Salmon Dissection

Instructions and Enquiry for Salmonids in the Classroom

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This activity is designed for teachers and students participating in the Salmonids in the Classroom program of Fisheries and Oceans Canada. Whole frozen salmon may be obtained, if available, from local Community Advisors of DFO. Safety Warning: when working with sharp instruments, safety guidelines should be discussed with all participants. This dissection is a guideline only, and individuals participate at their own risk. Health Warning: Dissection fish obtained frozen from hatcheries are not food fish and not edible.

Dissection Step-by-Step

I. External Anatomy

- Slime Coat
- Inner Ear
- Fins
- Nostrils
- Teeth
- Operculum
- Lateral Line
- Scales
- Vent
- Gills

II. Internal Anatomy

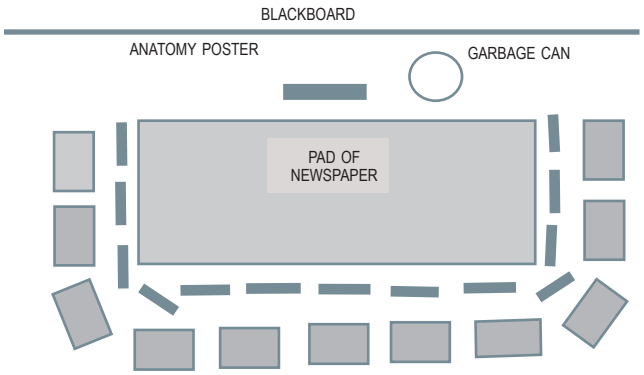
- Testes (Milt Sacs) OR Ovaries (Eggs)
- Liver
- Gall Bladder
- Heart
- Digestive System
- Swim Bladder
- Kidney
- Skeletal System
- Eyes
- Brain
- Summary

Supplies

- Ice Cream Bucket
- Paper Towels
- Newspapers
- Cleaning Supplies
- Paper Plates
- Felt Pen (to label plates)
- Gloves
- 12” Probe (spoon handle)
- Plastic Spoon
- Straw
- Model Eye (golf ball)
- Kitchen Knife
- Human Anatomy Poster

Classroom Set Up

• Fisheries and Oceans coho are bagged and frozen. Thaw in the bag for 24 hours on a counter - not in fridge.
• Dispose of carcass and parts in garbage (these dissection salmon are NOT edible).
• For a class demonstration use a large 6 ft table.
• Place near a blackboard and hang anatomy poster.
• Lay a pad of newspaper for the fish. Remove a layer when dirty. Place garbage can close to your chair.
• Surround table on three sides with a row of chairs.
• Surround row of chairs with a row of desks.
• Students can sit on desk tops creating a theatre where all can see. At half-way point students can change rows.



• An open window for air circulation is helpful

Procedure

● A dissection demonstration can be an hour or more.

● With young students the time can be divided between external anatomy (before recess) and continue after the break with internal anatomy.

● Print this manual for your reference. Pre-label paper plates with salmon anatomy in the dissection order.

● Half fill ice-cream bucket with water and keep nearby to demonstrate bouyancy with swim bladder.

● Distribute a paper towel to each student to wipe their fingers after touching the salmon parts.

● As each part is removed compare salmon and human anatomy using poster. Explore with students, *"why are we different or the same?"*

● Hold each part in your hand and pass by students to touch. Encourage observations, *"how did it feel?".*

● Do not have students pass around each part on a paper plate...attention becomes divided and the overall demonstration time becomes much longer.

● Place the part on paper plate and continue dissection. Remove parts to another area if table becomes crowded.

Student Preparation

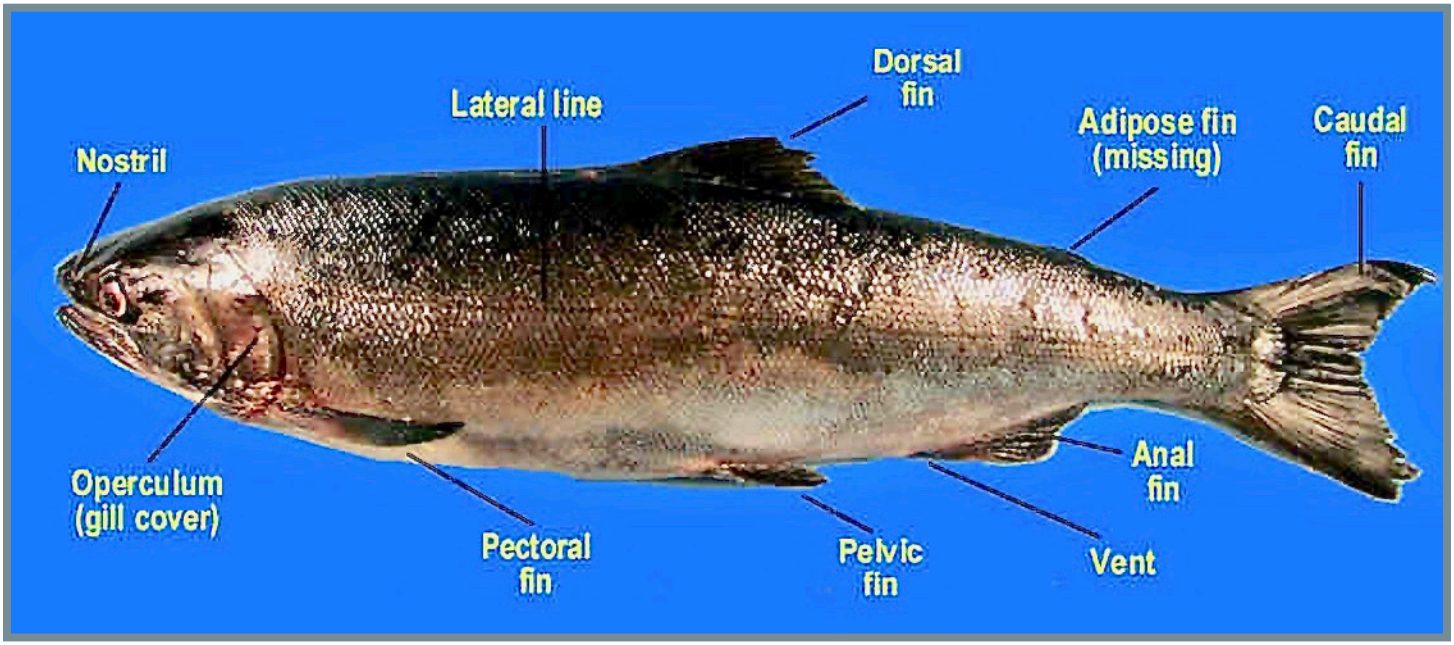
● Have a discussion with students about showing respect for all species. This should serve as a guiding principle for the students' behaviour during the activity. The frozen salmon from DFO were returning to spawn at a hatchery and were coming to the end of their natural life cycle.

● Advise students that, if they feel uncomfortable during the dissection, they can look away or move their chair farther back.

