

Lab

Dissection of a Squid

Background Information

The squid is one of the most highly developed invertebrates, well adapted to its active, predatory life. The characteristic molluscan shell is reduced to a horny plate shaped like a quill pen and buried under the mantle.

The mantle, the chief swimming organ of the animal, is modified into lengthwise fins along the posterior end of the body and projects forward like a collar around the head. As the mantle relaxes and contracts, the squid swims forward, upward, and downward. Water is expelled in jets from the muscular funnel located just below the head, propelling the squid backward in abrupt jet-like motions. Two of the ten sucker-bearing arms (used to steer in swimming) are tentacles that can seize prey, which is then cut into pieces by the animal's strong beak-like jaws.

The squid breathes through gills, and may emit a cloud of inky material from its ink sac when in danger. The circulatory and nervous systems are highly developed. The eye of the squid is remarkably similar to that of humans - an example of convergent evolution, as there is no common ancestor. Squids are also distinguished by internal cartilaginous supports. Some deep-sea forms have luminescent organs.

Purpose

In this laboratory you will become acquainted with a squid's features.

Materials (per group)

Preserved squid
Dissection tray

Dissection kit
Dissecting scope

Procedure**Orientation of the Body**

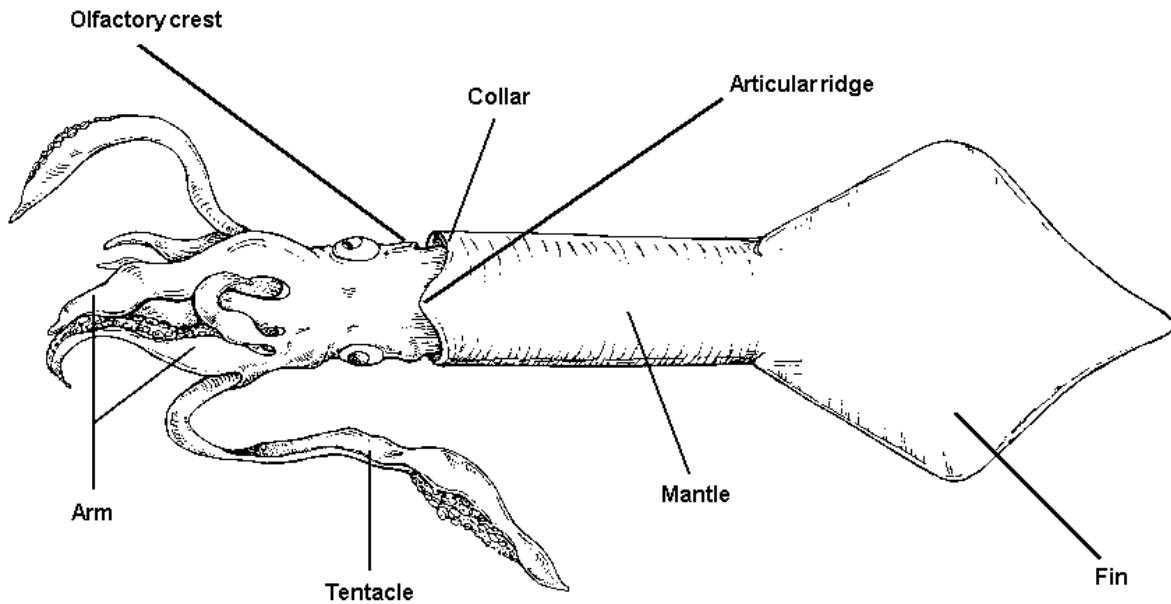
1. The squid body is shaped rather like a torpedo (see Figure 1). In most bilaterally symmetrical animals, the main body axis is an anterior-posterior presentation, but in cephalopods it is defined as a dorsal-ventral body. The cephalopods have modified the ancestral plan by lengthening this axis so that the head and appendages are at the ventral rather than the anterior end of an elongated animal. This shift can be a source of **confusion** for most students who expect animals to have their heads at the anterior end.

The easiest way to avoid this confusion is to **rename** the axes of squids according to their function rather than their morphology. Therefore, the end with the head and appendages will be referred to as **anterior**, even though it is really ventral. The opposite, pointed end will be called **posterior**, even though it is really dorsal.

The long straight edge with the funnel, or excurrent siphon, will be **ventral** and the opposite edge will be called **dorsal**. The adoption of this naming method eliminates confusion because the animal appears to conform to other bilateral animals where forward is anterior, rear is posterior, up is dorsal and down is ventral. Right and left are not affected. All of the remaining references to direction in this exercise will follow this convention.

In **Observations**, label the diagram of a squid according to the instructions above.

