**Dissection**

You will be dissecting a dogfish shark: ***Squalus acanthias***. The equipment you will be using includes:

o a large dissection tray

o surgical scissors

o scalpel

o probe

o forceps

Dissection is a learned skill that takes practice and patience. Some general rules to remember are:

1. Do not make deep cuts with scissors or scalpels as you may damage tissue underneath.

2. Know the anatomical terms listed next so you can follow the directions.

3. Read the section you are working on **before** you start cutting.

4. Try to answer each other’s questions about anatomy before asking your teacher for help.

**Anatomical Terms**

Cranial - toward the head

Caudal - toward the rear

Dorsal - toward the spinal cord (back)

Ventral - toward the belly

Medial - toward the middle

Distal - away from

Lateral - to the side

**I. External Features** (Figure 1)

Familiarize yourself with the following external features:

1. **External Nares** – These are a pair of openings (nostrils) on each side of the head, cranial from the eyes. Water is taken into the smaller of the two openings and expelled through the larger opening. The water passes by a sensory membrane allowing the shark to detect chemicals in the water.

2. **Spiracles –** These are small openings caudal from the eyes. These openings allow water to pass through the gills even when the shark’s mouth is closed.

3. **Mouth** – Although the eating function is evident, the mouth is also used for the intake of water that passes through the gills.

4. **Gill Slits –** Five vertical slits which allow water to exit after passing over the gills. They are located caudally from the mouth.

5. **Lateral Line –** A pale line that extends noticeably from the pectoral fin past the pelvic fin. This line is actually a group of small pores which open into the underlying lateral line canal, a sensory organ that detects water movements.

6. **Cloaca –** This is the exit from the digestive tract combined with being the opening for the sex organs. The cloaca lies between the pelvic fins.

7. **Clasper –** Found on male sharks only, these are finger-like extensions of the medial edge of each pelvic fin. They may have a single spine associated with each clasper. The claspers aid in sperm transfer during mating.

8. **Fins –** Refer to Figure 1 and familiarize yourself with each fin and its name.

9. **Rostrum –** This is the pointed snout at the cranial end of the head.

10. **Dorsal Spines –** Just cranial to each dorsal fin is a spine that is used defensively by the shark. Each spine has a poison gland associated with it.

**II. The Skeletal System**

Unlike the other ‘higher vertebrates’ (fish, reptiles, birds, etc.) the shark does not have a bony skeleton but instead has a skeleton composed of cartilage. Familiarize yourself with the skeleton as you proceed through the dissection.

**III. The Muscular System**

In the interest of time, we are skipping the full dissection of the muscular system. Below the skin, this is the most exterior system of the shark.

**IV. Dissecting the Abdominal Cavity**

Use the figure on the next page to show you where to cut through the muscles.

1. Place your shark ventral side up on the dissection tray.

Refer to Figure 5 on the page

2. Using scissors – blunt tip inside the shark – make a cut from the left side of the jaw (the shark’s left) caudally down through the middle of the gill slits and through the pectoral girdle down to just above the cloaca. **Cutting through the pectoral girdle may be difficult. Ask if you need help.**

Refer to Figure 5 on the page

3. From the cloaca make transverse (side to side) cuts around the shark.

4. From the pectoral girdle, make transverse cuts around dorsally.

5. You may pin the flaps of muscle tissue to the dorsal sides of the shark or remove the tissue and place to the side so you can cover the internal organs overnight.

At this point, with the help of the figure, you should be able to identify the organs in the list below.

**Esophagus** – The connection between the pharynx to the stomach. In the shark the esophagus is very short and wide.

**Stomach** – This J-shaped organ is composed of a cardiac portion which lies near to the heard and a limb portion which is after the bend of the stomach. The stomach ends at the pyloric sphincter – a muscular ring which opens or closes the stomach into the intestine. The pyloric sphincter can be felt if you choose to find it.

**Duodenum –** This is a short section immediately caudal from the stomach. It receives liver secretions known as bile from the bile duct.

**Liver** – The liver is composed of three lobes, two large and one smaller. The gall bladder is located within the smaller lobe. The bladder stores the bile secreted by the liver.

**Pancreas** – Divided into two parts: The ventral pancreas, which is easily viewed on the ventral surface of the duodenum and the dorsal pancreas which is long and thin located behind the duodenum and extends to the spleen.

**Spiral Intestine** – Located cranially from the duodenum and distinguished by the extensive network of arteries and veins over its surface.

**Rectum** – This is the short end portion of the digestive tract between the intestine and the cloaca. The rectum stores solid wastes.

**Spleen** – Located just caudal to the stomach and proximal (before) to the spiral intestine. This organ is not part of the digestive tract, but is associated with the circulatory system.

**Circulatory System**

1. Lift the flaps over the area of the heart and pin them where they stay out of the way.

**2.** It may be necessary to cut some tissue that may be attached to the heart.

**3.** If you would like to cut open the chambers of the heart for a better look you may do so.

You should now be able to identify the some of the structures that are listed below.

**Sinus Venosus** – Dorsal to the ventricle, this is a thin walled, non-muscular sac which acts as a collecting place for deoxygenated blood.

**Atrium** – Similar to the atrium of a human.

**Ventricle** – The main contracting chamber of the heart.

**Conus Arteriosus –** A muscular reservoir that empties after the ventricle contracts. It gives the blood flow an added boost.