● The dissection demonstration is an enquiry and an exploration. A Venn diagram comparing human anatomy and salmon anatomy is a useful pre-activity. Discuss what the students expect to find. At the end of the demonstration, discuss what was surprising - what did they learn?

● Student handouts of Salmon Anatomy are on this website and also in *Intermediate Salmonids in the Classroom,* Unit 4. www.streamtosea.ca

External Anatomy



SHAPE

Salmon are streamlined to move easily through water. Water has much more resistance to movement than air does, so it takes more energy to move through water. A streamlined shape saves the fish energy.

SLIME COAT

Have each student touch the salmon to feel the layer of slime covering its body. Show how difficult it is to pick up the salmon without lifting from under the body.

Compare to our skin. Why are we different?

The slime layer helps fish to:

- ***slip away from predators, such as bears.***
- ***slip over rocks to avoid injuries***
- ***slide easily through water when swimming***
- ***protect them from fungi, parasites, disease and pollutants in the water***

INNER EAR

Fish have an inner ear, but no outer ear. Sound waves travel through the water and through their body to the bones (otolith) in the inner ear. Salmon probably use hearing to detect predators and other threats. Fish also detect sound waves through their lateral line.

FINS

Salmon have eight fins including the tail. They are made up of a fan of bone-like spines with a thin skin stretched between them.

Compare to our limbs. Are the fins attached to bones in the salmon?

The fins are embedded in the salmon's muscle, not linked to other bones, as limbs are in people. This gives them a great deal of flexibility and maneuverability.

Each fin has a different function. The caudal or tail, pushes from side to side and moves the fish forward in a wavy path.The dorsal fin acts like a keel on a ship. It keeps the fish upright, and it also controls the direction the fish moves in. The anal fin also helps keep the fish stable and upright.The pectoral and pelvic fins are for steering and for balance and movement up and down in the water. The adipose fin has no known function. It is sometimes clipped off in hatchery fish to help identify the fish when they return or are caught.

NOSTRILS

Salmon have nostrils above their mouth, but no nose.

Q Have students breath deeply through their nose. Where does the air go? Into our lungs.

Fish do not breath through their nostrils. The nostrils are a small indention that is not connected to the mouth. Fish smell very tiny amounts of chemicals in the water. They use this information to detect harmful pollution and avoid potential threats, if possible. Salmon also use smells to recognize their way home from the ocean.

TEETH

Salmon have teeth that are sharp and needle-like.

Q Have students look at each others teeth. Why are they different from salmon?
We chew our food.

Salmon use their teeth to grab their prey but do not chew their food. Their tongue also has two sharp shafts. Salmon have taste buds inside their mouth, like people do. They probably taste salt, sweet, bitter and acid, but this has not been studied in detail.

OPERCULUM (GILL COVER)

The operculum is a hard outer lining like a flexible plate which protects the gills. **Show the students how a salmon breathes.**
Use the probe (handle of a long spoon) to reach through the open mouth and out over the gills showing the way water passes over the gills.

LATERAL LINE

The lateral line functions somewhat like an ear. It detects vibrations and pressure waves in the water, just as an ear does in air. The lateral line is a series of liquid-filled canals below the skin along the side of the fish. It combines aspects of touch, hearing and seeing. Fish use the lateral line mainly to tell distance and water flow, and to detect disturbances in the water. Some fish can use the lateral line to find their way when it is too dark or muddy to see.

SCALES

1 Remove a scale by scraping backwards with a knife. Show students the diagram of the magnified scale.

Q What is similar to these rings?
Our thumb print. The growth rings on a tree.

Q How old is this salmon?
Look for bands of lines indicating an age of about 3 years.

As the fish grows, the scales grow. They form lines, like the rings in a tree. Biologists can tell the age of a fish and how many years it spent in fresh and saltwater from the *groups of lines* on its scales.

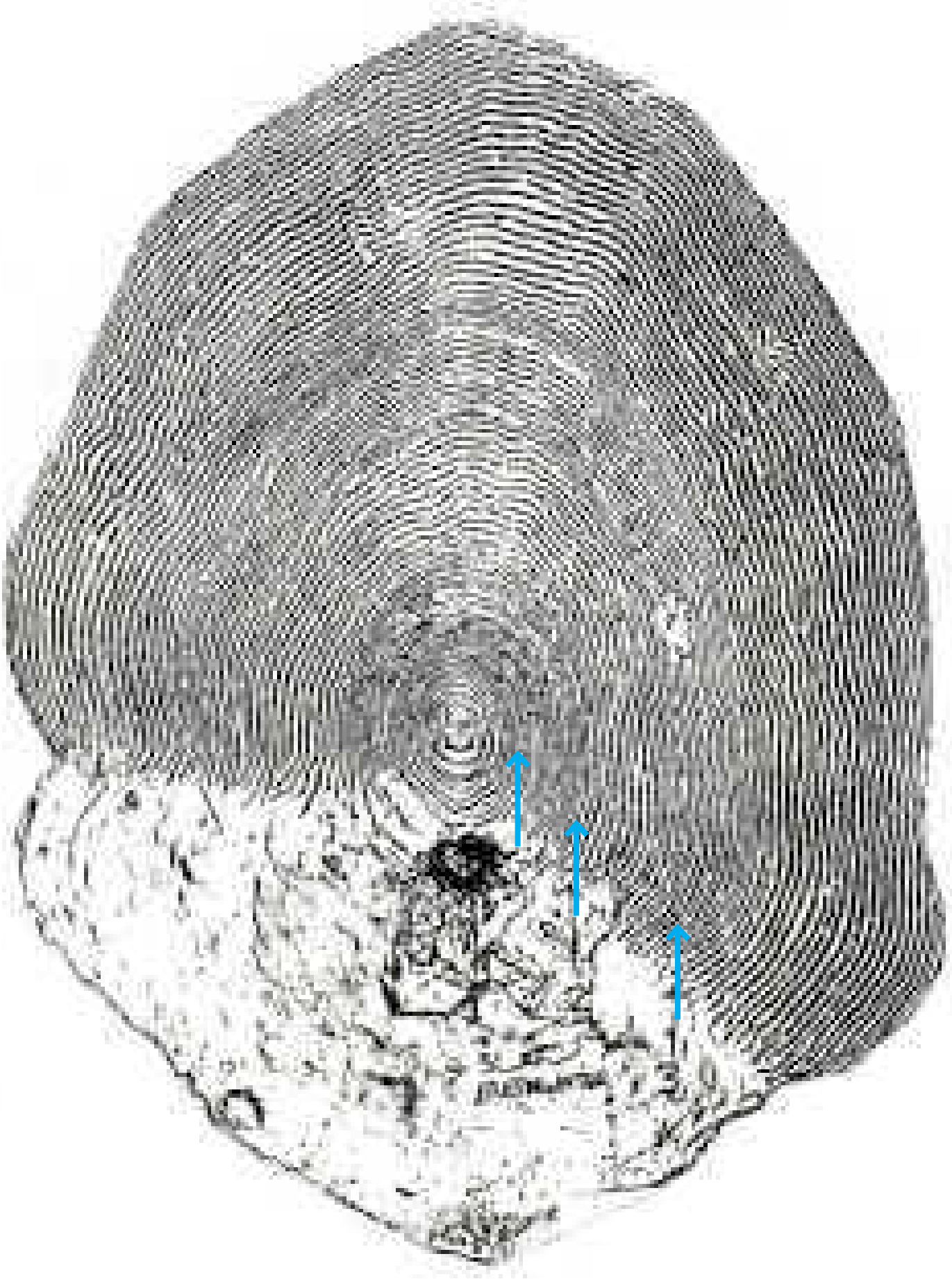
Q How do scales help a salmon?
Scales are small, hard plates, like fingernails, that cover the body for protection.

