

# Squid Dissection

## Objectives:

As a result of this lesson, students will be able to:

1. Locate and identify major external and internal features and organs of a squid.
2. Understand and use basic dissection techniques and terms.
3. Critically examine the functions of several squid features and organs.

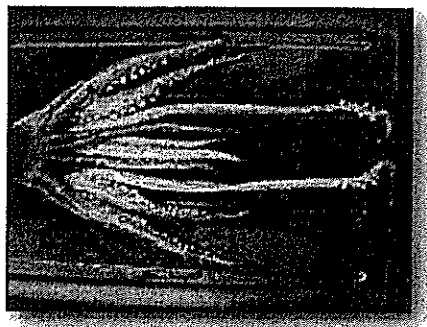
## Procedure

### 1. Orientation:

Place the squid with the dorsal (back) side up in the dissecting pan. This means put the side with the funnel down and the fin side up. Make sure the tentacles and arms are towards you. Locate the head, eyes, beaks (mouth), arms (8), two longer feeding tentacles, fins, mantle, and skin. Use the hand lens to examine the suckers on the tentacles and arms as well as the spots on the skin, which are chromatophores.



What are the differences between arm and tentacle suckers? Where are the suckers located on the feeding tentacles as compared to the location of the suckers on the arms?



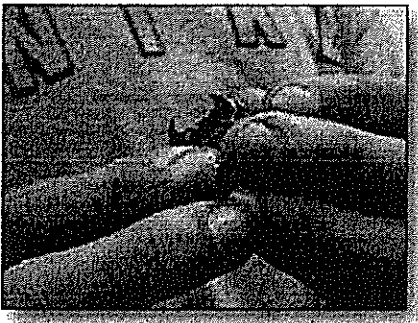
How do you account for the different locations of the suckers on the tentacles and the arms? What are chromatophores?

## 2. The Mouth and Beaks:

Locate the dark beaks in the center of the mouth.

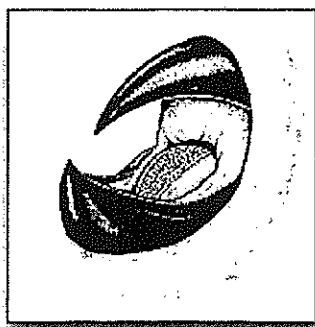


Open and close the beaks, noting how the ventral beak overlaps the dorsal beak. How is this different from a parrot's beak? Before you pull out the beaks, imagine what they will look like on the inside. With tweezers, remove the beaks and place beaks together with dark pointed parts opposite one another. Manipulate them (open and close) as if the squid were eating. What makes them work in this way?



In order to remove the radula (a ribbon with rows of teeth on a tongue-like muscle) from inside the mouth, make small incisions in the edge of the mouth. With tweezers, locate the small, folded, plastic-like radula between beaks and remove it. It is usually very small, yellow or white in color. What is the radula's function?

Store the radula and the beaks in water in a small cup if you are going to do a microscopic examination.



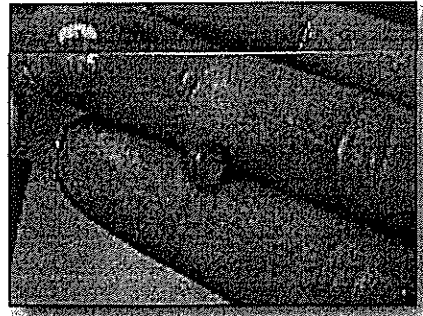
### 3. Funnel:

Turn the body over, ventral side up, and locate the funnel (a deflated fleshy tube located at the base of the head). A squid swims by squirting water from the mantle through the funnel. The direction it swims depends on which way the funnel is aimed. Move the funnel and note its flexibility.

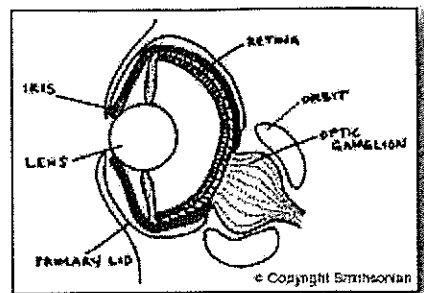


### 4. External Anatomy:

Orient the squid so that the tentacles are away from you, at the top of the dissection tray. Spread out the arms, tentacles, and fins. Draw and label the external parts of the squid: arms, tentacles (have suckers only at the tips), head, eyes, fins, mantle, funnel, tail, suckers, beaks (where each would be found on an intact squid) and mouth. If something cannot be seen, draw an arrow to show where it should be.



If you have time, slice open an eyeball and locate the lens, pupil, retina, and iris (colored part of the eye). Look for the creamy white brain between the eyeballs. For assistance in identifying these parts, refer to the illustration below.



## 5. Opening the Mantle:

Keep the squid on its back (the side opposite the funnel). Using forceps, lift up the opening to the mantle behind the funnel (near the head) and separate the mantle from the internal organs. Close the forceps firmly so as to "pinch" the mantle flesh to keep it taut, cut along the ventral midline of the mantle, from its opening all the way to the tail. Be careful to keep the scissors lifted away from the internal organs so they are not damaged.