**Mouth Structures**

**Teeth** – These are derived from the scales which cover the shark’s body! They have been adapted to function as cutting structures. The teeth of a shark are replaced regularly as they wear out.

**Pharynx** – The cavity caudal from the spiracles to the esophagus. The gill slits open on either side of the caudal region. The gill rakers are cartilaginous protrusions which prevent large particles of food from entering the gills.

**Tongue –** The tongue of the shark is immovable.

**V. The Urogenital System**

To view this system you need to remove all of the digestive tract

1. Remove the liver by cutting at its cranial end.

2. Cut through the esophagus where it enters the body cavity above the stomach.

3. Cut the colon at its caudal end.

4. Cut the membranes attaching the stomach, intestine, pancreas and spleen to the body wall.

This procedure exposes the sex organs, kidneys, and various ducts associated with these organs. Figure 11 shows the male urogenital system. Figure 12 shows the female urogenital system.

You should be able to identify the organs listed below once you have completed steps 1-4 above.

**Kidneys** – The shark has two dark-colored kidneys on either side of the midline. The shark regulates its urinary system in a way unique compared to most other vertebrates. The shark kidney extracts urea from urine and returns the urea to the blood. In this way the water pressure of the shark’s body fluids are maintained as high as that of sea water.

**Rectal Glands** – These are tube-like extensions of the rectum. This gland controls the salt concentration within the body. Excess salt is secreted into the gland tubule. Via the central gland cavity, salt is released into the rectum for expulsion.

**Archinephric Ducts** – In females these are the ducts that drain into the cloaca through the urinary papilla. In the male shark, this duct transports both urine and sperm (not necessarily at the same time). This duct is much easier to find on the males than it is in females. Also in the male shark the ducts enlarge caudally to form the seminal vesicle.

**Accessory Urine Ducts** – In general, these are absent in female sharks. In males these ducts drain the caudal portion of the kidneys. These are found dorsal to the seminal vesicles.

**Male Genital System** (Figure 12)

**Testes** – The testes are oval in shape and are dorsal to where the liver was. This organ is where male gametes are produced.

**Epididymis** – The cranial part of the kidney that collects sperm.

**Vas Deferens** (Archinephric duct) – A highly coiled tube that carries sperm to the seminal vesicle.

**Seminal Vesicle** – An enlarged section of the vas deferens that adds secretions to the sperm.

**Sperm Sacs** – A pair of small sacs created by invaginations of the seminal vesicles that receives sperm and seminal secretions from the seminal vesicle.

**Siphon** – Produces a secretion that is expelled with the aid of the clasper during mating.

**Female Genital System** (Figure 13)

**Ovaries** – Two cream colored organs that were dorsal to the liver and are on each side of the mid-dorsal line. Depending on the maturity of your specimen, it may or may not show eggs within each ovary. The eggs move into the body cavity and then into the oviducts when they are ready to be fertilized.

**Oviducts** – Elongated tubes that lay dorsal and lateral along the body cavity. These structures are very prominent in mature sharks. Both oviducts share a common opening to the body cavity called the ostium.

**Shell Gland** – Found at the cranial end of the oviducts. This gland secretes a thin shell around a group of eggs and is a reservoir for sperm storage. Eggs are fertilized in this gland as they pass through.

**Uterus** – The enlarged caudal end of the oviduct. It is here that eggs develop.

**VI. The Nervous System: The Brain**

1. Remove the skin from the dorsal section of the head.

2. With your scalpel, carefully shave the chondocranium (shark’s cranium) down to expose the brain, the olfactory lobes, and the major brain nerves. **Shave off thin sections so that you don’t cut into the brain or nerves.**

3. Remove chips of cartilage with forceps. Remove the chondocranium from the tip of the rostrum back to the gill slits.

Now that you’ve exposed the nervous system, you should be able to identify the following organs.

**Olfactory Sacs** – Two large bulbous nerve sensors that detect chemicals in the surrounding water.

**Olfactory Lobes** – Area of the brain that receives nerve signals from the olfactory sacs and processes them.

**Cerebrum** – The two hemispheres between the olfactory lobes and are associated with sight and smell.

**Diencephalon** – The region just caudal from the cerebrum and separates the fore and mid-brain. Includes the thalamus and the hypothalamus.

**Optic Lobe** – Large prominent lobes of the mid-brain that receive nerves from the eyes.

**Cerebellum** – Just caudal from the optic lobes it controls muscular coordination and position.

**Auricle of Cerebellum** (Restiform body) – A lateral extension of the cerebellum.

**Medulla Oblongata** – The base of the brain, a widening of the spinal cord. Controls many of the spinal reflexes.

**Dissection Clean-up**

Now that you have completed your dissection it is time to clean up!

1. Return **all parts** of the shark to the bag you stored it in.

2. Secure the bag with a rubber band – just like when we started the lab.

3. Place the secured bag in one of the boxes we removed them from at the beginning of the lab.

4. Wash and dry all of your dissection tools.

5. Return all of the tools to your teacher.

6. Wash and dry your dissection tray.

7. Return your dissection tray to your teacher.

**8. Make sure you have completed all parts of the dissection packet.**

**9. Turn in your dissection packet to your teacher in order to receive credit for the project!**