Salmon begin to grow scales at the fry stage. The way scales are arranged in rows or patterns is different for each species. Fish have the same number of scales all their lives. If a scale is lost, another scale will grow to replace it, but it will not have the growth lines in the center. On the picture of the scale, the area without lines indicates where the scale was attached to the salmon.

VENT

The vent opening is found on the underside of the salmon. Eggs are laid from here by females. Milt is released from here by males. As well, both males and females eliminate waste from the vent.

Magnified Salmon Scale

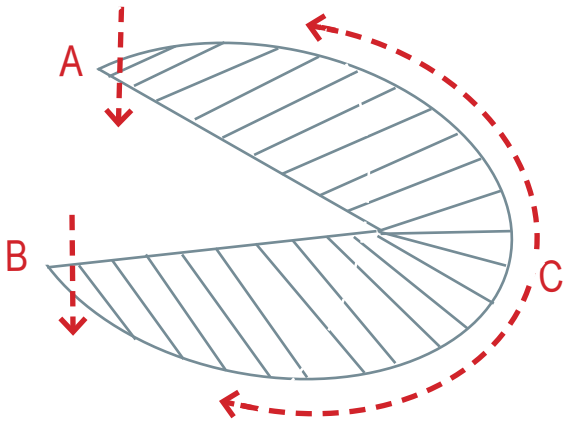


GILLS

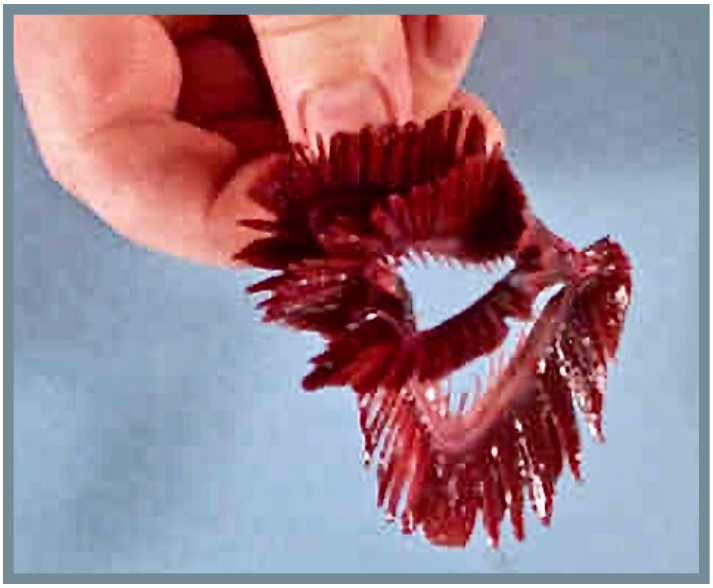
1 Lift the operculum (gill cover) to expose the gills. The diagram (right) shows the shape of the gills inside the salmon's head.

2 Remove the gills on one side of the salmon. The gills are attached at two points A and B. Cut down through the the gills at each point.

3 Lift the gills at C and make two cuts in each direction to separate gills from the head.



3 Each gill has 4 arches, each with a row of gill rakers.



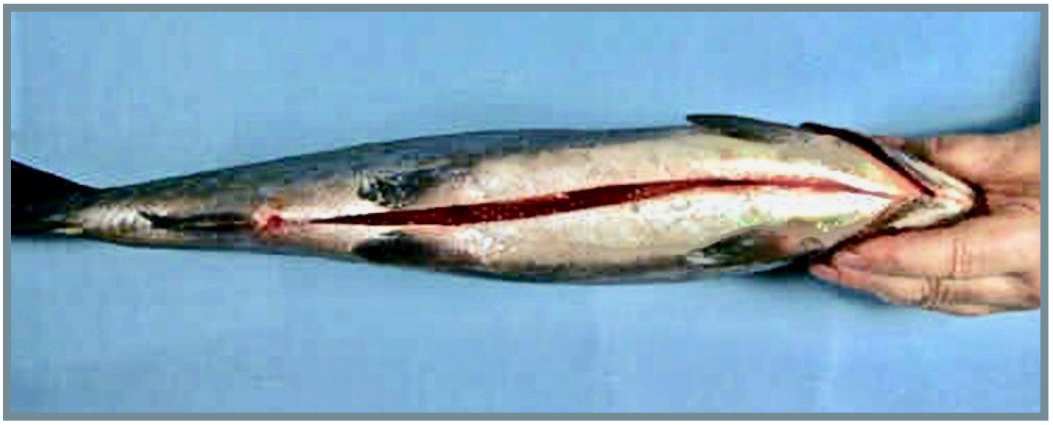
Q Is it helpful for the gills to have 4 layers?
Yes, this gives the greatest possible surface area to absorb oxygen from the water.

Q How do the gill rakers help salmon?
The rakes prevent food from entering the gill and instead guide it into the throat.

Internal Anatomy

1 **Using a knife, cut the fish open beginning at the vent. Cut in an upward direction away from the organs.**

Use shallow strokes. Do not cut too deeply or the internal organs will be damaged. Open the fish from the vent to the throat.

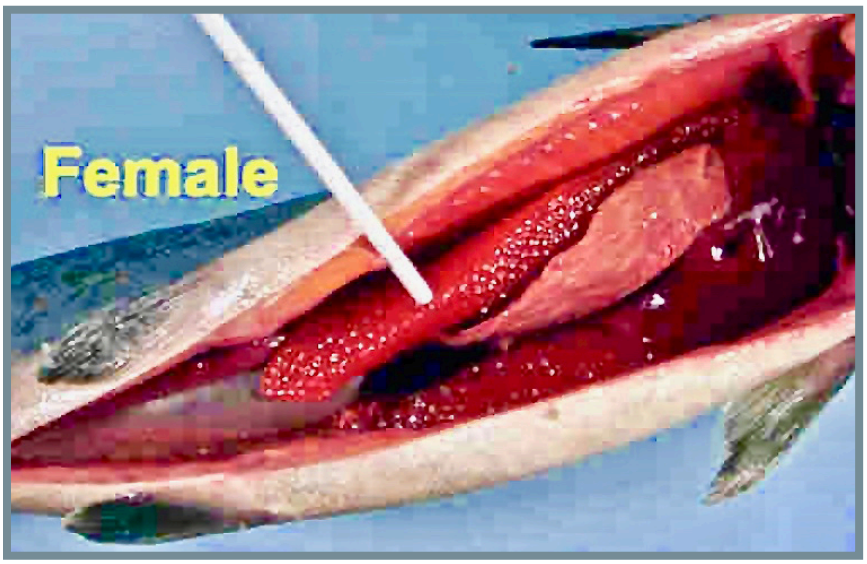


2 **Hold open the fish for the students to observe the beauty of the internal organs and how they fit neatly together inside the salmon.**

Q Is this fish a female or a male?