## 6. Locating and Removing Reproductive Organs:

Locate the gonad (reproductive organ) in the posterior end (refer to diagram for shape and location).



Upon opening female specimens, the large, firm, white nidamental glands are seen first. Males do not have nidamental glands. The glands lay on top of the other internal organs. These glands create the gelatinous matrix that envelops the eggs. In order to proceed further, carefully remove these glands.

In females the eggs are jelly-like in a conical sac at the posterior end of the mantle. The male genital duct is a white, fluid-filled sac in the posterior end of the mantle. The sperm are stored in thin tubes in an elongated sac behind and along one gill.



## 7. Gills:

Find the gills. These are the long, feather-shaped organs that are attached to the sides of the mantle and extend along the anterior half of the mantle. Identify the gill hearts, one on the posterior end of each gill (these are small, flat and white). Questions: Why are they white and our hearts are red or purple? The squid has a third heart (the systemic heart) that pumps blood to the rest of the body.



**Challenge:** Why does it have separate hearts for the gills alone?

## 8. Digestive Tract:



The long, silvery dark tube on the bottom of the liver (but appearing to be on top of the liver because of the squid's inverted position) is the ink sac. Be careful not to break it open. Locate the stomach and caecum. These lie together as one white, silky-looking tube, like a deflated bladder and a coiled sack. The bunched up organs that look like human intestines are digestive ducts for the squid. If you are curious about the liver, wait to cut it open until the end of the dissection. It contains a lot of brown, oily liquid which may obscure other organs. If possible, open the stomach and examine its contents. Many squid will have bits of partially digested crustaceans (pink and white pieces), or tiny fish scales and bones.



### 9. Removing the Ink Sac:

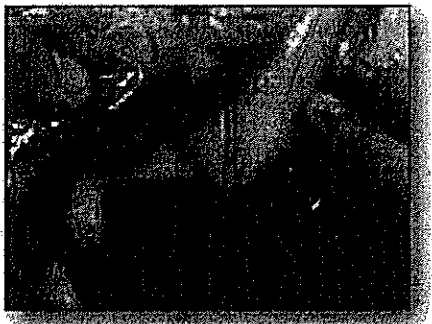
Find and carefully remove the silvery-black ink sac that lies connected to the intestine. To do this, pinch the opening of the sac (near the back of the funnel) with forceps while gently pulling up and cutting the connective membrane along its length. After cutting about 1/3 to 1/2 of it, hold the sac with your fingers and pull the sac off the liver. Be careful not to puncture it. Squid ink stains clothing and skin. Place the sac in a small cup for later use with the gladius (pen).



### 10. Removing the Gladius (Pen):

The gladius is a long, clear feather-shaped structure used to support the mantle and for organ attachment. It and the cranium, or brain case, make up the "skeleton" of the squid. It feels like plastic and is made of tissue similar to a shrimp shell.

There are two ways to remove it: from the tail or from inside the cut-open mantle. To remove it from inside the open mantle, grasp the head and organs firmly, and rotate them to the side with your left hand while holding on to one side of the mantle with your right hand and pulling away gently. Pulling the gladius out is like removing a splinter from your skin. You may need to cut away connective tissues that hold the gladius in place.

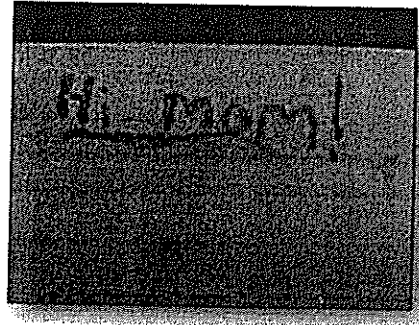


The gladius is revealed, lying along the dorsal midline of the mantle.

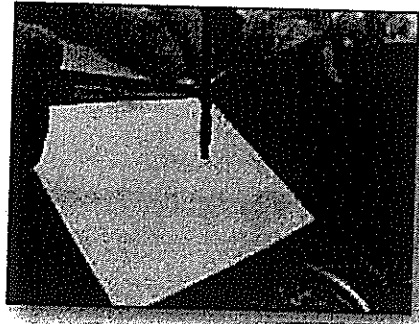


Grab the forward end of the gladius and pull it carefully from its slot in the mantle. It may be helpful to have one person hold down the lower mantle while the other removes the gladius.

To remove from the tail end, rotate the organs to one side, cutting connective tissues. Make sure the mantle is slit along the internal dorsal midline all the way to the tip of the tail. Pry out the tail end of the gladius and pull straight back, away from the body.

