slightly to allow light to enter. This will stimulate the alevin to move back into their appropriate habitat. The more energy that is used from the stored yolk for swimming means that there is less available for growth. Swimming alevin may indicate problems with water quality, temperature, or fish health.

FRY STAGE

REQUIREMENTS

- Cool, clean, clear, uncontaminated, dechlorinated water.
- Suitable food (Biodiet Starter or equivalent).
- Water temperatures not exceeding 12°C. Avoid temperature fluctuations.
- Dissolved oxygen levels of at least 10 mg/l (ppm).

- Increased water exchanges to reduce ammonia levels.
- Light

FEEDING FRY

Eventually the yolk sac food supply is absorbed and the alevin "button-up" and are required to leave the protection of their gravel nest in pursuit of food. At this point, these free swimming "emergent fry" will require food since they no longer carry their meals with them in a yolk sac. Salmonid starter food ("Biodiet Starter" or equivalent) is available through the nearest Department of Fish and Game hatchery, or a substitute fish food may be purchased from a local pet supply store. If food must be purchased, it should be reduced to a powder before it is introduced to fry. All commercial salmonid feeds, with the exception of "dry" diets, should be kept frozen and sealed in air-tight bags (Ziploc bags work well) or containers until ready to use. "Moist" and "semi-moist" diets lose their nutritional value and vitamin content if left exposed to air and unfrozen for long periods of time. Take enough food out of the freezer to last a few days and keep the remainder of the food frozen.

Don't start feeding until most of the fry have emerged and have been searching for food for a few days. When you are ready to start feeding, remove the front Styrofoam cover and put it away. At this point the fry will require light to feed. They are visual feeders and therefore need light to see their food. Allowing light to enter the tank also allows the fry to adjust to normal daylight hours (photoperiod). Introduce food in small amounts or enough to create a film on the surface of the water. When first feeding, it may be desirable to unplug the circulating pump for a short period (15-20 min.) so that the fry will have time to investigate and pick at the floating food before it is stirred up and sinks to the bottom. A sign should be placed on the front of the tank to remind you that the pump is unplugged. DON'T FORGET TO PLUG THE PUMP BACK IN.

You should try to feed fry every hour or so until they have gained some weight or are feeding aggressively. At that point, feeding periods may be reduced to three times per day. Teachers should not worry about feeding schedules to the point that they are feeding on weekends and using their much-valued free time. As a matter of fact, it may be beneficial for school fish not to eat all the time; their wild counterparts don't! Automatic timer feeders can be designed by innovative students to reduce the number of feeding visits to the incubator. It is best to allow fry to remain a bit hungry so they will strike at food readily when fed. Any excess food that is allowed to fall to the bottom will result in quicker deterioration of water quality and an increase in the need for water exchanges. Introduction of food into the incubator is perhaps the most critical stage in the incubation project, especially if fry are to be held for any length of time. Overfeeding may cause increased mortality and disease. Water quality parameters should be monitored closely at this point. If test kits are not available and water quality seems questionable or the water appears cloudy, do a water exchange. When most of the fry have emerged it is advisable to remove the large stream gravel or false substrate (if used) to allow removal of excess food with a gravel-vac during water exchanges. Fry may also dart into the substrate if they are frightened, making viewing difficult. When the substrate is removed, the fish are forced to swim in the water column. Some substrate may be left in a corner if all the fry have not yet buttoned-up.

Growth of the fry is determined by water temperature and the amount of food. Water temperature may be increased slowly (no greater than 2°C per 24 hour period) after emergence to increase the

growth, activity and feeding response of the fish. Remember, however, that by increasing the water temperature, the capacity of the water to hold oxygen is reduced, and the metabolism of the fish is increased; this means that the fry will require more oxygen and produce more ammonia. Proceed with caution, and monitor dissolved oxygen and ammonia levels often. Do not exceed 12°C.

In some instances, students may want to monitor fish growth during a classroom project.

The procedure for sampling fry to estimate fish size is as follows:

1. Collect a random sample of fry with a dip net; allow water to drain from the net.
2. Place the fry in a container with water that has been tared on a scale. Record the sample weight.
3. Count the fish as they are returned to the incubator. Record the sample number.
4. Sample weight divided by number of fish in sample = estimated individual fry weight.