Look for egg sacs on each side of the body. In immature fish the eggs are smaller than when ready to be layed. The fish is a male if no eggs are evident (instead look for a milt sac on each side of the body).

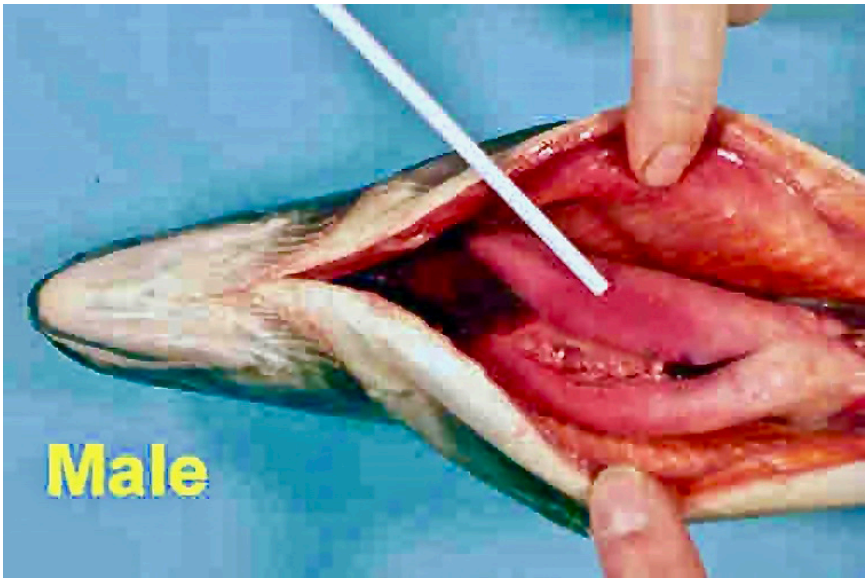
EGGS or MILT



1 Remove the eggs or milt. The sacs are joined to the fish near the head. Pinch and gently pull each sac away from the body.

EGGS

If the fish is female there are two sacs of eggs each held with a membrane. When the female is ready to spawn the eggs come loose inside her body and are laid from the vent.



MILT

If the fish is male there are two sacs or testes, that produce milt when ready to spawn. The milt becomes liquid containing sperm and is squeezed out the vent opening to fertilize the eggs. The milt sacs are usually firm and pinkish-white if the male has not spawned.

Q Why does one salmon lay so many eggs? Compare to other animals and ourselves.

We, and other mammals have less babies because:

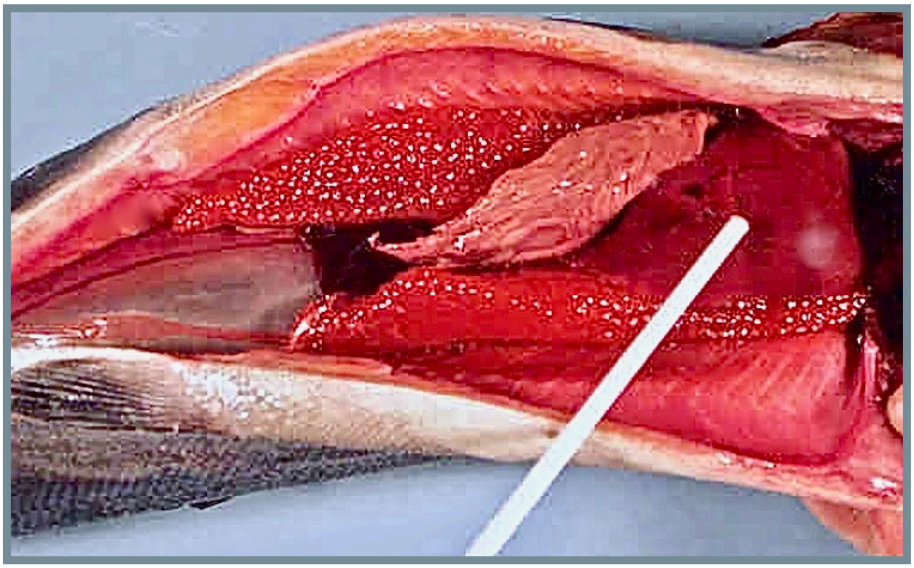
- we have live birth (and salmon lay eggs)
- we take care of our young, (and salmon die after laying their eggs)
- our children survive (salmon are low on the food chain and have many predators)

Coho salmon have an average of 2,500 eggs (some species have from 2,000 to 5,000).

- only 375 coho survive to become fry,
- only 30 survive to become smolts,
- about 4 to 5 become adults, and
- only two will return to spawn.

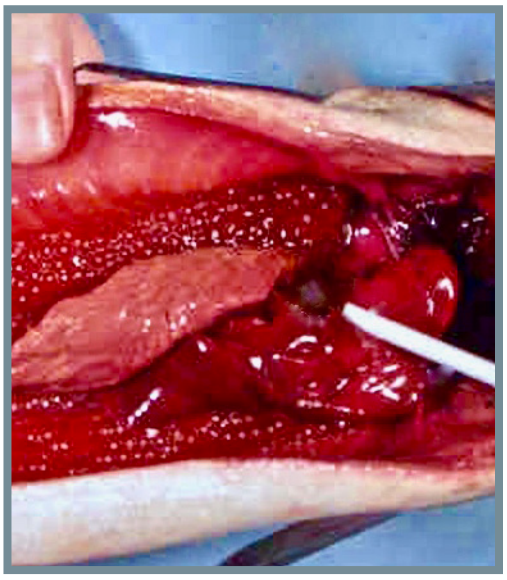
** This is a model, individual survival varies. Animals that dont care for their young at birth (sea turtles, spiders etc) need many offspring (usually as eggs) to ensure their next generation's survival.*

LIVER

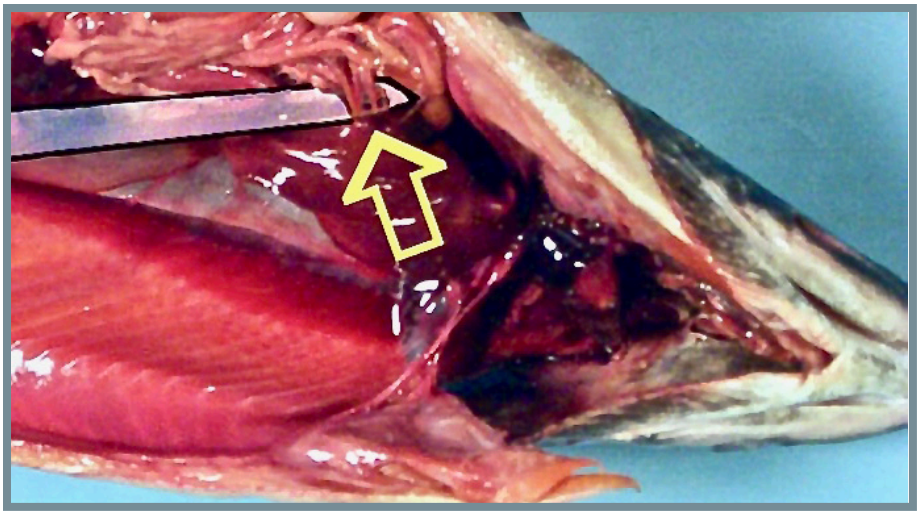


The liver is the largest organ in the fish's body. It is part of the digestive system. As in humans, it is essential for maintaining the proper level of blood chemicals and sugars.

