# Dissecting a Salmon

[demonstration]

*Adapted from procedures described by Chris Zimich, Helping Teacher, School District #36, Surrey, and Bev O'Connor, School District #39, Vancouver.*

**Materials:**
For each group conducting a dissection:

- A whole salmon (may require time to thaw)
- A sharp, thin kitchen knife
- A spoon
- A plastic drinking straw
- Paper plates
- A magnifying lens
- Toothpicks or bamboo skewers (optional)
- Newspapers
- Paper towels
- Thin latex or plastic gloves
- A bucket of water with disinfectant for cleaning
- Heavy plastic garbage bags for waste
- One copy of "Handout 4.3: Dissecting a Salmon" for each student
- One copy of "Handout 4.4: Salmon External Anatomy" for each student
- One copy of "Handout 4.5: Salmon Internal Anatomy" for each student
- Writing supplies

**Time required:**
Approximately 60 minutes in two periods

## Preparation

*Option:* Some independent education suppliers, education supply stores and science education catalogues carry cloth fish, 3-D models and posters that could help you to introduce this dissection activity to your students. You may also want to photocopy "Handout 4.4: Salmon External Anatomy" and "Handout 4.5: Salmon Internal Anatomy" onto an overhead transparency for reference.

- Depending on your students and the availability of salmon for dissection, you may prefer to do this activity as a demonstration or as a hands-on activity with pairs or groups of students dissecting a salmon as you model the procedure. If you do it as a hands-on activity, have pairs or groups of students take turns carrying out the steps as you model them. Have the non-participating students write notes describing the procedure and their observations on the handout. If you do the activity as a demonstration, have students pass the dissected parts and the magnifying lens around the observation table.
- Obtain a whole salmon for each group of students, plus one for modelling correct dissection. Spawning pinks, sockeye or coho are usually the best size and can be obtained from hatcheries. However, silver adults taken from streams also work well if you prefer to do the dissection in Unit Nine: Adult Salmon. You will need to obtain the fish from a fish hatchery or fish farm, as most commercially caught whole salmon are gutted at sea. Contact the community advisor for your area for assistance and discuss whether the salmon carcasses should be returned or disposed of in some other way.
- Advise students in advance to wear clothes that can get messy.

## Introduction

- Have a discussion with students about showing respect for all species. This should serve as a guiding principle for the students' behaviour during the following activity. You may wish to refer to "Ethical Discussions" on page viii of the foreword for inspiring quotes specific to salmon.
- Provide each student with a copy of "Handout 4.4: Salmon External Anatomy" and "Handout 4.5: Salmon Internal Anatomy". Sketch an outline of a human on the chalkboard. Refer to the salmon handouts, as needed,

**Level of conceptual difficulty:**
Simple

**Suggestions for assessment:**
Monitor the students' responses during the dissection and review their dissection observations and comparisons to ensure that the students can identify and describe the parts of a fish, their functions and their relationships to human physiology.

to explain the dissection. Refer to the human sketch to compare human physiology with fish physiology. (If convenient, you may prefer to make overhead transparencies from the illustrations.)

- Warn students to use care when using the knife, as it is very sharp. If the students are not doing the dissection, have them use toothpicks or bamboo skewers as probes when you ask them to feel the samples.
- Advise students that, if they feel uncomfortable during the dissection, they can look away or move their chair farther back.
- Have students in pairs or individually use "Handout 4.3: Dissecting a Salmon" to follow the dissection and record their information.

## Demonstration

- Have students observe the salmon as you dissect it and compare the salmon's anatomy with the anatomy of other animals or other organisms they know. Prompt them with questions, such as:

**Slime layer and scales**

- What is the first thing you notice when you hold a fish?

  *The fish is slippery. Many fish, including salmon, have a layer of slime covering their body. The slime layer helps the fish to:*

  - *slip away from predators, such as bears;*
  - *slip over rocks to avoid injuries;*
  - *slide easily through water when swimming;*
  - *avoid fungi, parasites, disease and pollutants that might be in the water. (It's a sort of living plastic bag in which the salmon lives.)*

- What covers the fish's body under the slime layer?
  *Most fish, including salmon, have a layer of scales covering their skin.*
  *Scales are small, hard plates like fingernails that cover a fish's whole body.*
  *The scales overlap to form a flexible armour plating that protects fish from predators and bruising.*
  *Salmon don't grow their scales until the fry stage or*



*later. They start to reabsorb their scales when they become spawners. (Scales aren't usually completely reabsorbed at the time of death.)*
*The way the scales are arranged in rows or patterns is different for each species of fish. You can tell one species from another by the size of the scales and the way they are arranged.*
*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 freshwater or saltwater from the lines on its scales.*
*If a fish loses a scale, it can grow another to replace it. New scales have a clear centre, because they do not have the growth lines.*

- Remove a scale and have students examine it later under a hand lens or microscope.