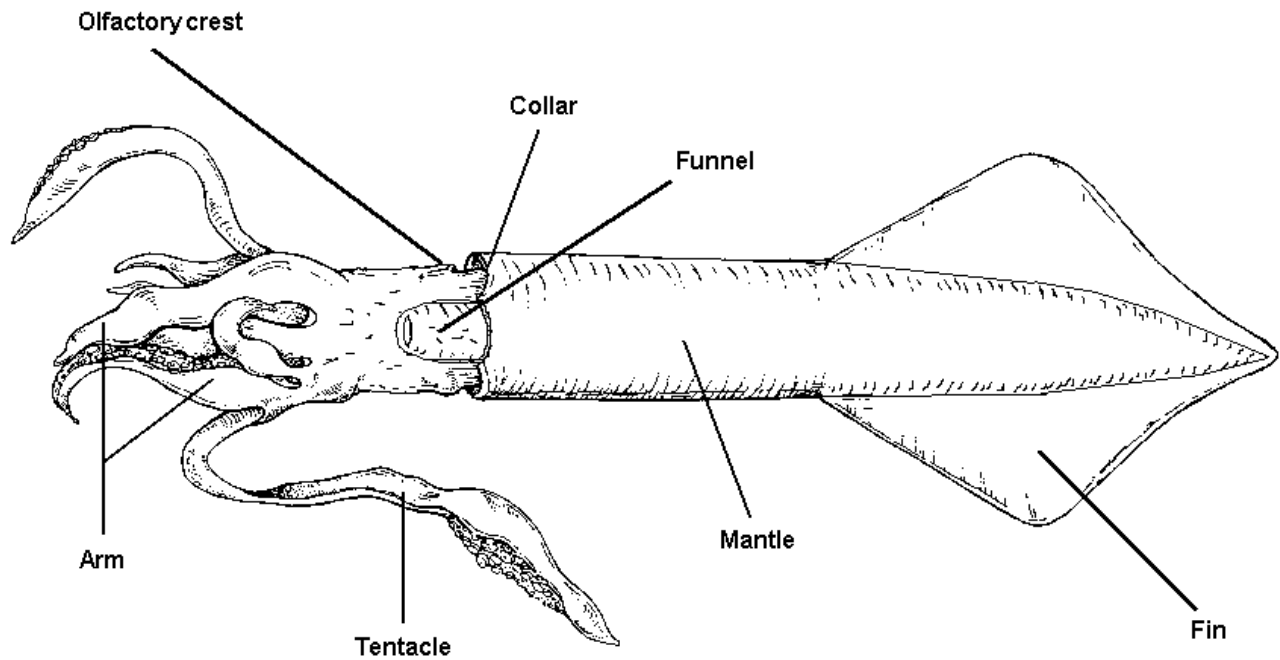
Figure 1 External Dorsal View



External Anatomy

2. Place a squid in a dissecting pan of suitable size so that it resembles Figure 1 above.
3. The body is composed of the anterior **head** and a long, cone-shaped, posterior visceral hump. The head bears 10 long appendages. The column of tissue connecting the head and the visceral hump is the **neck**. The **visceral hump** is the long narrow cone that forms the remainder of the body. Its thick muscular walls are called the **mantle**, which encloses the large mantle cavity and the visceral mass. The open space within the mantle is the **mantle cavity**. The organs in the core of the visceral hump make up the **visceral mass**.
4. The pointed apex of the hump is the posterior end of the animal and it bears a pair of lateral fins. The **fins** are thin sheets of muscle and connective tissue that are attached on the dorsal side of the cone. You now have all the landmarks needed to orient your specimen and identify its three principal axes. Use these landmarks to determine the plane of bilateral symmetry.
5. The free anterior margin of the mantle is the **collar** (see Figure 1). It is shallowly scalloped and bears three short, skeletal points. The center point is called the **articular ridge** and is the anterior tip of the rudimentary internal shell called the **pen**. The head and siphon are attached to the collar at these three points.
6. Ventrally, the **funnel** emerges from the mantle cavity (see Figure 2). It lies below the head on the ventral midline and is the exhalant siphon through which water exits the mantle cavity. Contractions of circular muscles in the mantle force jets of water from the mantle cavity out of the funnel. The animal relies on this for propulsion and respiration. Water enters the mantle cavity via two lateral inhalant siphons between the mantle and exhalant siphon.

Figure 2 External Ventral View

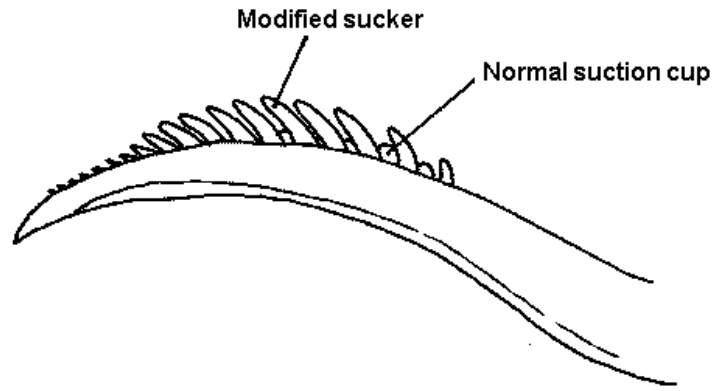


7. The mantle cavity contains the two gills and the outlets of the digestive, excretory, and reproductive systems. The respiratory current enters, passes over the gills, and then exits out the funnel. The siphons have valves to insure that water flows in the correct direction.

Head and Foot

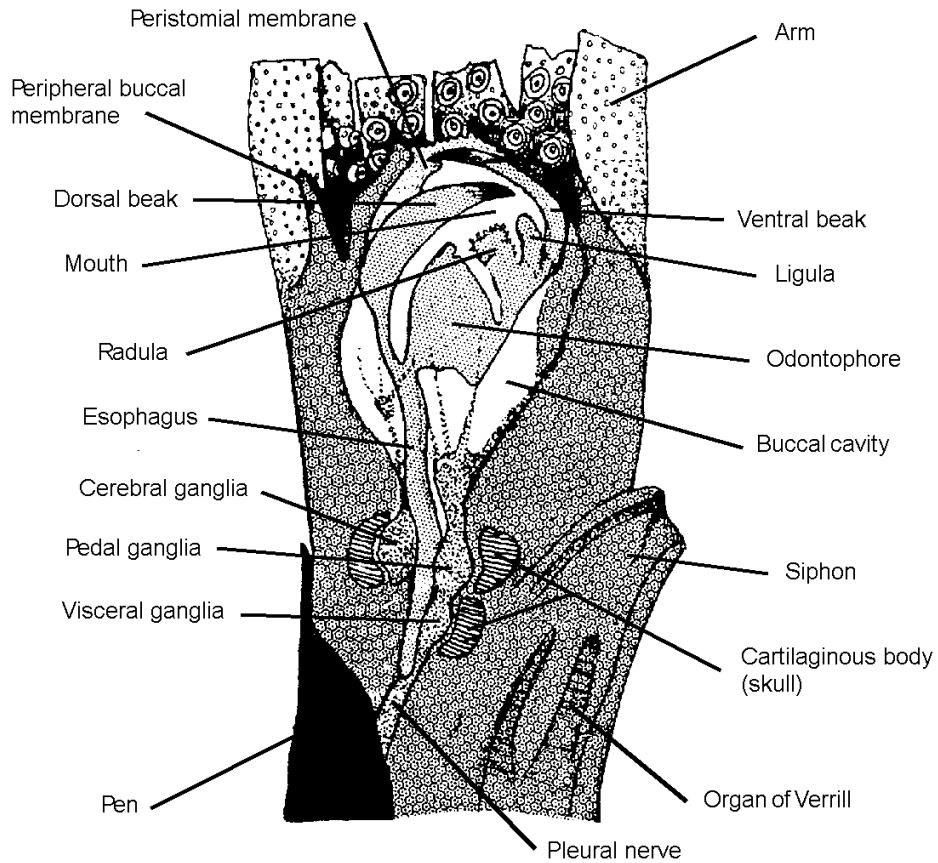
8. Arrange the squid in the pan so the dorsal surface is up and look at the anterior end. The region known as the head is the combined head and foot of the mollusk and the name **Cephalopoda** alludes to this combination. The foot of cephalopods is divided into numerous appendages that are referred to as arms and tentacles. Squids and cuttlefishes have a total of 10 such appendages. Eight of their appendages are relatively short **arms**, and two are much longer **tentacles**. An octopod has a total of eight appendages all of which are arms.
9. Squids have five appendages on each side numbered from dorsal to ventral. Starting dorsally on the right, find and assign numbers to the five right appendages. Appendage 1 is the dorsal most appendage and is the shortest. Appendages 1, 2, 3, and 5 are arms. Each arm bears two rows of suckers. The fourth appendage is a tentacle and it is much longer than any arm. It is contractile so its length is variable. It is expanded distally to form a club with four rows of suckers. Except for the club, the tentacles do not bear suckers. The clubs are used to capture food which is transferred to the arms for manipulation. The left fifth appendage of males is slightly modified to form a **hectocotylus arm**, which is used to transfer spermatophores to the female (see Figure 3). Its suckers have reduced cups and enlarged pedicels. The pedicels are long, finger-like, and arranged in a comb-like row at the end of the arm. Determine the sex of your specimen by examining the left, fifth arm.
10. With magnification look at a large sucker near the base of an arm. The oldest and largest suckers are proximal on the arm and new suckers are added to the growing distal tip. The suckers are usually not symmetrical and each consists of a deep, muscular cup with a toothed, chitinous ring for reinforcement. These rings are easily dislodged in dead specimens and several may be lying about on the bottom of the dissecting pan. The cup is attached to the arm via a slender, muscular, stalk-like pedicel. The distal end of the pedicel is expanded to form a disk-shaped piston that can be seen in the bottom of the cup. When in contact with a firm surface, the rim of the cup seals against the surface. Contraction of the pedicel withdraws the piston and generates a suction inside the cup.

