Dissection Inspection: Form and Function [MS]

Adapted from various dissection labs

Grades: 6-8
Time: 45 minutes to 1 hour

Goals: To learn and utilize the technique of dissection to understand the form of function of marine species.

Objectives:
Students will be able to: understand dissections as a biological tool; properly dissect three local estuarine species, invertebrate and vertebrate; and understand the form and function of internal organs and compare them to humans.

Key Words:

Anatomy and Physiology	Dissection	Morphology
Invertebrate	Vertebrate	

Background Information:
From invertebrates, to bony and scaly fish, to cartilaginous carnivores, to mammals just like us, the estuarine watershed is complete in its roster of species. Whether you want to dig in the sand for worms, mole crabs, or sand fleas, or you want to pick up a pair of binoculars and try scouting the horizon for seals, dolphins or whales, there are so many species right in our backyard. The reason for this overabundance is the uniqueness of the barrier island formations – the created lagoons, saltmarshes, and tidal pools.

Inside the bay community, species have adapted to withstand not only the influx of the daily tides, but the changes in temperature throughout the year as well as the changes in salinity with storm surges or river floods. The Barnegat Bay, as an example, at roughly 15-20 parts per thousand salinity, is what is considered a brackish water community. Only particular species can live there, so it makes our watershed extremely valuable.

Directions: Follow the procedures for the dissection of clams, sea stars, and fish on the following pages. Fill in the appropriate morphology worksheets and questions.

Clam Dissection

Adapted from Biology Junction

Procedures:

1. After putting on safety gear and preparing your lab area with all dissection materials, place the clam on the dissection tray and identify the anterior and posterior ends of the clam as well as the dorsal, ventral, and lateral surfaces. Refer to Figure 1 below.

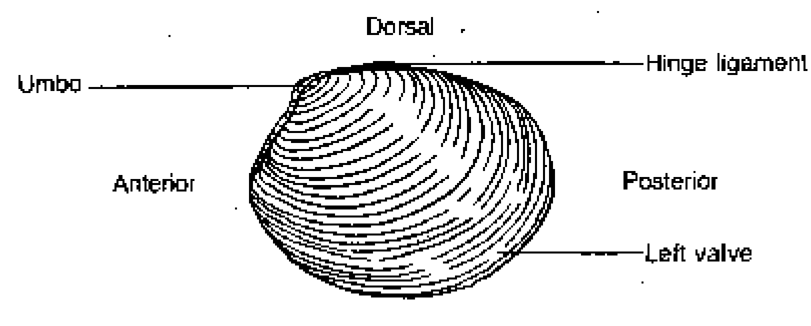


Figure 1

2. Locate the umbo, the bump at the anterior end of the valve. This is the oldest part of the clam shell. Find the hinge ligament which hinges the valves together and observe the growth rings.

3. Turn the clam with its dorsal side down and insert a flat edged blade (such as a screwdriver) between the ventral edges of the valves. Carefully work the edges of the blade between the valves so you do not cut your hand.

4. Turn the blade so that the valves are about a centimeter apart. Leave the tip of the blade between the valves and place the clam in the pan with the left valve up. Locate the adductor muscles. With your blade pointing towards the dorsal edge, slide it between the upper valve and the top tissue layer. Cut down through the anterior adductor muscle, cutting as close to the shell as possible. Do the same with the posterior adductor muscle. Refer to Figure 2 below.