**Fish shape and features**

- What shape is a fish? What shape is a salmon? Why are fish shaped this way?
  *Fish come in many shapes, although torpedo shape is the most common. Salmon are torpedo shaped. However, some fish, like flounder and halibut, are flat. Some are almost string-like and a few are round, like a balloon.*
  *The streamlined shape of a fish lets it move easily through water. Water has much more resistance to movement than air does, so it takes much more energy to move through water. A streamlined shape saves energy.*

- What are the main parts of a salmon that you can see?
  *On the head, you can see the mouth, eyes, nostrils and gills.*
  *On the body, you can see the fins and tail, the vent and the lateral line.*

**Fins and tail**

- How many fins can you see? How are they arranged?
  *Salmon have eight fins, including the tail.*
  *Some fins are arranged in pairs, one on each side of the salmon's body.*
  *The pectoral fins are in the front, below the shoulder. The pelvic, or ventral, fins are on the belly, farther back from the head.*

*The others, known as median fins, are arranged in a line on the salmon's belly and back.*
*The dorsal fin is in the centre of the back.*
*The anal fin is in the centre of the belly, just in front of the tail.*
*The adipose fin is on the back, in front of the tail. (The adipose fin is sometimes clipped off in hatchery fish to help identify the fish when they return or are caught.)*
*The tail is a special fin at the back of the body, called the caudal fin. It includes the end of the backbone.*

- What do the fins do?
  *The fins each have a different function.*
  *The caudal fin, 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 in which the fish moves.*
  *The anal fin also helps keep the fish stable and upright.*
  *The pectoral and pelvic fins are used 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 does not seem to harm salmon if it is cut off from nursery fish.*

  *Note that a fish uses its whole body to move through water, but the fins give it much more control. Even without fins, however, a fish would be able to swim, but it would not be able to right itself easily.*

- Hold the salmon by the tail, with the belly facing away from you. Without cutting deeply into the belly, cut open the salmon from the vent to the pelvic fins. Cut through the pelvic fins and remove them.

  - What do the fins (except the adipose fin) have in common?
    *The fins 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 manoeuvrability.*

- Place the pelvic fins on a paper plate and have students examine them.

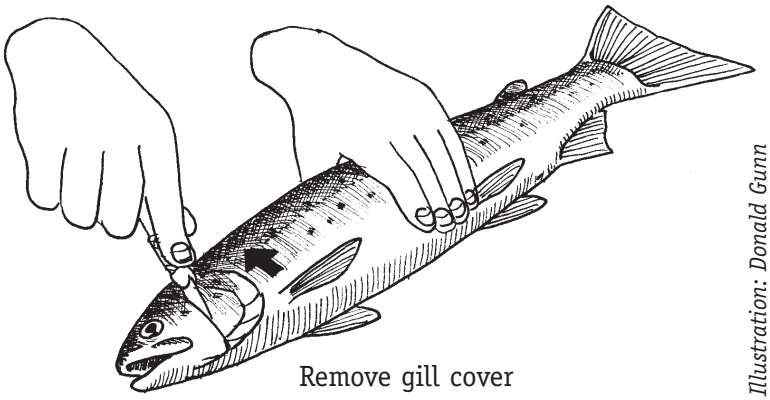


**Gills and gill rakers**

- How do fish breathe? Can someone demonstrate the motions for the class?
  *Fish gulp water through their mouth, then close their mouth and throat.*
  *They force the water out through an opening in the back of the their throat. Gills line the opening.*
  *Gills are very thin membranes (two cells wide) that line the gill passage. Oxygen dissolved in the water diffuses through the membrane into the fish's blood. (This is similar to the way oxygen in the air diffuses through the membranes in an animal's lungs.)*
  *Carbon dioxide in the fish's blood diffuses out through the gills.*
  *Salmon also secrete excess salt through their gills when they are in salt water.*
  *Gills are much more efficient at extracting oxygen than lungs are. They can extract oxygen if there are as few as five molecules of dissolved oxygen for every million parts of water. Animals with lungs are used to one part oxygen to five parts of air (200,000 parts per million).*

- What protects the outside of the gills?
  *The operculum, or gill cover, is a hard outer lining like a flexible plate that the fish opens and closes to let water through.*

■ Remove both sets of gill covers. Cut through the bone from the apex near the throat, then pare away upward toward the spine on both sides. Cut only as far as necessary. Once the gills are freed, pull them out with the fingers. Place them on a paper plate and have students examine them with a magnifying lens.