Figure 3 The Hectocotylus Arm of a Male Squid



11. The arms and tentacles are borne on a ring of muscle that surrounds the mouth. Look at the anterior end of the head. Spread the 10 appendages apart so you can see the mouth in the center of the circle of arms. It is a large opening equipped with a pair of dorsal and ventral brown or transparent, proteinaceous jaws, forming a beak resembling that of a parrot.
12. With forceps, remove the two beaks while looking carefully down into the mouth. If needed, you may make some small cuts at the side of the **buccal bulb**. When you remove the dorsal beak, you should be careful to see if any other parts pull out with it. Often the **radula** comes with it. If not, dig deeper to remove it for closer inspection.. The **ventral beak** overlaps the **dorsal beak** (see Figure 4).

Figure 4 The Mouth and Buccal Cavity



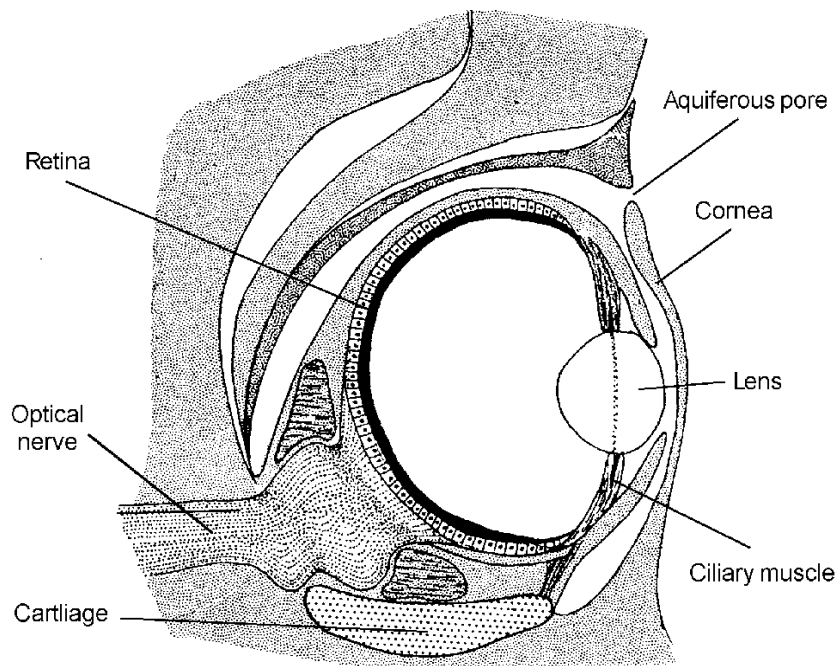
13. The mouth is surrounded by two concentric circular membranes. The outermost is the **buccal membrane**. It covers the bases of the appendages and has seven small, points on its margin. The second and innermost ring is the **peristomial membrane** near the mouth (see Figure 4).

14. The eyes of cephalopods are remarkably similar to those of vertebrates. Each consists of an outer, transparent **cornea** which is the lateral wall of the head and is separated from the remainder of the eye by a water chamber (see Figure 5). The **iris** lies internal to the cornea and the **pupil** is a circular opening in its center. A small silver fold of the iris extends into the otherwise circular pupil. This fold extends farther into the pupil under conditions of bright light and retracts in dim light. It is analogous to the vertebrate iris diaphragm.

15. Carefully remove one of the squid's eyes to observe its internal structure. Use a dull probe to free the eye from the squid's head. Use the scalpel to make a cut through the side of the eye ball. Remove the lens and rinse out the inside of the eye. Some pigmented particles may come out of the eye as you cut it open. These are pigments of the **retina** that were released when the retina was damaged by the scalpel. Observe the inside of the eye where the retina is located. You may see where the **optic nerve** joins the retina. This area is called the **blind spot** in humans because there are no photoreceptors there. Put the lens on a hard surface and press down on it with your finger.

Is the lens hard or soft? _____ .

Figure 5 **Cross Section of a Squid Eye**



16. Below each eye is a low narrow ridge called the olfactory crest. The olfactory crest is covered with chemosensory cells that are used for detecting "smells" in the water. Water entering the mantle cavity passes over the crests.

