

Squid- Strange Beasts

Squid are invertebrates in the phylum Molluska, a group that includes snails, clams and chitons. They belong to the Class Cephalopoda (which means head-foot) along with octopus, cuttlefish and nautilus. There are about 400 species of squid, all of which are marine and are found from the Arctic to Antarctic in all depths of water.

Squids, and their cousins, octopuses, hold a special place in the imaginary world of marine terror. Both are carnivores with grasping arms and tentacles and have the ability to blast clouds of ink when threatened. The squid is a fascinating creature, with its translucent body, eerie iridescence, ability to change colors, and its propulsion method of locomotion.

The squid has eight short arms and two long tentacles, located near the head. All its appendages are equipped with adhesive discs, or suckers, which are used in feeding. The agile tentacles can shoot out to grab prey, usually fish and shrimp, with blazing speed.

Squid are the fastest swimmers among the invertebrates. Some species of "flying squid" have been known to leap out of the water for short distances reaching speeds of 16- 24 mph. This is amazing, considering they are related to snails and clams. They suck the water in through a funnel (siphon) located by their head and through the contraction of the muscular wall of the mantle, the squid forces water back out its siphon. The result is that the squid literally jets backward.

There are over 300 kinds of squid including the most famous, the Giant Squid. They range in size from 4 inches long to the giant squid at 57 feet long.

The male squid has color cells called chromatophores on the surface of his skin, which are capable of turning a variety of hues in the red, brown, and yellow. This marine peacock also has thousands of special cells, called iridiophores, which reflect iridescent shades of blue, green, pink and gold depending on the species of squid.

The squid was discovered to have a giant nerve cell, which has made it popular with research institutions. They use the giant nerve cell to learn how nerve impulses are transmitted throughout the body.

In Asia, the countries of the Mediterranean, and other parts of the world, the squid is a popular protein-rich food source. They live in all oceans and are fished commercially. On the West Coast the market squid is harvested and is available in US West Coast fish markets. Squid are a staple in the Japanese diet. The squid we are going to dissect are *Loligo opalescens* from Monterey, California. They were caught by fishermen with gigantic lights on their fishing boats. The huge lights fool the squid into thinking that it's a full moon, and they rise to the surface to reproduce.