Remove gill cover

*Illustration: Donald Gunn*

- What colour are the gills? Why? What do they look like?
  *The gills are red because they are filled with blood. They look like fine, branched structures, like a Christmas tree. The branching structure gives the greatest possible surface area to absorb oxygen from the water.*

■ Cut the gill rakers from the opening of the throat. Place them on a paper plate and have students examine them.

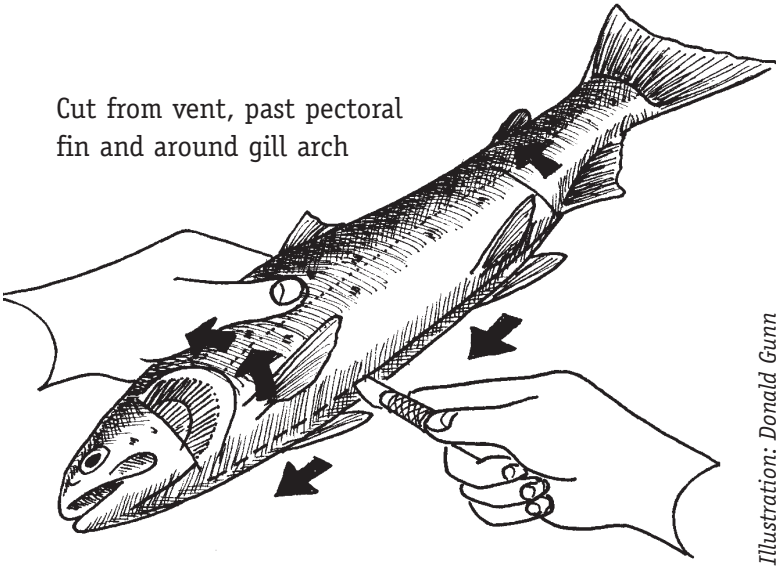



*Illustration: Donald Gunn*

- Why does a fish need spines lining the gill opening on the inside of the throat?
  *The spines prevent food from entering the gill passages and guide it into the throat.*

**Eggs or milt**

- What hypothesis would you make about whether the fish is male or female?
  *If the fish is female, much of the body cavity will be filled with eggs.*
  *If it is ready to spawn, the eggs will be loose. More likely, they will be enclosed within a membrane.*
  *If the fish is male, you will see a white bladder of milt.*

■ Gently pull the egg or milt sack away from the body and detach it. Place it on a paper plate, cut it open and have students examine it.

- Why does one salmon have so many eggs?
  *A female coho salmon has about 2,500 eggs, while other salmon species have from 2,000 to 5,000.*
  *In coho, only about 15 per cent survive to hatch and*

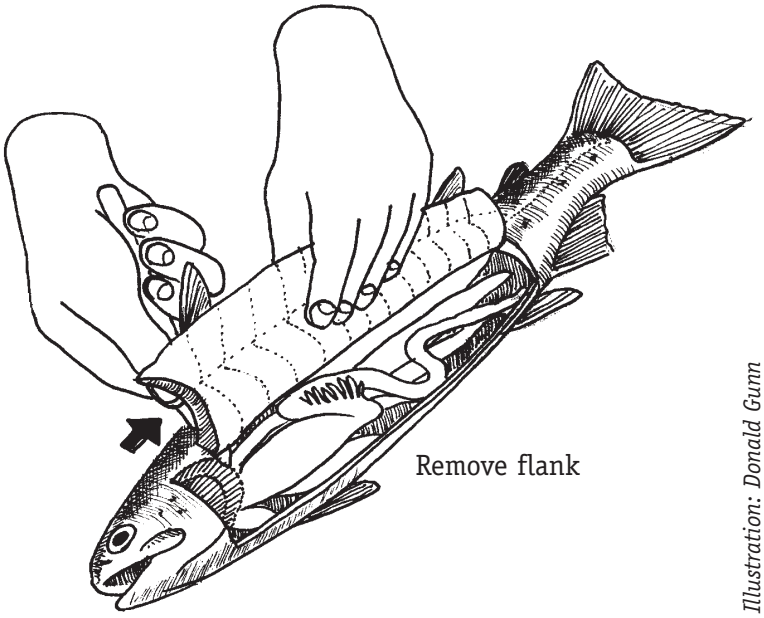



*Illustration: Donald Gunn*

*only about 30 survive the first year. About four will grow to become adults, and only two will live long enough to spawn. So each female produces enough eggs to replace only one pair of fish.*