Body wall

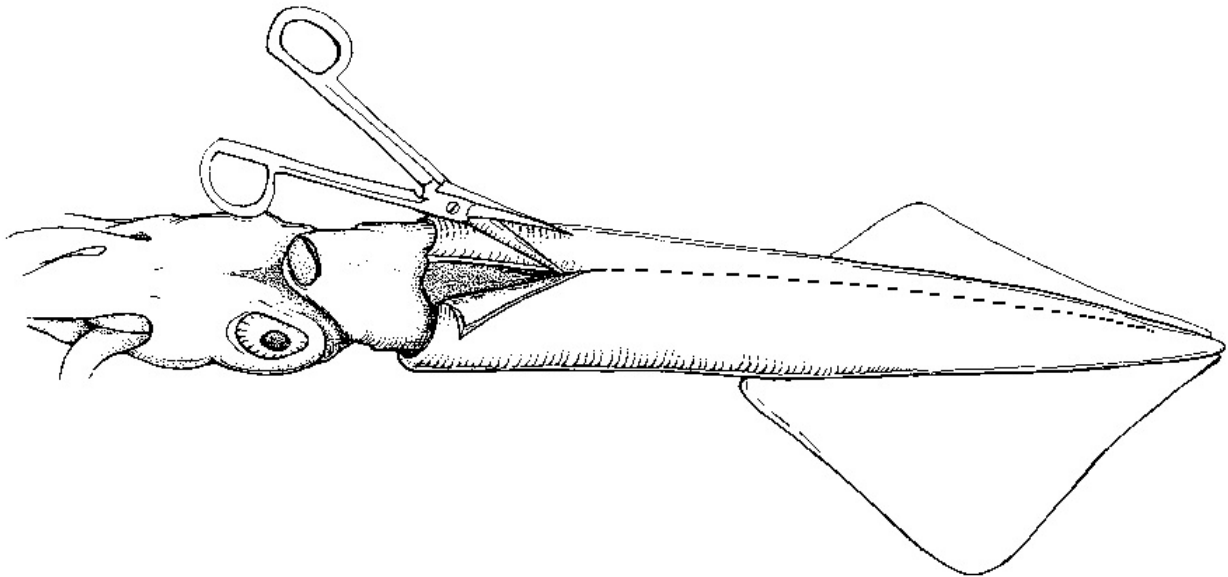
17. The body is covered by thin, easily shed epidermis underlain by a thicker connective tissue dermis. Complex, multicellular chromatophores are located in the outer layer of the dermis. Each chromatophore contains a single pigment in a sac and a wide range of colors has been reported from various squid species including brown, black, violet, blue, yellow, orange, and red. **Chromatophores** are capable of rapidly changing the color of the animal. The dermis contains iridiocytes in its deeper layers. These flat cells contain guanine rods that diffract light. They are abundant near the eye where they produce a shimmering iridescence.

Internal Anatomy

1. With scissors make a longitudinal, ventral incision a little to the right or left of the midline of the visceral hump. Begin at the collar and cut all the way to the posterior end of the hump to open the mantle cavity (see Figure 6). Use strong pins to hold the cavity open. Examine the cut surface of the mantle wall. Most of its thickness is muscle composed mostly of circular and radial fibers. Squids possess an **endoskeleton** composed of a chitinous shell, or pen. The **pen** is located on the dorsal midline of the visceral hump and is embedded in the mantle. The endoskeleton also consists of 11 cartilaginous structures found within the cranium, fins, funnel, eye orbits, and the collar.

When you are completely finished with your dissection, make a shallow, longitudinal cut and remove the pen. You may press the pen in a thick book and keep it indefinitely.

Figure 6

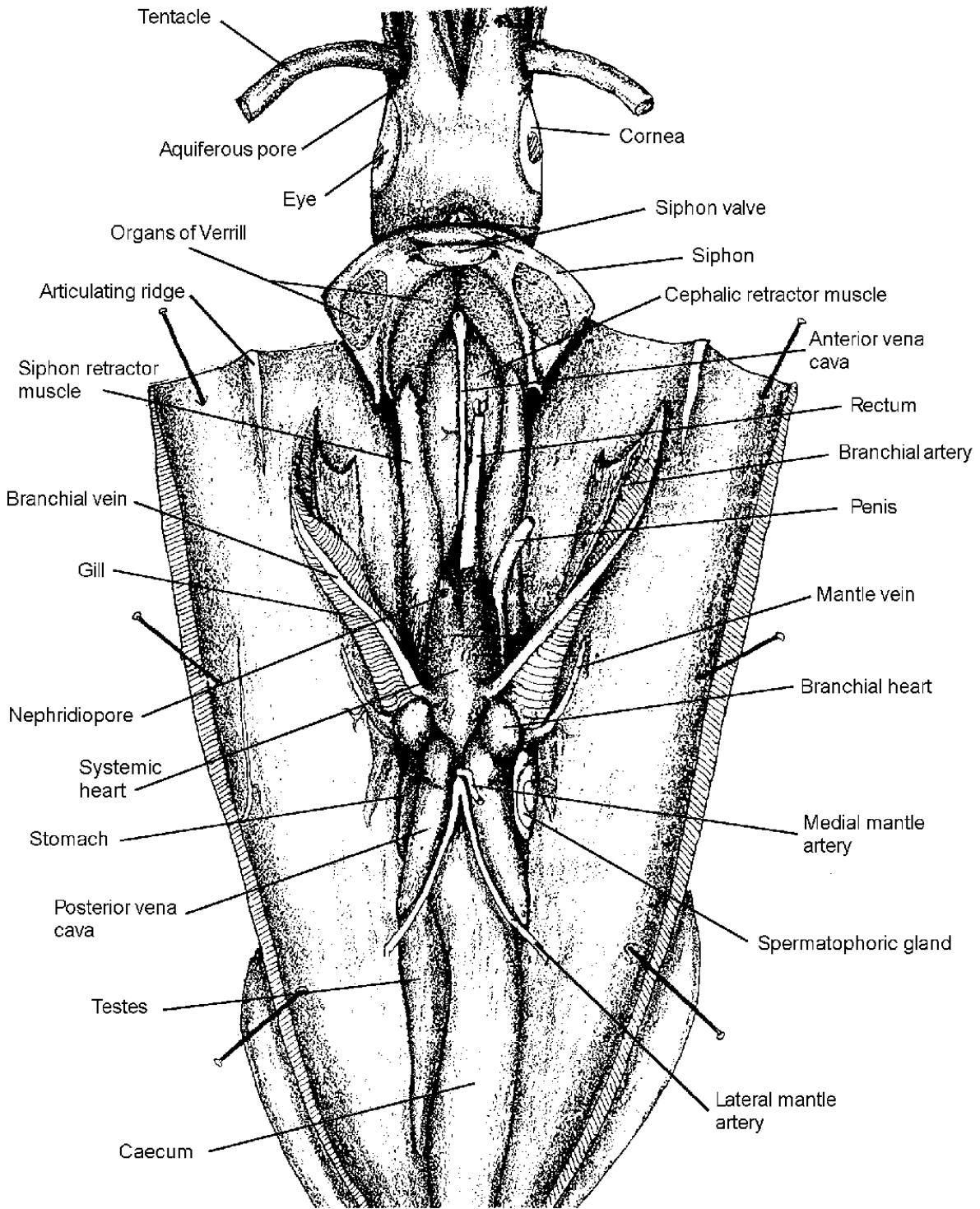


Mantle Cavity

2. The mantle cavity and its contents are now visible as a result of the incision just completed. The large mantle cavity extends almost to the end of the visceral hump. Note that the funnel opens into the mantle cavity and that its posterior margin is thin and flexible (see Figure 7).