GALL BLADDER



The gall bladder is a small sac of green bile attached to the live. It helps in the digestion of fats.

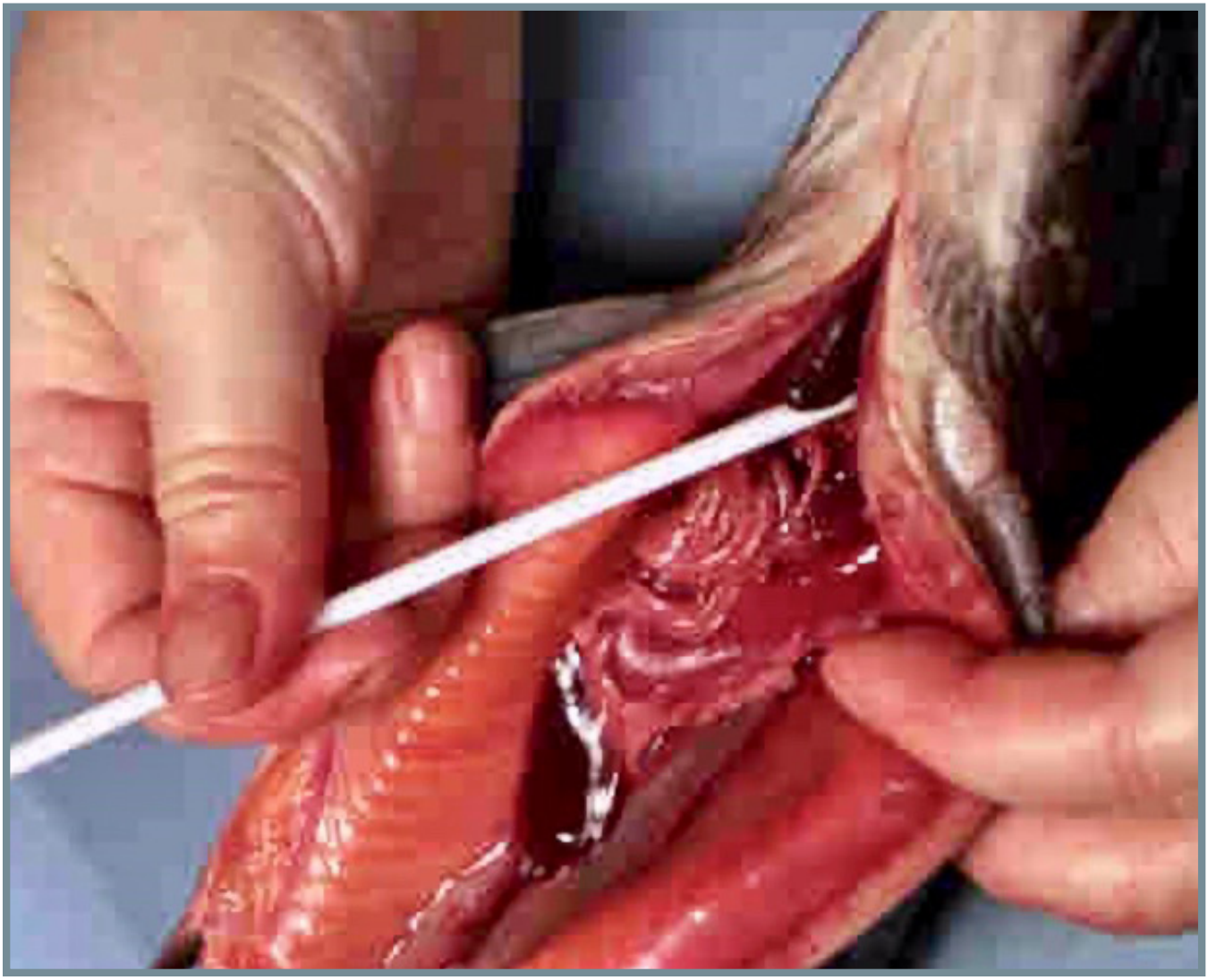


The gall bladder is very fragile and will often brake when removed. It is difficult to identify once empty of bile.

1 Turn the liver over to view the gall bladder. Remove the liver and gall bladder by gently cutting any small membranes that join them to the digestive system.

Q What is the largest organ in our body (and in salmon's)?
The liver is the largest organ. It is part of the digestive system.

HEART



1 Locate the heart near the head. You may need to push through a membrane which protects the heart in its cavity. Pull out with your fingers.

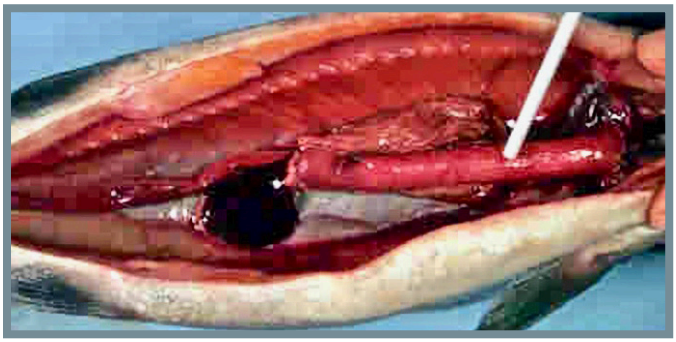
The heart pumps blood through the body. At left, heart showing ventral aorta leading to gills.

Q Have students place hand on their own heart. Then show where the salmon's heart would be located on our body? Why? At our throat. The salmon's heart is very close to the gills where fresh oxygen enters the blood. In humans, the heart is close to the lungs to pump fresh oxygen through our bodies.

DIGESTIVE SYSTEM

1 Look in the mouth and show students the teeth. Demonstrate how the salmon eats and digests food. Gently push a probe (8'' spoon handle or chopstick) through the mouth and into the stomach.