**The liver**

- What is the largest organ in the fish's body (and in a person's body, too)?
  *The liver is the largest organ.*
  *It is dark red and firm in texture.*
  *The liver cleans the blood, and manufactures and secretes nutrients into the blood. The liver is essential for maintaining the proper level of blood chemicals and sugars.*
  *The gall bladder is attached to the liver. It contains green bile, which is used in the digestion process.*

■ Gently pull the liver away from the body and detach it. Place it on a paper plate, cut it open and have students examine it.

**The heart**

- Where would you look for the heart?
- Why is the heart located so close to the throat?
  *It is very close to the gills, where the blood gets refreshed, just as the heart is close to the lungs in humans.*

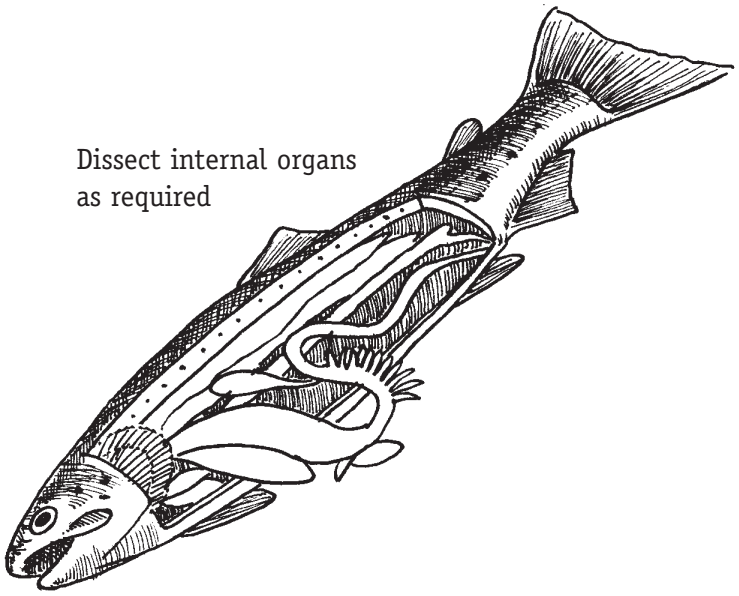



*Illustration: Donald Gunn*

- Carefully cut the skin from the belly to the throat. Locate the heart in the cavity in the throat area near the gills. Pull the heart out. Place it on a paper plate, cut it open and have students examine it.

  - What does the heart feel like? Why?
    *The heart feels tough but flexible. It is a strong muscle, but it has two hollow chambers that pump blood around the fish.*

**The digestive system**

  - How would you find the digestive system?
    *The digestive system consists of several pieces, attached to the mouth at one end and the vent, or anus, at the other end.*

- Gently push the straw through the mouth of the salmon, down the throat and into the digestive system.

- Detach the system at the throat and vent. Place it on a paper plate and have students examine it.
  *The first part of the system, the stomach, extrudes digestive juices that break down food and absorb nutrients into the blood. It is similar to the small intestine in people.*
  *A red spleen is attached to the digestive system. It acts as a storehouse of blood for emergencies and it recycles worn-out red blood cells.*
  *Food absorption occurs mainly in the intestine, the tube-like section at the end of the system.*
  *The digestive system of a fish is much shorter and simpler than the digestive system of mammals. Because fish are*



*cold-blooded, they do not use as much energy as a warm-blooded animal of the same size. They do not need to extract as much energy from their food when they digest it, so they can expel it more quickly.*

**The swim bladder**

- Most fish swallow air into their swim bladder to counteract the weight of their bodies. Where would you look for the swim bladder?
  *The swim bladder is attached to the throat, along the top of the abdominal cavity.*

- Gently detach the swim bladder, without tearing it, by stripping it out with your fingers. Cut open one end and insert the straw. Have a student gently inflate the bladder by blowing through the straw, then twist the end and float it in the bucket of water. Place the bladder on a paper plate and have students examine it.
  *Salmon can adjust the air in their swim bladder so they can hover comfortably at different levels in the water without sinking or rising.*
  *Because the swim bladder is located just below the centre of the fish, it keeps the fish slightly off-balance. This is why fish float upside down when they die.*