Figure 7

Internal Ventral View of a Male Squid

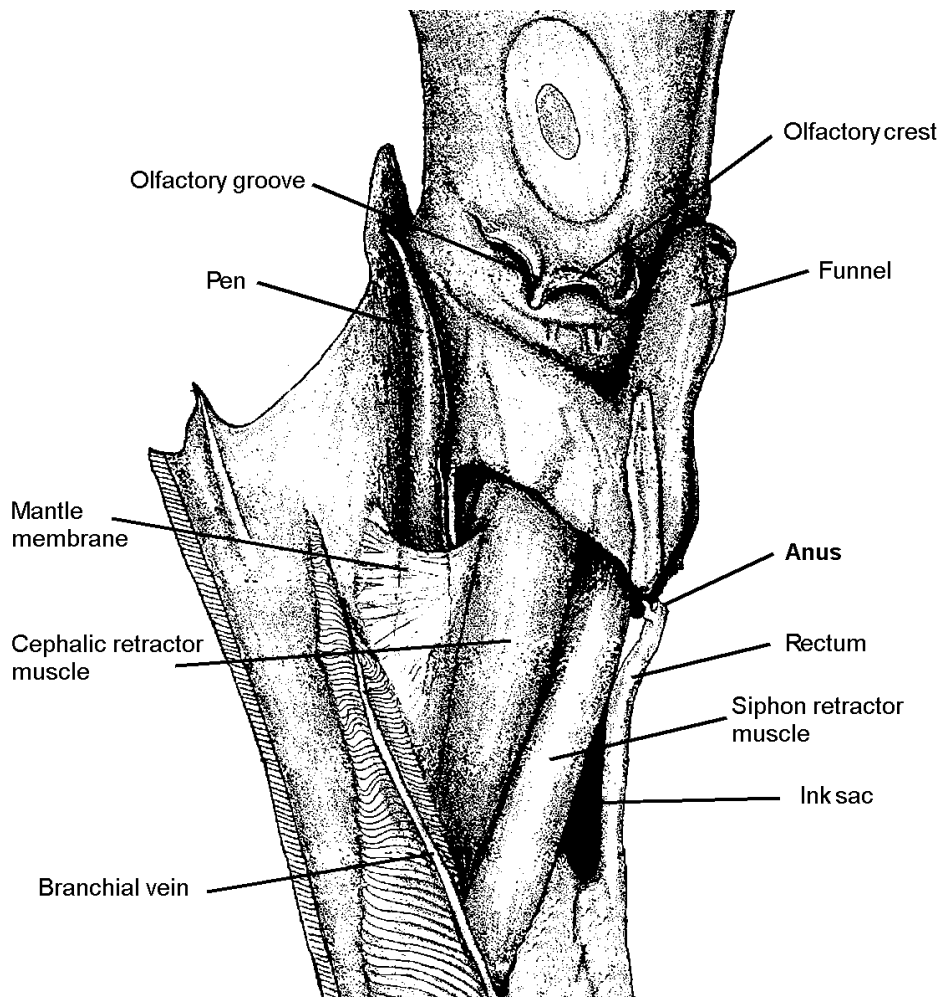


- Open the funnel with a midventral incision along its entire length and look inside it. The thin, flexible sheet of tissue just inside the anterior opening is a one-way valve to prevent the intake of water through the funnel during inhalation. The valves assure that water enters only through the two inhalant siphons and exits only via the funnel. This provides the necessary power for swimming and insures that clean water will flow over the gills before it reaches the genital pore, kidney pores, ink sac, and anus. The funnel can be aimed by the squid to control the direction of motion. Aiming is controlled by a pair of large, **funnel retractor muscles** that look like white cords extending posteriorly from the funnel beside the visceral mass. These muscles insert on the sides of the funnel and originate on the posterior end of the pen (see Figure 8).

Another pair of cord-like muscles that are thicker than the funnel retractor muscles are the **cephalic retractor muscles** that originate on the pen and insert on the posterior surface of the head. These and other muscles connect the head with the visceral hump and adjust the position of the head.

- Study the structures visible in the visceral hump (see Figure 7). The two large **gills** are located laterally, beside the visceral mass in about the middle of the mantle cavity. Each is long and feathery and composed of numerous non-ciliated gill filaments projecting from a longitudinal central axis. The axis is attached by a thin sheet of tissue to the mantle cavity.
- At the base of each gill is a small oval **branchial heart**. These are accessory hearts that supply the gills with deoxygenated blood. A third heart called the **systemic heart** is located between the two branchial hearts. It will receive oxygenated blood from the gills. The systemic heart will supply the rest of the body with blood high in oxygen. Cephalopods have a closed circulatory system.