RELEASING FRY

Fry may be released only at approved release sites and with an approved permit. Be sure to notify ADF&G personnel before the release is scheduled.

It is best to release fry during a period of optimal natural food production at your release location. In Alaska, this occurs shortly after "ice out" in lakes, rivers and streams. Natural productivity increases as the sun warms water and provides energy to power photosynthesis. Increased plankton and zooplankton as well as increased insect production will insure that fry have a suitable natural food supply when they are introduced into their new fresh water habitat. Releases should be planned from late April through early June, depending on location.

Feeding of fry should be discontinued at least 24 hours before they are transported. This reduces the amount of ammonia the fry will release into the transport container, thus minimizing the stress the fish undergo during this period. Handle fry gently during all phases of transport. Fry may be removed from the classroom incubator by dip net and placed into a transport container (5-gallon buckets with lids work well) with the transport water temperature approximating that of the release site (within 2°C). Water should be aerated during transport. Battery operated air pumps are available for this purpose. Simply drill a hole through the bucket lid large enough to accommodate the air hose. Water temperature may be controlled with ice, if necessary. If the ice originated from a chlorinated source, it must be in a sealed container before being placed into the transport container.

Upon arriving at the approved release location, check the water temperature and place the transport bucket(s) that contain the fry into the receiving waters to acclimate the fish if there is a large temperature difference. Following a 15-30 minute soak period, gently tip the container on its side and allow water to slowly fill the bucket. Continue laying the bucket over until it is partially submerged, allowing the fish to exit easily. Count the fish as they swim out.

Elementary students may wish to release their fish individually to allow them to say "good-bye" or even name their fish. These fish can be dipped out with a dip net and placed in a Styrofoam cup or other suitable container.

Be certain to clean up the area before departing.

Overall survival rates may now be calculated.

DESTROYING FRY

Instructors may elect or be directed by permit to destroy resultant fry from classroom projects. In either case, it is possible to turn this task into a valuable learning experience for students. The process may be made easier by removing eggs over the course of development for study. Examples include looking at eggs under dissection microscopes to check embryonic development, or preserving them as a permanent record of developmental stages. Discussions and experiments using eggs or fry may also include lethal variations in any of the four critical elements presented earlier. A discussion concerning pathology, genetics, and fishery management problems may also be appropriate.

Fish may also be destroyed by adding chlorine to their water supply. Remember that fish must be removed from the main incubator and placed into other units if the addition of chemicals is planned. Toxic chemicals should not be placed in the main incubator.

EQUIPMENT STORAGE

When the incubation process is complete, all equipment should be cleaned and stored properly. The aquarium, powerhead, uplift tubes and filter plates may be cleaned with a mild detergent. Rinse thoroughly when done. The stream gravel (or false substrate) should be rinsed vigorously with clean water only and then allowed to air dry to prevent the growth of mold. Spread gravels in thin layers to quicken the drying process. It is best to perform cleaning duties while the incubator is still wet, don't let it dry out while it is still dirty. All incubator components may be disinfected in an iodophore solution (such as "Betadine") if available (50 ppm for 10 min); however, air drying should be sufficient, especially since the equipment will not be used again for several months. Once thoroughly dry, the incubator may be reassembled for the next season. Remove dust from the chiller fins. Discard any remaining fish food because it will have no nutritional value in a year's time.

The entire system must be thoroughly cleaned prior to storage if any chemicals were added to the system for experimental purposes. Residual toxic chemicals may remain and affect survival of future classroom eggs, alevin or fry. It is best not to add any chemicals to the main incubation tank.

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CDFO (Canada Department of Fisheries and Oceans). 1989a. Salmonids in the classroom, primary curriculum resource materials for the study of Pacific salmonids in British Columbia. Prepared by the Salmonid Enhancement Program (federal Department of Fisheries and Oceans and the provincial Ministry of Environment). Distributed by BC Teacher's Federation, Lesson Aids Service, #100-550 W 6th Avenue, Vancouver, BC, V5Z 4P2.

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APPENDIX A

FISH RESOURCE PERMIT (FRP) FOR CLASSROOM INCUBATION PROJECTS

September 1 — Schools should have a Fish Resource Permit for their classroom incubation project. (If the school does not have a permit, and they plan to obtain eggs prior to the end of the calendar year, they should apply immediately. The application review process is 30 days.) The classroom instructor who has daily supervision is the applicant. The school is considered the primary employer, not the school district.