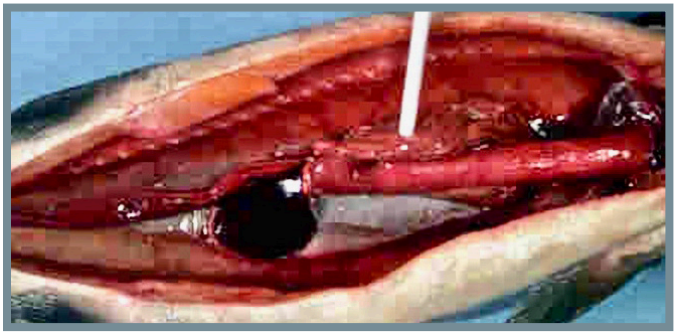
Q Have students look at each others teeth and compare to a salmon's. Do they chew like us?
Human teeth are flat for chewing, a salmon's teeth are pointed for grabbing moving food in the water. They do not chew their food.



The digestive system is shorter and simpler than in mammals. They have a very short asophagus at the stomach opening. Fish are cold-blooded - they do not use much energy to keep warm and do not need as much food as warm-blooded humans.

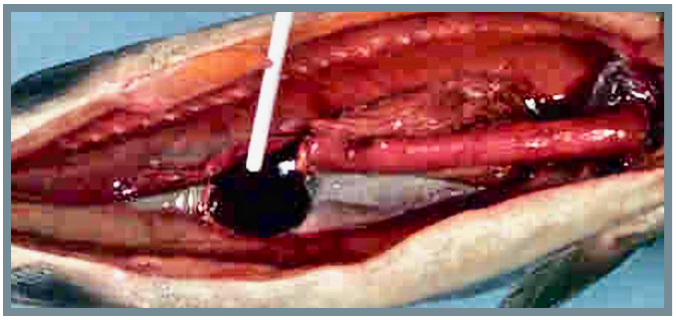
STOMACH

The stomach breaks down food with digestive juices.



PYLORIC CAECA

The pyloric caeca absorbs nutrients into the blood. It is similar to the small intestine in people.



SPLEEN

The spleen is a storehouse of blood for emergencies and recycles worn-out red blood cells.

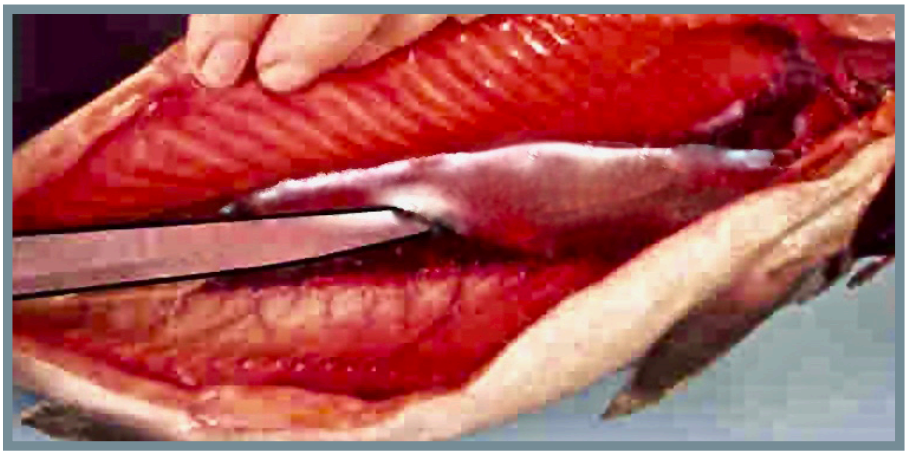
2 With a knife cut through the stomach at the throat. With your finger under the intestine gently release to its end - at the vent. A tug here will then remove the complete digestive system.

INTESTINE

Most food is absorbed in the intestine, the tube-like section at the end of the digestive system.

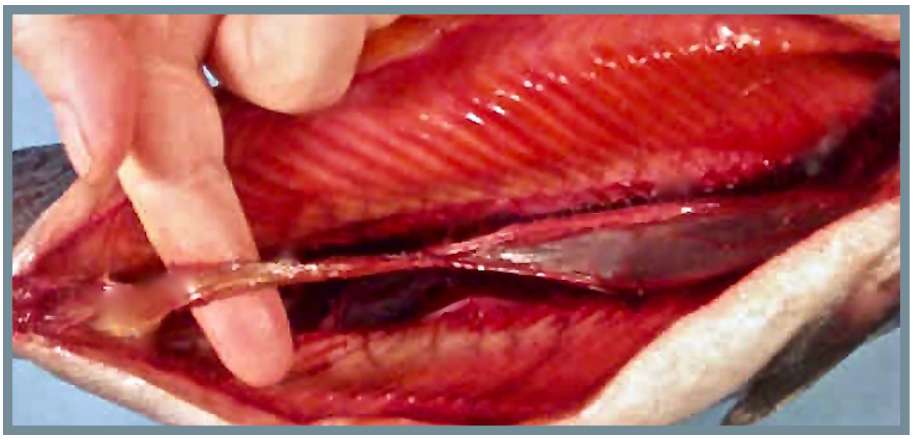
SWIM BLADDER

1 **If the swim bladder is flat from a tear, insert a straw in the hole and gently add air.**



Salmon fill their swim bladder with air as swim-up fry. The air provides buoyancy, allowing them to float in the water. Salmon can adjust the air in their swim bladder so they can hover at different levels in the water. The swim bladder may remain full of air after the salmon dies (dead fish often float upside down).

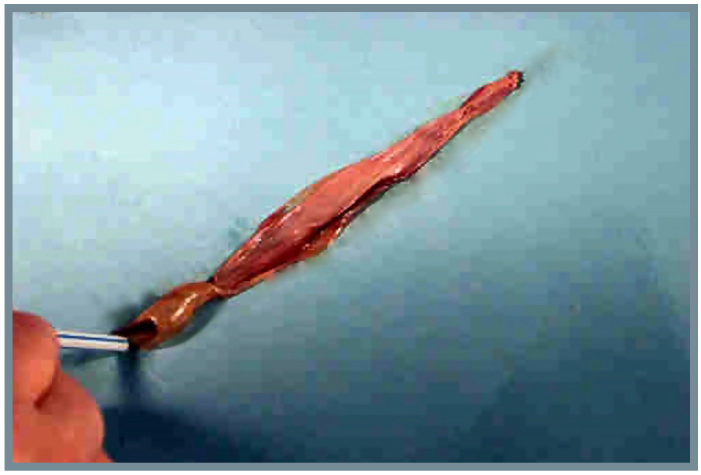
2 **Remove the bladder by gently scraping it away from the sides of the body with the flat side of the knife.**



3 **At the vent end of the fish, reach one finger under the swim bladder and pull it away.**

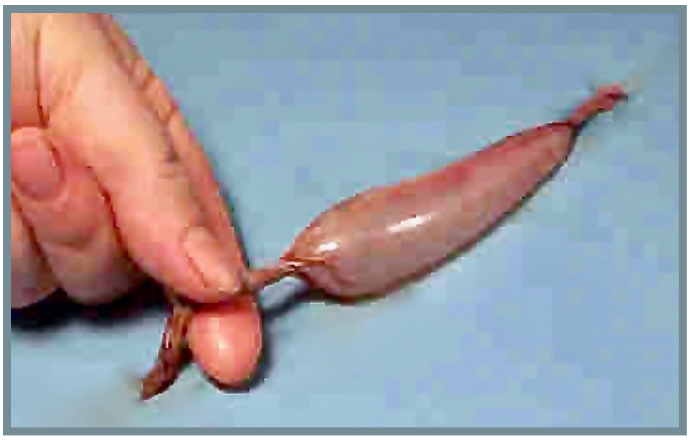
Continue lifting all the way to the throat. A gentle tug at each end will remove it.

