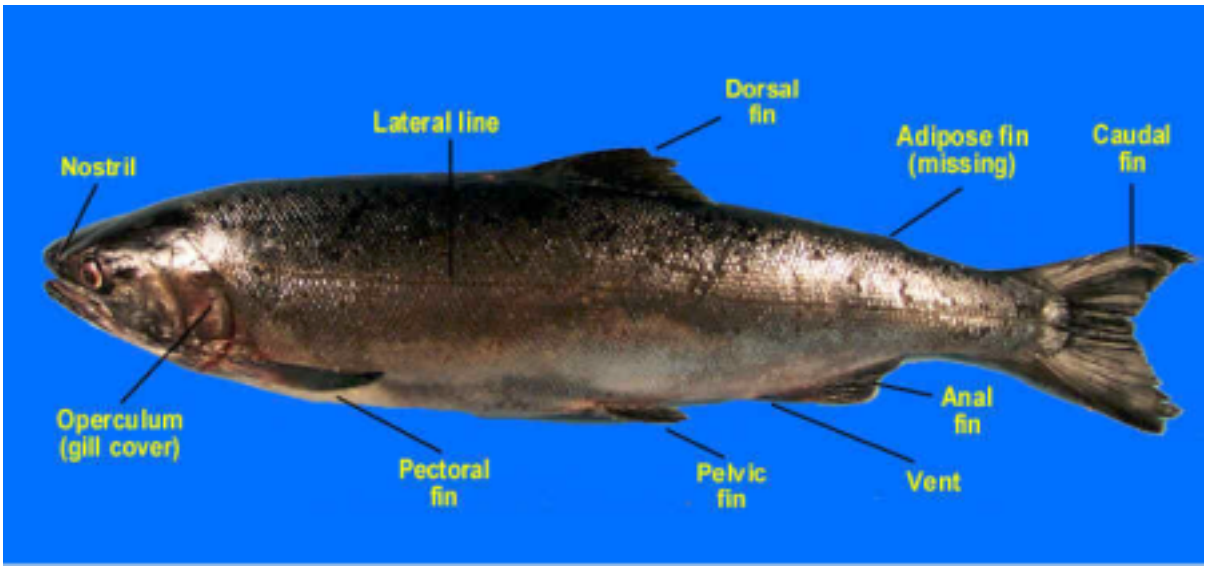
SALMONIDS IN THE CLASSROOM: SALMON DISSECTION

Materials

- sharp kitchen knife
- plastic drinking straw
- plastic spoon
- magnifying lens
- golf ball (represents human eye)
- probe
- latex or plastic gloves
- paper plates
- cleaning supplies
- garbage bags for waste
- ice-cream buckets

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.

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. 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 manoeuverability.
- Each fin has a different function. The caudal or tail, is the largest and most powerful. It 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 fused for steering and for balance. They can also move the fish 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.

Slime

- Many fish, including salmon, have a layer of slime covering their body. 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

Scales

Remove a scale by scraping backwards with a knife. Look at the scale with a magnifying lens.

- Most fish, including salmon, have a layer of scales covering their skin. Scales are small, hard plates, like fingernails, that cover the body for protection. The scales overlap to form a flexible armour plating to protect from predators and bruising.

- 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. 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.
- If a scale is lost, another scale will grow to replace it, but it will not have the growth lines in the center.

Magnified Salmon Scale

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.

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.

Nostrils

- Salmon have nostrils above their mouth, but no nose. 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.

Mouth

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

Operculum (gill cover)

- The operculum protects the gills. It is a hard outer lining like a flexible plate that the fish opens and closes to let water pass over the gills.

Return to Top

STEP 1

GILLS

- Fish breath by gulping water through their mouth, then close their mouth and throat. The water is forced though the opening in the back of their throat that is lined with gills.
- Gills are very thin, they look like fine, branched structures, like a Christmas tree. This gives the greatest possible surface area to absorb oxygen from the water.
- Gills are red because they are filled with blood. Oxygen in the water passes into the blood and is carried through their body. Gills are more efficient than lungs at extracting oxygen.