Oct-Nov — If the school has a permit, it may obtain eggs and begin the classroom incubation project. (A copy of the permit must accompany the fish or egg transport.) The classroom is expected to:

1. Measure and record daily water temperatures
2. Keep a cumulative log of temperature unit development.
3. Note on temperature unit log when the eggs are eyed, when hatching begins and ends, and when fry begin to "swim up" in the tank.

December 31 — **All permits expire December 31.** An application for next calendar year is due, *with a copy of the study plan* for the calendar year, and a collection report (Report # 1). Negative reports and "no collections" reports – <u>are required</u>. The application and study plan may be filed anytime during this month.

The study plan is a written operational plan that identifies the purpose and need for the project, the research objectives, procedures, and an explanation of benefits that may accrue from the requested activities. It is a requirement of the "Uniform Application Procedures."

January 31 — If not already filed, the report is absolutely due. Failure to file a report, even a negative or "no collection," can result in denial of a permit for the school in future years. The commissioner will not re-issue a permit to the teacher or school until reporting requirements are met. Incubation cannot continue into the new calendar year without a new permit. You may be requested to destroy the fry immediately if you continue incubation without proof of filing an application or a permit.

May-June — Note the date the fry are released or sacrificed on the cumulative log. Send a copy of the log with the final report (Report #2).

The permit does not expire until December 31. The teacher will be able to use this permit to begin the project the following school year.

<u>AMENDMENTS</u>: If you decide you need to change the egg source, write a short letter/memo/note/e-mail explaining why you need to make the change and name the new source. Send it to the address below. You may not use the new source until you receive the permit.

<u>OTHER COLLECTIONS</u>: A permit is required for the collection of fish, shellfish, or aquatic plants. The permit is required if the specimens will be killed at the collection site, or caught and released unharmed at the collection site.

<u>PROBLEMS? CONTACT</u>:

Jeri Museth
Natural Resource Technician
ADF&G/CFMD
P.O. Box 25526
Juneau, AK 99802
907-465-6149 (office)
907-465-4168 (fax)
jeri_museth@fishgame.state.ak.us (e-mail)

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME

CLASSROOM INCUBATION PROJECT

PROPAGATION APPLICATION
for

FISH RESOURCE PERMIT for scientific or educational purposes to take, transport, possess, hold alive, FISH AND THEIR EGGS (except gold fish and decorative tropical fish) for a CLASSROOM INCUBATION PROJECT. The amount that can be held is less than or equal to 500 eggs or one spawning pair.

_____ _____
(Name of Instructor) *(Organization or School)*

_____
(Mailing Address) *(City, State, Zip Code)*

Telephone:_____(work) _____ (home)

School District: _____ _____

A WRITTEN OPERATIONAL OR STUDY PLAN IDENTIFYING THE PURPOSE AND THE NEED FOR THE CLASSROOM INCUBATION PROJECT, RESEARCH OBJECTIVES, PROCEDURES, AND AN EXPLANATION OF BENEFITS THAT MAY ACRUE TO THE STUDENTS MUST BE ATTACHED.

I would like to conduct a classroom incubation project using the following: (*check the appropriate box*)

chum(dog) salmon [ ] pink (humpy) salmon [ ]
coho (silver) salmon [ ]

I would like to incubate/rear a total of (*amount requested*). The maximum amounts for this permit are less than or equal to 500 eggs or one spawning pair.

Life stage requested: *(check appropriate box)*

[ ] Spawning adult (*maximum one spawning pair*)
[ ] Green eggs (*newly fertilized-later summer through late fall*)
[ ] Eyed eggs (*eyes visible in egg-available early winter through mid winter*)
[ ] Alevin (*newly hatched yolk-sac fry-generally not transportable*)
[ ] Emergent fry (*early free swimming juvenile salmonid-available spring*)

I wish to obtain the above by means of: (check appropriate box)

[ ] Directly from hatchery. Name of hatchery:_____
Appoximate date of transport:_____to_____, _____(year)
[ ] production egg-take [ ] incubator