4 With a knife cut off the end of the bladder at the vent end.



5 Gently pull back the top layer of the bladder 1/2 cm with your finger. With a straw held almost parallel, blow firmly at the end, (do not insert the straw yet).The bladder will open.

6 Continue to gently blow while sliding the straw into the opening. While blowing pinch the bladder tightly against the straw. Check for leaks by closing off the straw in your mouth with your tongue.



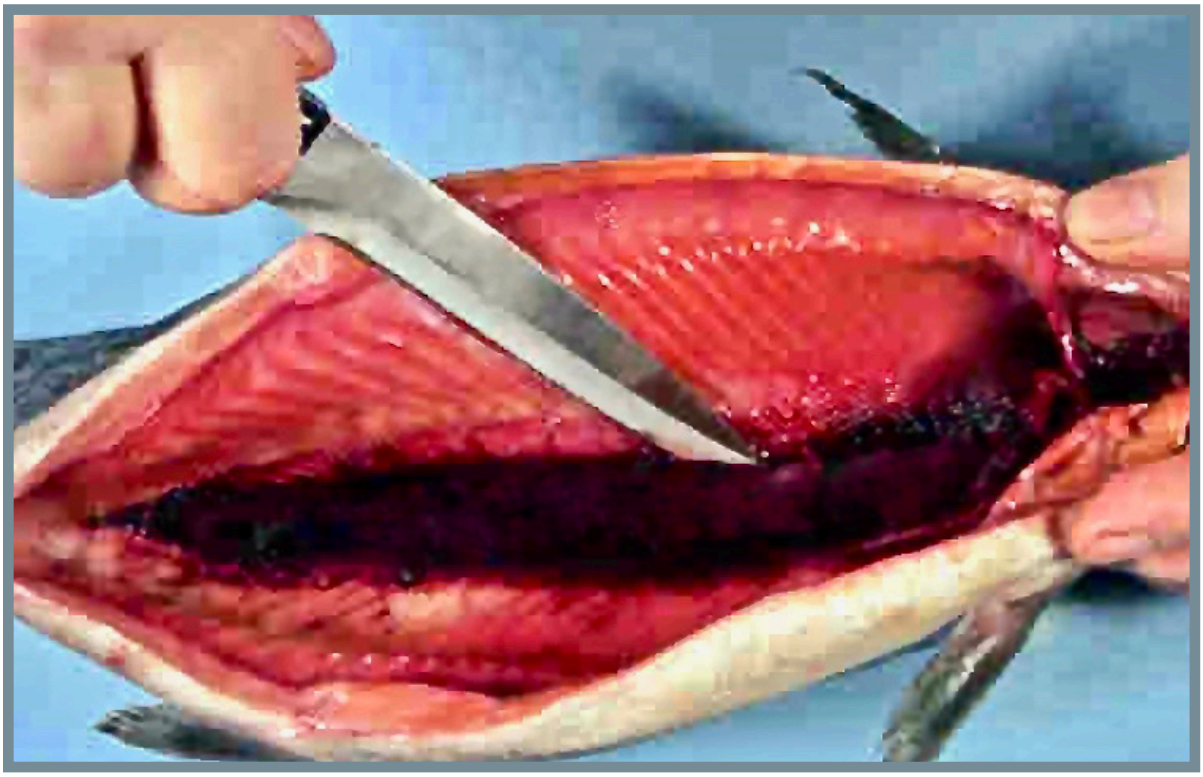
7 Slide the swim bladder off the straw. Twist at each end to seal the openings.

How to fix a leak. . .

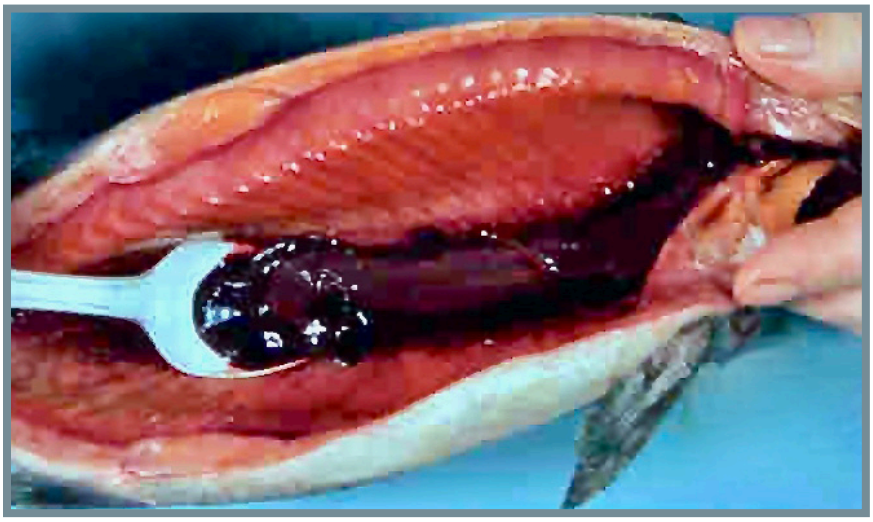
If the bladder de-flates, blow again and hold your hand close to feel air escaping. Once a hole is found, cut off the bladder at this spot, re-insert straw and begin to inflate again,.

8 Float swim bladder in water to demonstrate buoyancy.

KIDNEY



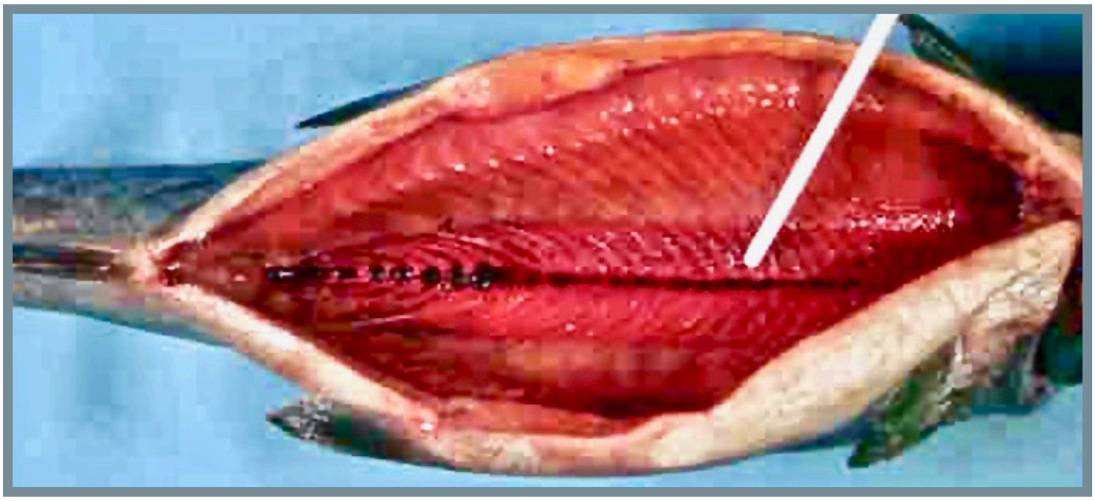
1 Remove the kidney by cutting along each side. Use a spoon to lift it out.