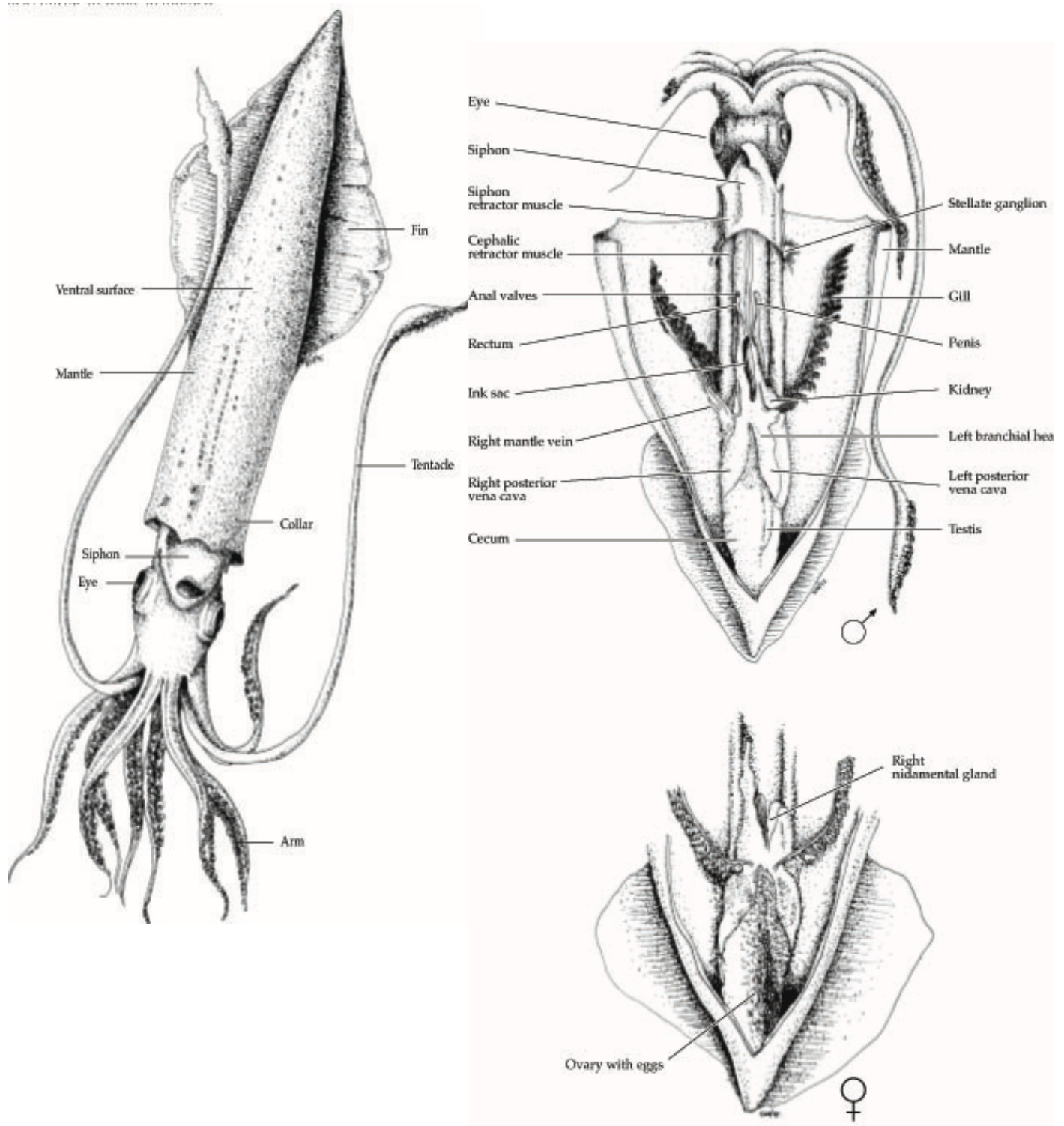
Squid feed on fish, jellyfish, crab and shellfish and in turn they are one of the major food animals of the seas. They are a food source for a number of fish and seals. Even sperm whales feed on the giant squid. West Coast fish that commonly feed on squid include tuna, salmon and rockfish.

Squid escape their predators through a sack that carries ink. They eject the ink to create a dark cloud in the water that shields the squid as it jets away.

Most squid have 3 hearts. The first pumps blood through the body. The other 2 pump blood to the gills for respiration. Their eyes, like octopus eyes, are quite large and provide keen eyesight. They are located on the sides of their heads.

The squid are alien jet fighters of the ocean. They swim with jet propulsion, and actually have stealth camouflage and visual countermeasures (ink) to fool predators and prey. Cephalopods are the most intelligent of invertebrates. By some estimates, some octopuses are as intelligent as cats! Squid aren't that smart, but they're up there.

Adapted from: <http://secchi.hmsc.orst.edu/education/relatedinfo/squid.html>



The Squid Dissection - adapted from: <http://giantsquid.msstate.edu/LessonList/dissection.html>

A. 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.

1. What are the differences between arm and tentacle suckers? Where are the suckers located on the tentacles as compared to the location of the suckers on the arms? How are the tentacles used, compared to the arms?

2. What are chromatophores?

B. 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. 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.

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.

3. Based on the shape of the beak and radula, do you think that squid are carnivores or herbivores? Do you think that they can eat shelled animals?

C. 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. Which way do squid swim (for the most part): in the direction of their tentacles, or the opposite direction of their tentacles? What else about their anatomy gives you a hint about their swimming direction and ability?

D. 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.

E. 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.

F. Locating Reproductive Organs:

Locate the gonad (reproductive organ) in the posterior end (refer to diagram for shape and location). The male gonad is generally white, the female gonad is usually more yellow to clear.

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.

G. 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). The gill hearts pump blood to the gills. The squid has a third heart (the systemic heart) that pumps blood to the rest of the body.

5. Why don't humans need 2 hearts to pump blood through our lungs?

H. 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 (squid ink stains clothing and skin). 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. Do not puncture either the ink sac or the liver! 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.

I. 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.

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.

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

**** When you are finished with the dissection, and drawings, you may use the gladius to puncture the ink sac, and use the ink to write your name at the bottom of your drawing.