1. Remove the gills on one side of the salmon. Cut through the bone at the top where the gills are joined to the head.

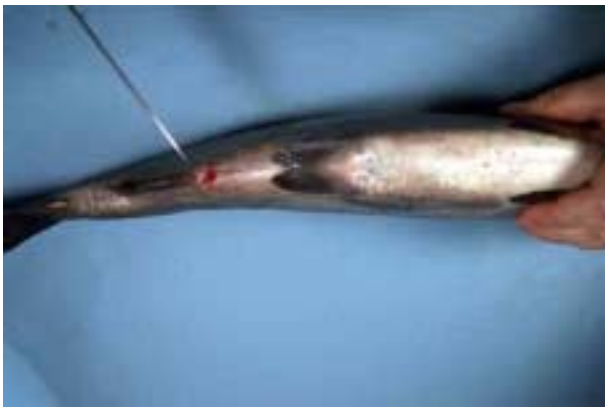
2. Cut through the bone at the bottom where the gills are joined to the head.

3. Lift the back edge (farthest from the mouth) of the gills and cut away from the skin.

4. Each pair of gills has 4 arches, each with a row of gill rakers. These rakes prevent food from entering the gill and instead guide it into the throat.

Return to Top

STEP 2



THE VENT

- The vent opening on the underside of the salmon. Eggs are layed from here by females.

Milt is released from here by males. As well, both males and females eliminate waste from the vent.

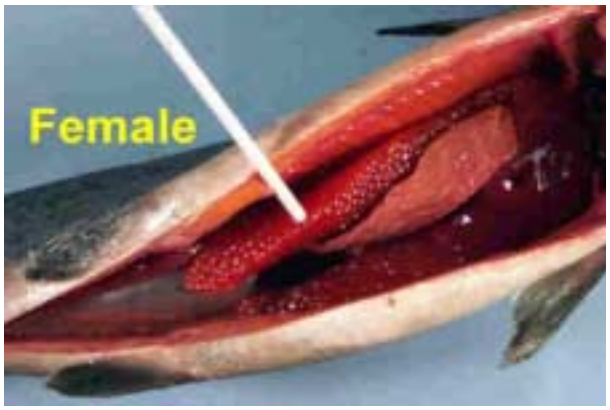
1. Cut the fish open beginning at the vent. Do not cut too deeply or the internal organs will be damaged.

2. Open the fish from the vent to the throat.

Return to Top

INTERNAL ANATOMY

STEP 3



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 layed from the vent.

MILT

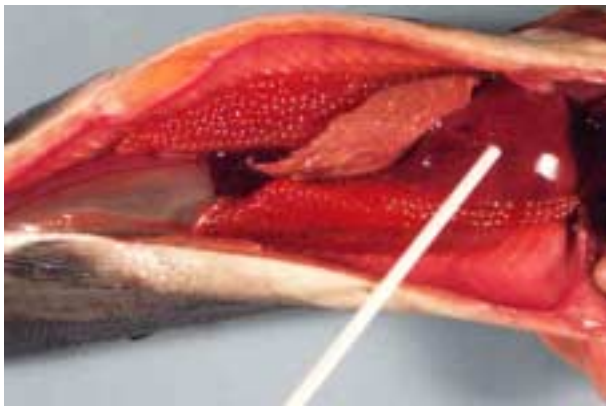
- If the fish is male there are two sacs or testes, that produce milt when ready to spawn. The milt becomes liquid containing sperm and is squeezed out the vent opening to fertilize the eggs. The milt sacs are usually firm and white if the male has not spawned.

1. Remove the eggs or milt by gently pulling the sacs away from the body.

- Coho salmon have an average of 2,500 eggs but 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.