[ ] Remote location. Name of stream, river, or lake: _____
Appoximate date of transport:_____to_____, _____(year)
Method: (*check appropriate box*)
[ ] beach seine [ ] gillnet [ ] dipnet [ ] rod and reel
[ ]other technique (please explain the procedures planned for the egg take:

Isolation measures planned to control disease during transport, including description of container, water source, and method and plan for transport:

_____

_____

_____

The eggs and fish will be reared in:

[ ] recirculating aquarium [ ] flow-through aquarium

[ ] other(*describe incubation and rearing system*)

Source of water for rearing and proposed effluent discharge location:_____

_____

_____

Final disposition: (check appropriate box)
And approximate date of disposition: _____to_____,_____(year)

[ ] destroyed as a result of experimentation
[ ] destroyed at termination of project
[ ] released at egg take site
[ ] released into ADF&G approved landlocked lake. Name: _____

Release should be timed as nearly as possible to the natural timing of the donor stock, the plankton bloom, or at a time appropriate to maximize the survival rates. The project is for educational purposes only and any adult returns from this project may not be claimed as exclusive property of the project.

The following persons will participate in the project under terms of the permit being requested:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

I certify that all statements entered on this application are true, that I will abide by all conditions and restrictions of a permit if issued, and promise to submit a report of activities carried out under terms of such permit within 30 days of its expiration date.

_____
(*Signature*)

_____
(*date*)

The completed application must be submitted to the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, PNP Program, P.O. Box 25526, Juneau, AK 99802

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME

CLASSROOM INCUBATION PROJECT

Report #1 Due December 31

_____ _____
(Name of Instructor) *(Organization or School)*

_____ _____
(Mailing Address) *(City, State, Zip Code)*

Telephone:_____(work) _____ (home)

Species: [ ] coho [ ] chum [ ] pink [ ] other _____

Eggs Received: _____ Stage Received: [ ] green [ ] eyed

Current Stage: [ ] green [ ] eyed [ ] hatch
[ ] alevin [ ] fry

Mortality to date: _____ Estimate % survival (Live eggs/total received)_____

Water Exchange Intervals: [ ] weekly [ ] monthly
[ ] < 1 x/week [ ] < 1 x/month

Accumulated Thermal Units to Date:_____

What educational activities have you done in regards to your incubation project? Explain:

_____

_____

_____

_____

_____

Note: student reports, art, etc., are appreciated.

Problems experienced during your project to date: _____

_____

_____

Assistance available from local biologist or other teachers incubating eggs? [ ]yes [ ] No

I certify that the statements made in this report are true and that I have followed the guidelines as originally specified in my approved permit.

_____ _____
Signature Date

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME

CLASSROOM INCUBATION PROJECT

Report #2 (Due end of school year)

_____ _____

(Name of Instructor) *(Organization or School)*

_____

(Mailing Address) *(City, State, Zip Code)*

Telephone:_____(work) _____ (home)

Species: [ ] coho [ ] chum [ ] pink [ ] other _____

Eggs Received: _____ Stage Received: [ ] green [ ] eyed

Water Exchange Intervals: [ ] weekly [ ] monthly
[ ] < 1 x/week [ ] < 1 x/month

Accumulated Thermal Units to Critical: _____

Eyed:_____ Alevin (hatch) _____ Emergence(fry): _____

Fish were:
[ ] destroyed as a result of experimentation
[ ] destroyed at termination of project
[ ] released at egg take site
[ ] released into ADF&G approved landlocked lake.
Name of lake: _____
Date released: _____
[ ] Released into drainage of origin
Name of stream/river: _____
Date released:_____

Problems experienced during your project: _____

_____

_____

_____

_____

What educational activities have you done in regards to your incubation project since the last reporting period? Explain:

_____

_____

_____

_____

I certify that the statements made in this report are true and that I have followed the guidelines as originally specified in my approved permit.

_____ _____

Signature Date

APPENDIX B

Daily and Accumulated Temperature Unit (ATU) Log and Maintenance Information Form

School _____ Class _____

Month _____ (page 1 of 2) Year_____

Species _____

Start of month

Enter last month's Cumulative ATU Total from previous log. If just starting, enter 0. →

Day	Date	Daily Temp	Cumulative Temp Units	Maintenance	Comments
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				

Enter mid-month Cumulative ATU Total →

Enter this value where instructed on the next page, and continue adding to it.