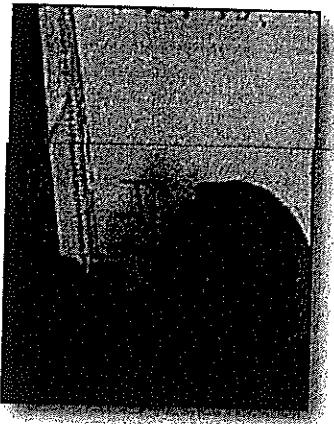


**11. Writing with the Gladius (Pen) and Squid Ink:**



Cut one end of the ink sac open and press it against the bottom of the cup with forceps or toothpick. You can also hold one end and push the ink out with your finger, as you would toothpaste from a tube. This will release the ink. Dip the pointed tip (the anterior end) of the gladius into the ink, filling the tip with the dark fluid. Then, using only the ink-filled tip of the gladius, write your name on your squid illustration or paper. If there is enough ink, create and write the name of your dissected squid under its picture. If the ink seems dry and pasty, add one drop of water at a time to create fluid ink. Though this is an unusual way to write, squid ink was actually used to write and draw in ancient times, and it is used today in some cultures. Unfortunately, it tends to fade over time (except from your clothes!).

**12. Internal Anatomy:**



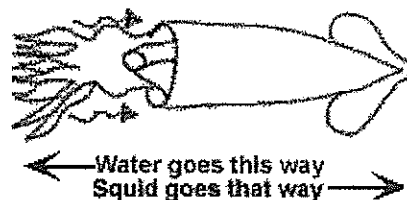
Draw, label, and identify the function of the following internal parts of the squid:

- stomach
- caecum
- hearts (systemic and gill)
- gills
- reproductive organs
- ink sac
- liver (digestive gland)
- gladius
- brain
- eyeball

## Squid Biology/Anatomy Notes, based on *Loligo sp.*

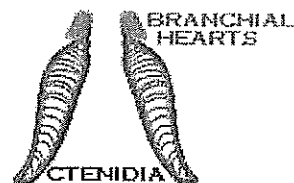
### Moving/Locomotion

Squid are among the fastest invertebrates on earth speeding through the water at up to 40 km/h (24 mph). Very odd when compared to other members of the phylum Mollusca like the snail, slug, oyster, etc. When escaping predators, some squid can even jump 3m (about 12ft) out of the water and glide like a flying fish. They can move fast because they are naturally jet propelled. The outside body of the squid is called the **MANTLE** which fits like a hat over the real body and organs of the squid. By opening up the mantle around the head squid suck water inside the mantle. Then they squish the mantle closed. The water is let out in only one place, the **FUNNEL**. Like a jet fighter engine nozzle, the squid can open, close, twist, and turn the funnel to go where they want. Of course they would fly around like a released balloon if they didn't have **FINLETS** to act as rudders on the outside. Also like a balloon they would flop and fold if they didn't have a strong support beam, called the **PEN** inside the mantle to make it stiff.



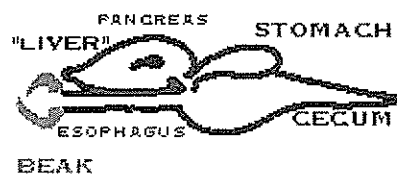
### Breathing/Respiration

Squid live in the ocean, therefore they need some type of gill(s) in order to get oxygen from the water. Oxygen needs to pass from the water into the blood. Squid do this by putting the blood next to the water with only a thin wall, one cell thick, between water and blood in a feathery structure called the **CTENIDIUM** (two are called **CTENIDIA**). The ctenidia are found on either side of the siphon. Oxygen-rich water is continually pushed past the ctenidia by contraction of the **MANTLE**. Some rare, deep-water squid that swim using webbed arms don't have gills, the webs are so thin that they work as gills.



### Eating

Squid are very successful predators. They feed on fish, shrimp, just about anything swimming that's smaller than them. Squid have eight **ARMS** and two **TENTACLES**, unlike octopus which only have eight arms. The arms are short. They rip-apart prey and stuff it into the mouth in the center of them. The tentacles are much longer and have suckers only at the ends. Squid get close to prey, then shoot out the extra-long tentacles to capture it and pull it in. The squid takes bites out of the prey with a **BEAK** made out of the same stuff as human fingernails. The meat is ripped apart even more by the **RADULA**, a conveyor belt of tiny teeth that nearly all molluscs have.



Food is swallowed and travels through the **ESOPHAGUS** into the small muscular **STOMACH** where digestive juices from the **LIVER** and **PANCREAS** help break it down. The mushy food is then passed into the big **CECUM** where it is absorbed into the squid's hemolymph (blood) and spread through the body. Wastes are passed out the rectum, through the funnel, and into the water as the squid squirts away.

### Sex/Reproduction

Most squid live only a short time, one to three years. A male squid makes sperm with a single **TESTIS** and then wraps it into a packet of sperm called a **SPERMATOPHORE** with a gland called **NEEDHAM'S SAC**. He hands it off like a football to the female using his long tentacles. The spermatophore is stuck to the inside wall of the female's mantle so she can use it to fertilize her eggs when she lays them. Often the female doesn't wait for the male to remove his tentacle and she rips