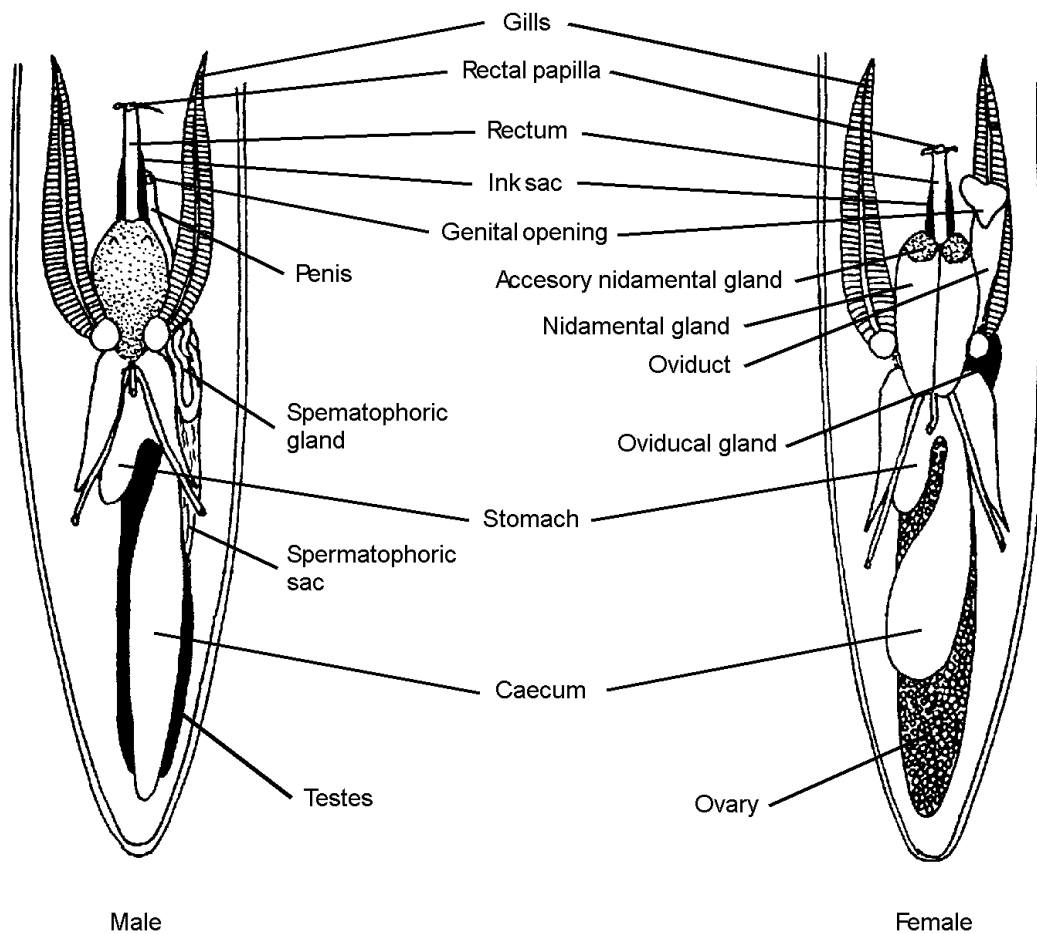
Figure 8 Neck Muscles



Female Reproductive System

- If your specimen is a female, much of the anterior mantle cavity will be occupied by two large, white **nidamental glands** which are not present in males (see Figure 9). These glands secrete part of the egg envelope. The **ovary** is a translucent, lobed mass of tissue lying in the posterior end of the visceral mass. Its size is variable. The **oviduct** exits the left side of the ovary and extends anteriorly. It swells enormously to become the large, white **oviducal gland** on the left, just posterior to the left branchial heart. The oviduct extends from the oviducal gland to open into the mantle cavity via the female genital pore located anterior to the left branchial heart. There may be a cluster of bristle-like, white **spermatophores** attached to the dorsal mantle wall on the left side of the mantle cavity. If present, they will be medial to the left gill and anterior to the opening of the oviduct. The spermatophores are placed here during courtship.
- If your specimen is female, remove the nidamental glands before continuing your examination of the mantle cavity. Be careful that you do not damage any of the organs to which they are attached.

Figure 9 Male and Female reproductive Systems



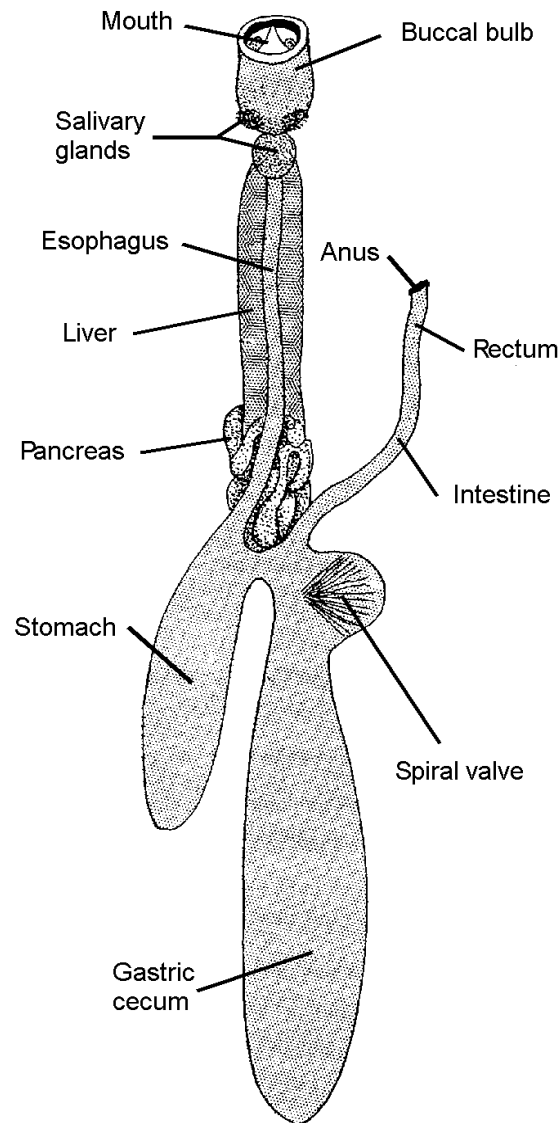
Male Reproductive System

- If your specimen is a male, there will be no nidamental glands but you will see a single white **spermatophoral gland** on the left of the visceral mass just posterior to the left branchial heart. **Spermatophores**, resembling small white sticks, may be visible within the gland. The **testis** is a white mass of tissue lying by the organs of the posterior visceral mass. Sperm will travel through a tubule to the spermatophoral gland where sperm are packaged into spermatophores. The sperm duct leaves the gland and runs to a long, wide, thin-walled **spermatophoral sac** where spermatophores are stored. The **penis** exits the sac and lies on the left side of the rectum. The male genital pore is at the tip of the penis.

Digestive System

9. The **stomach** is a muscular sac on the right side immediately posterior to the right branchial heart (see Figure 10). It is relatively thin-walled and may be difficult to recognize. It may contain granular material and is dorsal to and posterior to the heart. The large **gastric cecum** opens from its medial side and extends posteriorly, on the left. When expanded, the gastric cecum is thin-walled and much larger than the stomach. The stomach, intestine, esophagus, liver, and gastric cecum join at a complex junction with a five-way valve.
10. The intestine exits the valve and runs anteriorly in the visceral mass from which it emerges as the rectum. The **rectum** is a small tube attached to the midline of the mantle cavity. The **anus** is at its anterior end.