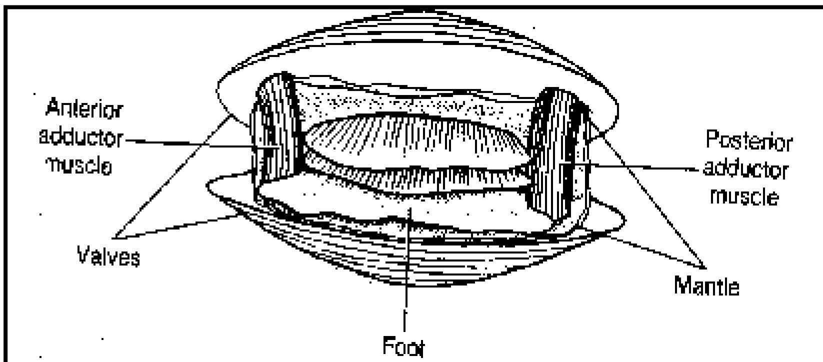


Figure 2

5. Bend the left valve back so it lies flat on the tray. Run your fingers along the inside of the left valve and compare its texture to that of the outside of the shell.

6. Examine the inner dorsal edges of both valves near the umbo and locate the toothlike projections. Close the valves and notice how the toothlike projections interlock.

7. Locate the muscle “scars” on the inner surface of the left valve. The adductor muscles were attached here to hold the clam closed. Refer to Figure 3 below.

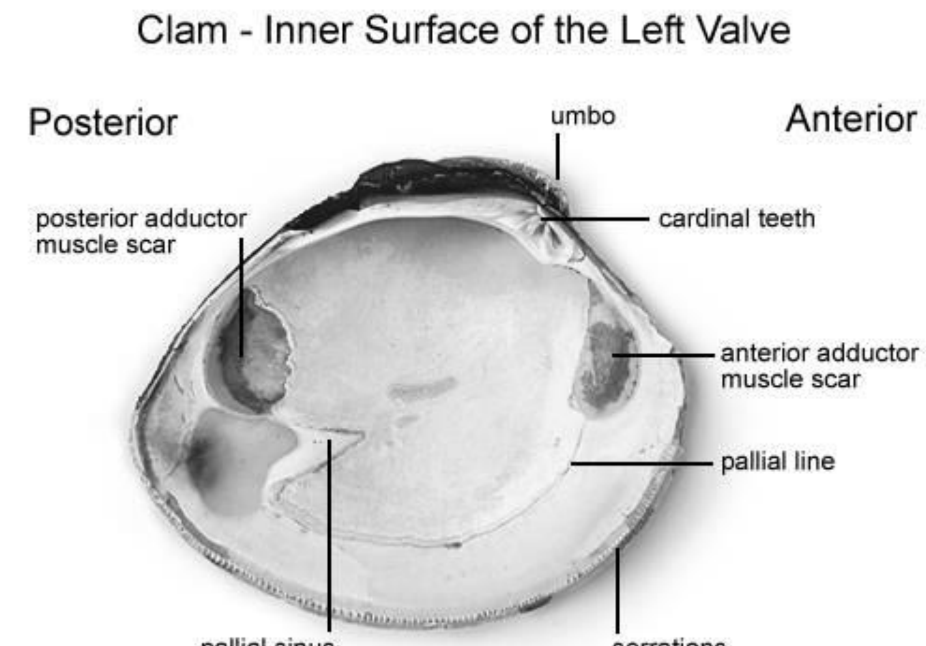


Figure 3

8. Identify the mantle, the tissue that lines both valves and covers the soft body of the clam. Find the mantle cavity, the space inside the mantle. Locate the incurrent and excurrent siphons on the posterior end of the clam. These are for bringing water in and taking waste out.

9. Carefully cut away the mantle lining the left valve, locating the gills. Ventral to the gills is the muscular foot, used to burrow in the mud or sand. Anterior to the gills are the palps, flaplike structures that surround and guide food into the mouth, which is beneath the palps. Refer to Figure 4 below.