Salmon have two kidneys joined together. The front kidney produces red blood cells and the back kidney cleans the blood.

The kidney regulates water and salt concentrations which allows salmon to live in freshwater and saltwater. Excess water, waste and harmful chemicals are released through the vent opening.

SKELETAL SYSTEM



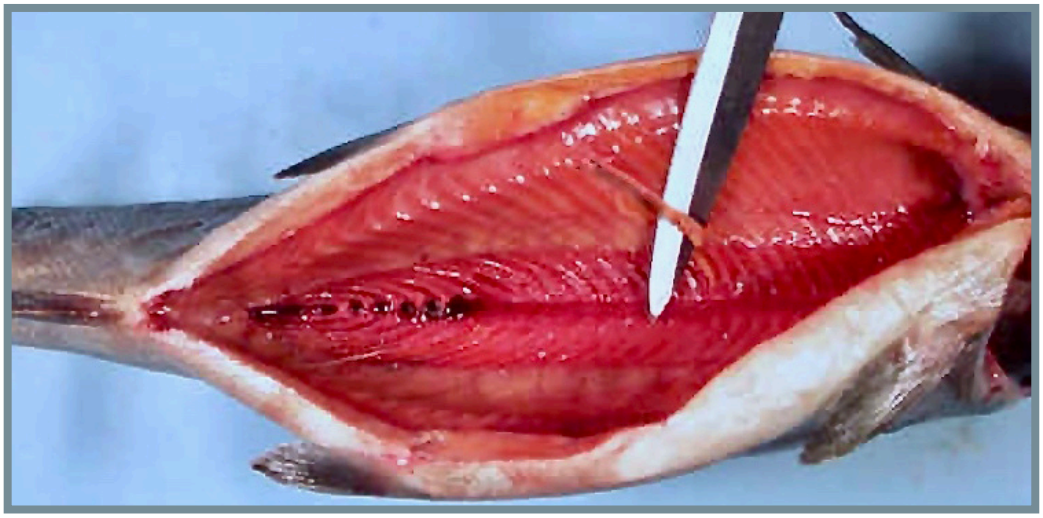
BACKBONE

The backbone is made up of a series of interlocked disks. Salmon can move from side to side, but can only bend up and down a small amount. The backbone protects the spinal cord that runs through the body to the brain and gives structure to the fish's body.

1 Have the students feel their ribs and arm bone. Hold up the fish to observe the backbone and ribs.

Q Do salmon have a similar skeletal system to us?
We both have a flexible backbone. Salmon do not have the same bone structure.

Q Have a student stand up to demonstrate our differences. Count to 3 and imagine the student's skeleton becomes a salmon's. What happens? Why?
The student will fall to the floor because of gravity. In water, a salmon floats using their swim bladder.



RIBS

The ribs are lightweight, curved bones that give the fish its shape. The ribs protect the salmon's internal organs.

MUSCLES

Salmon are very strong, powerful swimmers. They travell thousands of miles in the ocean and then return to spawn against swift running rivers, rapids and waterfalls.

2 Remove a rib by slicing on each side and pulling it up toward the backbone. Cut through the rib where it connects to the backbone.

EYES

1 Ask students to show where their eyes would be if they were salmon.

Salmon have eyes on each side of their head. They do not have binocular vision, which would give them depth perception. However, they can swivel each eye independently forward and backward to cover a much wider field of vision than people have. Fish have very sharp vision under water. Some can see five meters or more.

Q What size and shape are our eyes? Are salmon the same?

Human eyes are round and about the size of a golf ball. Most of the eye is hidden inside the skull for protection.

2 Remove an eye by reaching under the gill with a finger and pushing hard to loosen the muscles in the socket behind the eye. Cover the eye with your other hand until the eye is pushed out of the socket.

3 From the outside, gently pull up on the eye with one hand and cut it away from the head. Reveal the empty eye socket to show how most of the eye is hidden for protection.

Q Hold the salmon eye close to your own. Ask students to find any differences. As you move your gaze to each student, blink frequently.

Salmon have no eyelids.

Q Why do we have eyelids? Have the students not blink for a 10 seconds. Why do we blink?

Our eyes need moisture. Unlike us, salmon have no need to blink. Their eyes are continuously washed in water.

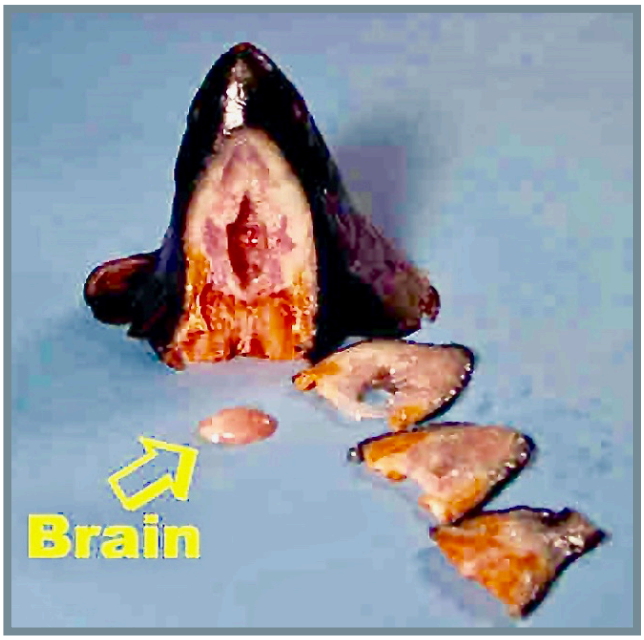
BRAIN

1 Remove the head by cutting straight down behind the gill covers.

2 Place the head cut side down with nose up. Remove a very thin slice (1/3 cm) from the top of the head. Cut parallel to the top of the head (on an angle, not straight down).

Salmon have a brain at the end of their spinal cord where the nervous system transmits the information they receive about their environment. The forebrain controls the salmon's sense of smell. The midbrain controls vision, learning and responses to stimuli. The hindbrain coordinates movement, muscles and balance.

3 Remove two additional 1/3 cm slices to reveal the brain. It has three pea-shaped sections and is surrounded by cartilage.



4 Use the tip of the knife to gently probe and scrape out the brain. Tilt the head on its side and slide the brain onto a plate.

Q Compare our eye size to our brain size. Do salmon have the same ratio?

Our brain is about 10 times bigger than our eye. The salmon's brain is 1/3 the size of its eye. Salmon rely on their sight and their senses and an inborn instinct to help them survive.

SALMON ANATOMY