Return to Top

STEP 4

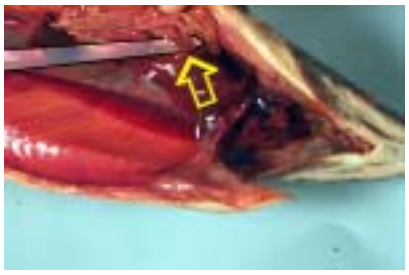


LIVER

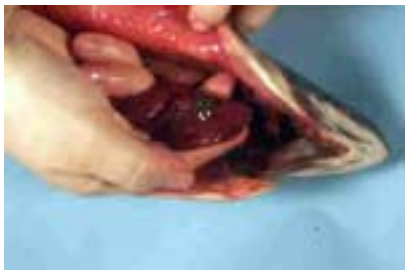
- The liver is the largest organ in the fish's body. It is part of the digestive system. As in humans, it is essential for maintaining the proper level of blood chemicals and sugars.

GALL BLADDER

- Turn the liver over to view the gall bladder. The gall bladder contains green bile which is used to help digest fats.



1. Remove the liver and gall bladder by gently cutting any small membranes that join it to the digestive system.



2. Pull away from the stomach and remove.

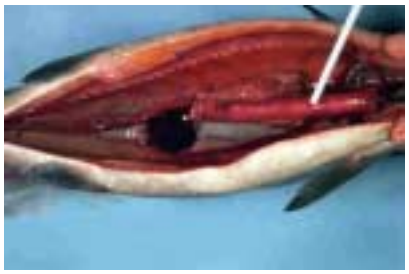
3. Liver with empty gall bladder.

Return to Top

STEP 5

DIGESTIVE SYSTEM

- Observe the digestive system by gently pushing a probe (8'' spoon handle or chopstick) through the mouth and into the stomach.
- The digestive system is shorter and simpler than in mammals. Because fish are cold-blooded they do not use as much energy to keep warm and do not need as much energy from their food so they expel it more quickly.

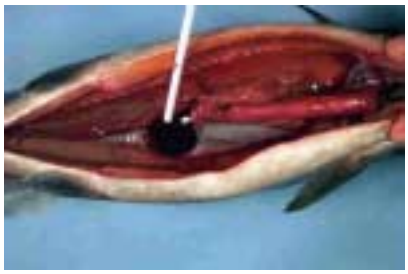


Stomach

- 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.

1. Remove the stomach by cutting it away at the throat and gently pulling.

2. Remove the complete digestive system and intestines, which end at the vent.

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

Return to Top

STEP 6

THE HEART

- The heart pumps blood through the body. It 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.

Heart showing ventral aorta leading to gills.

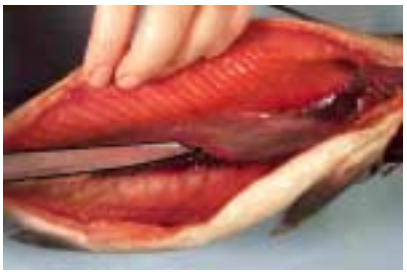
Return to Top

STEP 7

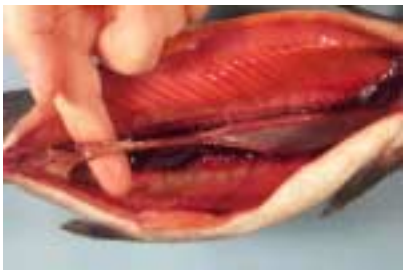
SWIM BLADDER

- Salmon fill their swim bladder with air for the first time 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.
- Often the swim bladder remains full of air after the salmon dies.

1. If the swim bladder is flat, show it by inserting a straw in the tear and gently adding air.



2. Remove the swim 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.

4. Continue pulling up to the throat where a gentle tug will release it.

5. Make a clean cut at the vent end of the swim bladder.

6. With a fingertip, gently pull back the top layer of the bladder 1/2 cm. With a straw blow firmly at this end, and it will open up.