Figure 10 Digestive System



11. The gastric cecum of cephalopods is divided into two parts. The large digestive gland, or **liver**, lies dorsally on the midline in the visceral mass between the funnel retractor muscles. It is not obvious unless dissected. It is a large, off-white organ extending from the posterior end of the head to the anterior end of the stomach. It is wide anteriorly, pointed posteriorly. The **pancreas** is a separate, much smaller, U-shaped region of the gastric cecum located anterior to the stomach where it is surrounded by the kidneys. Ducts from the liver run to the pancreas and from there to the gastric cecum. Together the two portions of the gastric cecum secrete an acidic mixture of peptidases, amylases, and lipases into the stomach.

Ink Sac

12. Lying beside the rectum is the ink sac. **Iridiocytes** in its walls give it a shiny, metallic appearance. Its transparent duct can be seen extending anteriorly from it to empty into the rectum just posterior to the anus. The walls of the duct do not contain iridiocytes and ink contained within is clearly visible.

Nephridia

13. The paired renal sacs, or **kidneys**, are located beside the midline just anterior and ventral to the systemic heart. The renal sacs cover most of the organs and structures in the area between the systemic heart and the posterior end of the ink sac but may be difficult to discern. Each opens to the mantle cavity via a **nephridiopore** located on the sides of the base of the rectum, immediately posterior to the ink sac. Each pore is in the center of a small donut-shaped papilla. In females the donut is associated with the white and orange accessory nidamental gland, but in males it is transparent.

Nervous System

14. Further dissection is required to expose anterior portions of the digestive system and the nervous system. With a sharp scalpel bisect the animal with a clean vertical section coinciding with the median sagittal plane. Cut all the way through the animal from dorsal to ventral along its entire length so that it is divided into right and left halves (see Figure 4).
15. The mouth opens into the **buccal cavity**. The two anterior **salivary glands** are located beside the buccal cavity and release a peptidase into it. They are not visible in sagittal section. The radular sac is a small, median pocket in the floor of the buccal cavity containing the small radula. The fine teeth of the **radula** are barely visible with the dissecting microscope. The **esophagus** exits the posterior wall of the buccal cavity. It is a narrow, white tube that runs posteriorly through the nerve ring and cranium, then dorsal beside the rectum before curving sharply ventrally to enter the stomach. The liver occupies the ventral face of the visceral mass and extends the length of the mantle cavity.
16. The nervous system is well-developed, bilaterally symmetrical, and strongly cephalized. It consists of 31 ganglia and many sensory and motor nerves. It is supplied with information by sophisticated, well-developed sense organs and it coordinates a large and complex musculature. Cephalopods have a well-developed, centralized nerve ring, or brain, around the esophagus (see Figure 4).

Supplemental Reading about the Anatomy of the Squid

Digestive System

The organs of digestion in squid include the jaws, radula, salivary glands, esophagus, liver, stomach, intestine and anus. Squid typically eat twice a day. Food is grasped in the chitinous jaws and gripped by the radula, which is like a tongue with teeth. The radula transfers the food to the throat, from which it passes to the esophagus. The esophagus connects the mouth to the stomach. The esophagus receives digestive juices from salivary glands. Some glands may secrete a toxin as in select species of octopus. In squid, the juices of the digestive gland are not harmful to people. The esophagus empties into the stomach. The stomach is a small, shiny white sac that connects to the cecum.

Digestion begins in the stomach. The cecum also performs some digestion and is the primary site of absorption of nutrients in squid. Digestive enzymes are added by the liver (a large oval, yellowish organ) and the pancreas. Enzymatic secretions may be added to the stomach or cecum in separate phases. The stomach and cecum are usually found behind the liver. The cecum dumps its contents into the intestine, a narrow tube adjacent to it. The intestine empties into the rectum and finally, the terminal end of the digestive system, the anus. The anus empties into the funnel or siphon, which is the exit for all waste products.

Respiratory System

Seawater, that contains oxygen, enters the mantle cavity near the head. The water swirls around the paired gills, which have a feathered appearance due to the presence of gill filaments. Squid may have 20-80 filaments on each side. Oxygen diffuses from the water into the gills and is transported to the gill hearts by the many blood vessels that serve the gills. Respiration or ventilation in squid is measured by the number of times the mantle cavity contracts to take in water. Respiration rates in squid vary from 20-30 movements per minute, when at rest. In cold waters, it may be as low as 10. When swimming quickly, the rate is 300-350 movements per minute. Squid are known to be very sensitive to oxygen levels in the water. Low levels of dissolved oxygen cause them to quickly lose strength and die.

Circulatory System

Cephalopods, like most mollusks and arthropods, have blood that has a bluish tint. This is due to the presence of a pigment that contains copper, rather than the iron that is found in humans. Squid have three hearts. There is one heart at the base of each gill. These hearts receive blood that is rich in oxygen from the blood vessels that serve the gills. The gill or branchial hearts pump blood to the third heart, known as the systemic heart. The systemic heart serves the internal organs and the mantle. It is located between the branchial hearts, just slightly anterior to them. The systemic heart pumps blood to the blood vessels that serve the mantle, head, digestive organs and kidney.

Nervous System

The nervous system of cephalopods is far more intricate than that of other molluscs and invertebrates in general. In squid, the brain is enclosed in a cartilaginous head capsule. The brain mass is the same as fish, but it is less than that of birds and mammals by body weight. Faster squid have larger brains. Up to 80% of the brain is devoted to processing visual information; that information is then used to assist in fast swimming. As previously mentioned, scientists like to study the giant nerve cells and fibers found in squid and cuttlefish. It has also been found that some nerve cells in squid contract, a characteristic that is usually found only in muscle cells. The stellate (star-shaped) ganglion found in the mantle are studied for those contractile abilities.

Finally, it was pointed out that octopuses have the ability to learn. They have good memories and can be trained as well as rats. A few squid have also demonstrated an ability to learn, but in general the deepwater oceanic squid show no capacity for learning.

Vision

Although most cephalopods have monocular vision, meaning they can use their eyes independently, cuttlefish and squid are capable of binocular vision. Initially it was thought that all cephalopods were color-blind, although behavioral studies indicate that they may be able to detect color. They do have the ability to see images. Certain varieties of squid have been found to have one large eye and one small eye. It has been postulated that the large eye is used to look up and receive light from above. The small eye is used to look down and forward. Some cephalopods also have light sensitive vesicles in their brains. Their function varies from species to species, but it is thought that they help the animal to determine the amount of light present in the surrounding water. In squid, this information may be used to regulate the intensity of the special reflecting cells in the mantle and aid with camouflage. The vesicles may also help detect bioluminescence in deepwater animals. Not much is known about the light sensitive vesicles.