**The kidney**

- The kidney cleans the blood and produces red blood cells. It is also critical in the salmon's smolting process (going from fresh to salt water) in a process called osmoregulation. What colour should the kidney be?
  *The kidney looks like a dark red line along the backbone.*

- Slice through the membrane holding the kidney in place and use the spoon carefully to lift it off. Place it on a paper plate and have students examine it.
  *The front part of the salmon's kidney replaces red blood cells and the back part filters waste products out of the blood.*

**The ribs and backbone**

- What are the bones that surround the abdominal cavity?
  *The ribs are lightweight, curved bones that give the fish its shape, just as ribs create the barrel-like shape of a human torso. The ribs serve to protect that salmon's internal organs.*

- Slice through the membrane on either side of a rib and pull it up toward the backbone. Pull to disconnect it, place it on a paper plate and have students examine it.

    - Fish share a very important characteristic with mammals: their flexible backbone. What does the backbone look like?
      *The backbone is made up of a series of interlocked disks. They can move from side to side, but fish 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.*

- Cut off the tail, and expose a segment of backbone. Place the tail on a paper plate.

**Lateral line**

- Have students examine the cross-section of the body and note the indentation where the lateral line runs along the fish.

    - What is the lateral line for?
      *The lateral line is a specialized organ which all fish have, and which functions 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 an organ of touch, an organ of hearing and an organ of 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, feel movement around them and detect changes in the water.*

    *Option:* If the fish is edible, filet the fish by slicing the flesh away from the ribs and backbone, first on one side, then on the other, exposing the ribs and backbone. Refrigerate the filets.

**The head**

- Reach under the gill with a finger and push up to loosen the muscles around the eye. Then cut the muscles attaching the eye to the eye socket and pull it out. Place the eye on a paper plate and have students examine it.



- How are fish eyes similar to and different from people's eyes?
  *Salmon have two eyes but, unlike people,salmon do not have binocular vision, which would give them depth perception. However, the salmon 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 metres or more.*
  *Fish have no eyelids. Their eyes are continuously washed in water.*

- How do salmon smell?
  *Fish have nostrils above their mouth, but no noses. The nostrils are a small indentation that is not connected to the mouth cavity.*
  *Their scent organs detect chemicals in the water in very tiny concentrations. They use this information to detect harmful pollution and avoid potential threats, if possible. They also use smells to recognize their way home.*

- Can salmon hear?
  *Fish have an inner ear, but no outer ear. Sound waves travel through the water and through their body to the inner ear.*
  *Fish may also detect sound waves through their lateral line.*
  *The hearing range in fish is probably not as wide as in humans. However, fish probably use hearing to detect predators and other threats.*

- How do salmon taste?
  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.

**The brain**

■ Split the head open by placing the fish on its back, pressing the knife vertically into the backbone at the base of the head, and levering forward into the mouth. The brain will be visible in the split.

- What organ do salmon use to process all the information their senses gather and to respond to stimuli in their environment?
  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.
Salmon brains have three pea-shaped sections.
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

**Clean-up and conclusion**

- If students are conducting a dissection, have them gather all scraps, rubber gloves, newspaper, paper towels, paper plates, etc. in the garbage bags (unless you have made provisions for returning or disposing of the waste).
- Have students use buckets of clean water with disinfectant and paper towels to thoroughly clean the knife, tables, chairs, sink, etc.
- Have students draw a stick figure on a sheet of paper, with a large thought bubble on one side and a speech balloon on the other. Have them write in the thought bubble words that describe how they felt during the dissection. Have them write in the speech balloon words that describe what a scientist would conclude following the dissection.
- Invite students to share their thought bubbles and speech balloons with the class and discuss their reactions. If necessary, prompt them with questions, such as:
    - What would make people feel uncomfortable during a dissection?
      *Cutting open a body, unusual sights and smells, etc.*
    - How do scientists react if they feel uncomfortable?
      *They talk about their concerns, discuss why they feel uncomfortable, and why they want to continue or stop the investigation.*
    - What would a scientist conclude from the observations?
      *Salmon have many complex biological systems in order to live. Some have similarities to humans and other animals. Some are unique to fish.*
- Have students refer to their notes and information sheets and compare the structural and internal anatomy of a fish with that of a human, including the muscular, skeletal, respiratory, digestive and reproductive systems.