7. Slide the straw into the opening and gently blow to fill the bladder.

8. Seal the bladder opening by pinching it against the straw. Now sllide the bladder off the straw.

9. Twist the bladder to lightly seal the opening.

10. Float in water to demonstrate buoyancy.

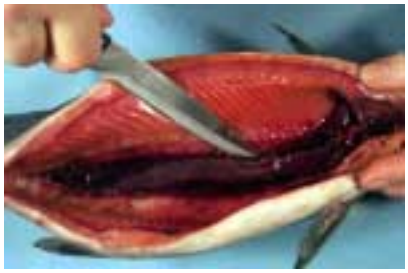
Return to Top

STEP 8

KIDNEY

- Salmon have two kidneys joined together. The front kidney produces red blood cells and the back kidney cleans the blood. Urine is collected by ducts near the vent.

- The kidney is also critical in the smolting process (going from fresh to salt water) in a process called osmoregulation.



1. Remove the kidney by cutting along each side.

2. Use a spoon to lift it out.

3. Kidney

Return to Top

STEP 9

SKELETAL SYSTEM

- Fish have a flexible backbone, as do mammals. The backbone is 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.
- The ribs are lightweight, curved bones that give the fish its shape. The ribs protect the salmon's internal organs

You may also cut off the tail to show the spine. Membranes carry messages via nerves from the lateral line to the spine.

1. Remove a rib by cutting on each side and pulling it up toward the backbone.

2. Cut to disconnect it.

Return to Top

STEP 10

EYES

- Salmon have two eyes, but unlike people, salmon do not have binocular vision, which would give them depth perception. However, they 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.

1. Remove one eye by reaching under the gill with a finger and pushing hard to loosen the muscles in the socket behind the eye.

2. When it is pushed out of the socket, remove your finger.

3. From the outside, gently pull up on the eye with one hand as you cut it away from the head.

Human eyes are approximately the size of a golf ball. As do salmon, most of the eye is hidden inside their skull for protection. Unlike humans, salmon have no eyelids and no need to blink. Their eyes are continuously washed in water.

Return to Top

STEP 11

BRAIN

- Like all chordates, salmon have a brain at the end of their spinal cord where the nervous system transmits the information they receive about their

environment.

1. Begin by cutting through the salmon's head behind the gill covers.

2. Hold the head by the nose and place the back of the head on a cutting surface.

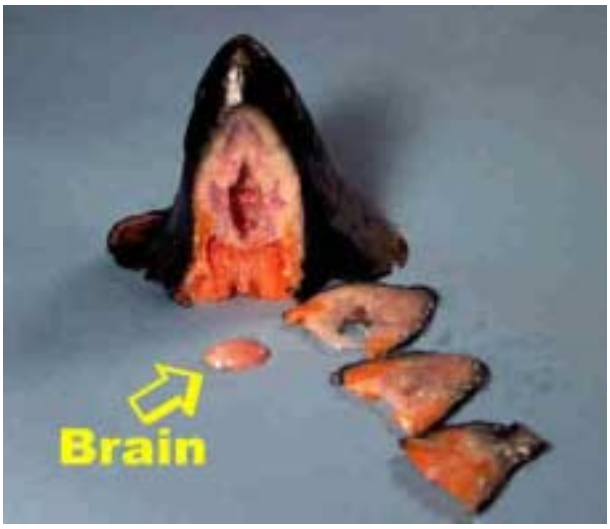
3. Remove a very thin slice (1/3 cm) from the top of the head. Thin slices will prevent damage to the soft brain tissue.

4. Remove a second 1/3 cm slice.The opening to the brain is surrounded by cartilage.

5. Remove a third 1/3 cm slice. There are three pea-shaped sections.

6. Use the tip of the knife to gently probe and scrape out the brain. Tilt the head up side down and continue to scrape until removed.

- The salmon brain. 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.
- Compare the size of the salmon’s eye to the size of their brain. Compare a human eye (the size of a golf ball) to the size of our brain. Salmon rely on their senses and an inborn knowledge



called instinct to help them survive.

Return to Top

STEP 12

CLEAN-UP

Clean the dissection area and all instruments with disinfectant and paper towels.

SUMMARY

You may wish to conclude this dissection by comparing human mammals and salmon. The structural and internal anatomy can be compared, including the muscular, skeletal, respiratory, digestive and reproductive systems. Salmon have many complex biological systems in order to live. Some have similarities to humans and other animals. Some are unique to fish.