Smell

Over 100 years ago, scientists discovered a sensory organ located behind the eyes in squid that was thought to be associated with smell. It seems to help the animal monitor the water quality by detecting chemicals in the water and passing that information on to the brain. When noxious substances are in the water, this causes the squid to activate its escape jetting mechanism.

Hearing

Some squid have been shown to react to sound. Pacific squid are able to produce sound when eating and swimming fast. They also react to the crunching sounds made by other squids and can be killed by the intense blast of sound generated by toothed whales.

Although they do not have ears, cephalopods do possess specialized structures called statocysts. They are located in the brain and are thought to help regulate balance.

Taste and Touch

Taste receptors are located on the rims of suction cups and on the mouth region. Their tasting ability is two to three times more sensitive than people for some chemicals. They detect objects in the environment with tactile receptors that are also located on the suction cups. Although they can "feel," squid are unable to determine the difference between light and heavy objects.

Reproductive System

Cephalopods engage in sexual reproduction. In squids, it is not always possible to distinguish males from females externally. The fourth arm in males in some species is modified slightly to assist with reproduction. Either the left or right arm in this position has smaller suckers that are used to transfer the sperm from the male to the female.

The mantle cavity of male squids has a single cigar shaped gonad, the testis, located on the left side of the mantle. It is usually white and has a series of tubules and ducts associated with it that comprise the male reproductive system. Sperm produced in the testis pass through the vas deferens and then the seminal vesicle. In the seminal vesicle the sperm is encased in a spermatophore composed of several tunics or outer coatings. Specialized glands provide additional structures including a cement body, ejaculatory organ and cap which aide in fertilization. The completed spermatophores are shaped like baseball bats and pass into Needham's sac for storage. There may be 400 or more capsules stored in this structure.

In female squid, the eggs are produced in the ovary. The ovary looks like a bunch of grapes and is shaped like an ice cream cone. It rests in the mantle cavity between the gills. Squid have a shell gland, the nidamental gland, which provides the outer coating for the eggs. Females can also be distinguished by the bright orange accessory nidamental glands, whose function has not been fully elucidated. In some species, the nidamental gland produces a jelly-like coating that surrounds the entire egg mass, after each individual egg has been covered by secretions of the oviductal gland.

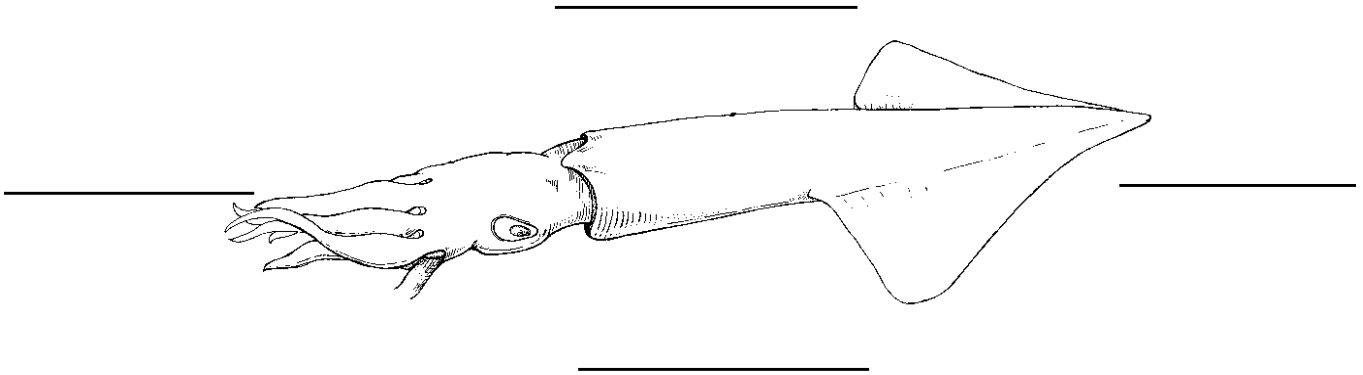
Fertilization can take place either inside or outside of the female's mantle cavity. During copulation, the male removes spermatophores from Needham's sac with the specialized arm and places them inside of the female's mantle cavity near the oviducts. In some species, spermatophores are expelled from the penis and exit the mantle cavity by way of the funnel. (Needham's sac becomes the penis.) The cement body glues the spermatophore in place. When the spermatophore is removed from Needham's sac, the cap is torn off. Once exposed to seawater and placed inside of the female, the ejaculatory organ turns inside out resulting in release of the mass of sperm. The female simultaneously releases eggs from the mantle cavity and holds them with her arms so that they can be fertilized by the sperm. Once the eggs are exposed to seawater, the coating hardens and the egg capsules swell. The female then attaches the egg strings to the ocean bottom. Sperm and egg maturation in squid is typically regulated by environmental factors such as temperature, light and available food. Spawning in mature animals is usually stimulated by the onset of longer days in those animals that reproduce during spring and summer. However, cephalopods living in tropical regions may reproduce year round.

Ink Sac

The ink sac is found in nearly all squid and consists of an ink gland and a sac. The ink gland produces the ink, composed of melanin granules in a clear liquid. The sac acts as a reservoir, storing ink until it is needed for ejection. Once ejected, the ink enters the intestine and pours out through the anus. Ink can not only irritate the eyes of a potential predator, but it also temporarily prevents the target animal from smelling. Human eyes are also irritated by squid ink. Finally, recent research has shown that squid ink has the ability to kill certain kinds of bacteria.

Observations

1. Label the body surfaces of the squid below. Use the terms *anterior*, *posterior*, *dorsal*, and *ventral*.



2. The squid has _____ tentacles and _____ arms. There are more suckers on the _____.
3. How many arms does an octopus have?
4. What is the difference between the arms and tentacles of the squid?
5. The color of the beak tip is _____.
6. On which surface are the fins attached? _____ (dorsal or ventral surface).
7. If water shoots out the water propulsion system, which direction would the squid swim?

8. Name two external features that are adaptations for the squids predatory life.

a)

b)

Analysis and Conclusion

1. What characteristic does class Cephalopoda have that make it more advanced than Gastropoda or Bivalvia?

2. Discuss the two mechanisms that a squid would use for evading a predator.

3. What would be the value of possessing chromatophores?

4. How are the beak and radula of the squid similar to the mouth of a human?

5. Describe the squid's hearts and the flow of blood throughout the squid's body.

6. Squid have a closed circulatory system. What is meant by a closed circulatory system?

7. Starting at the mouth and ending with the anus, list the digestive organs in the order that food would pass through.

8. How does the squid obtain oxygen from the water?

9. Label the drawing of a squid's internal structures below.