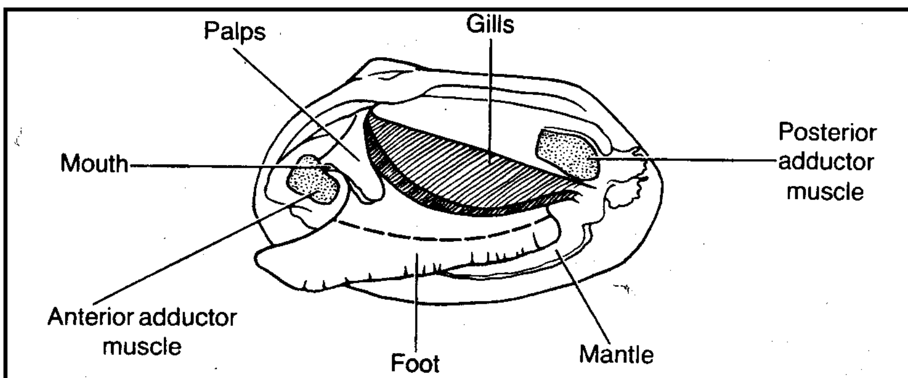


Figure 4

10. With scissors, cut off the ventral portion of the foot. Use the scalpel to carefully cut the muscle at the top of the foot into right and left halves. Carefully peel away the muscle layer to view the internal organs.

11. Locate the spongy, yellowish reproductive organs. Ventral to the umbo, find the digestive gland, a greenish structure that surrounds the stomach. Locate the long coiled intestines extending from the stomach.

12. Following the intestines to the dorsal surface, locate the pericardial area where they pass through. Here you will find the clam's heart. Continue following the intestines to the posterior end where you find the anus, just behind the posterior adductor muscle.

13. Label your organs on the student morphology sheet. Below your morphology diagram, state the name of the organ and its purpose to the clam.

Key Words:

Mollusca	Trocophore	Radula
Mantle	Muscular foot	Valves
Visceral mass	Dorsal surface	Ventral surface
Lateral surface	Anterior end	Posterior end
Umbo	Adductor muscles	Incurrent siphon
Excurrent siphon	Gills	Palps

Background Information:

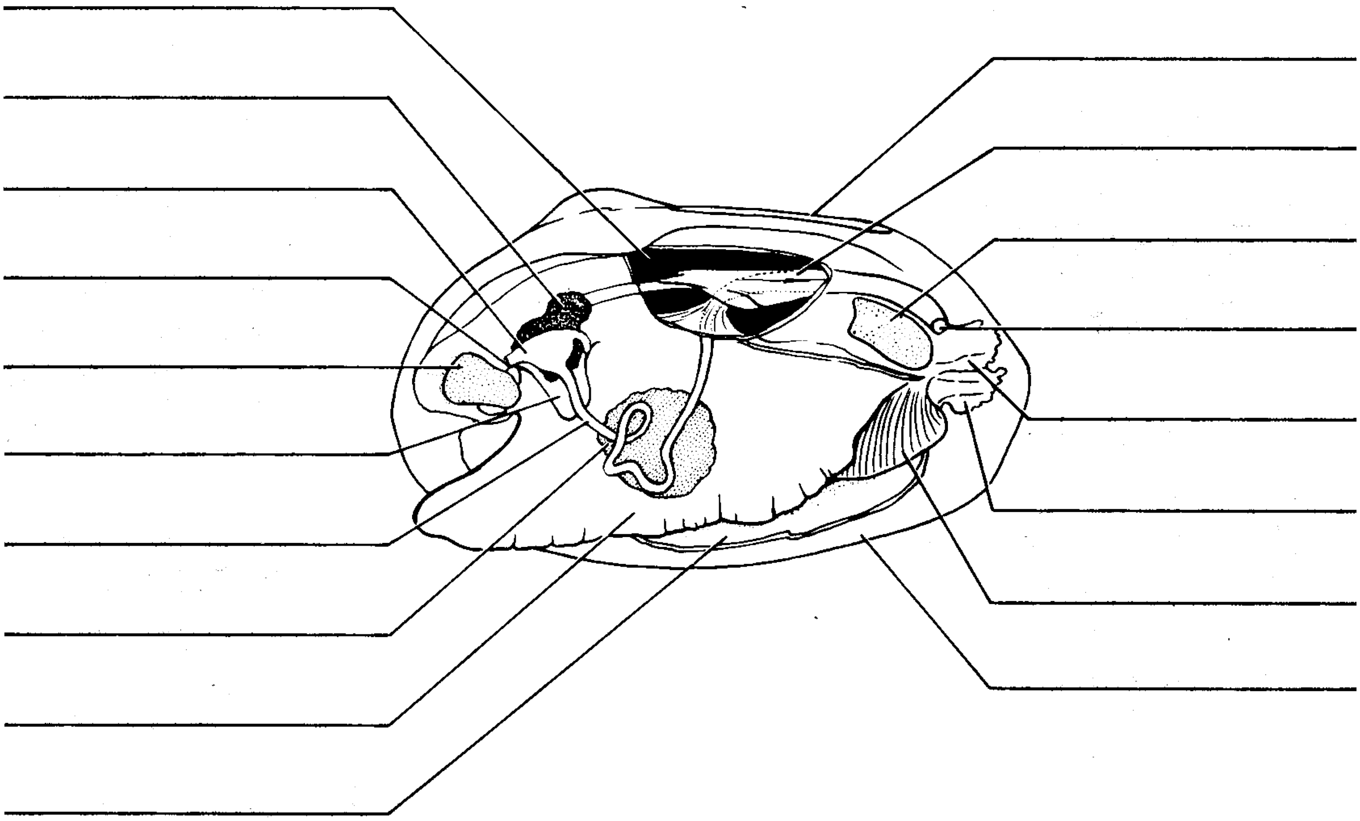
Adapted from Biology Junction

Clams are part of the phylum Mollusca. Mollusks can be classified as bivalves or univalves, based on the number of shells. Some, like clams, have hardened shells made of calcium carbonate, while others, like the octopus and squid, have a reduced internal shell. Clams, by taxonomy, are one of the simplest forms of mollusks and their body form is very similar to other bivalves.

From egg to adult, clams will metamorphose through one larval stage called a trocophore, a free-swimming planktonic stage with cilia for movement. In its adult form, clams have soft body tissue surrounded by a mantle, which assists in growing the shell. As a mollusk and like others within the phylum, clams have a muscular foot to move about on the sandy bottom or to help bury themselves to escape predators and low tide. Above this foot, is soft tissue called the visceral mass, which contains the organs. To assist the clam with feeding, it has a radula, a spiny organ similar to a tongue, used to drill holes into the shells of other mollusks it preys on. The scientific taxonomy of the common clam is: Kingdom Animalia, Phylum Mollusca, Class Bivalvia or Pelecypoda, Order Veneroida, Family Veneridae, Genus and Species *Mercenaria mercenaria*.

Student Morphology Worksheet – Clam Dissection

Label the diagram with the proper organs:



Use the space provided below to explain what each organ's function is inside the clam.

Sea Star Dissection

Adapted from Biology Junction

Procedures:

1. After putting on safety gear and preparing your lab area with all dissection materials, place the sea star on the dissection tray with its dorsal or aboral side up. Refer to Figure 1 below.

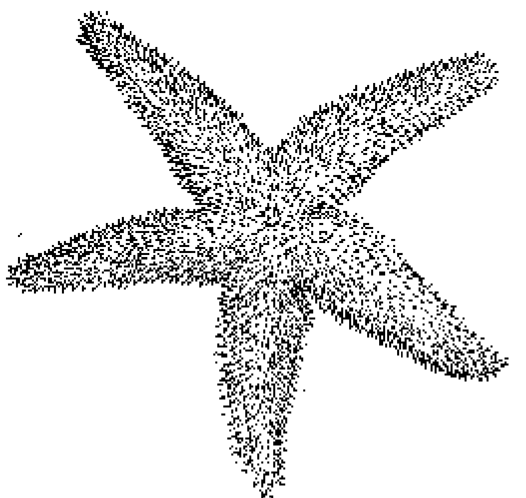


Figure 1

2. Locate the central disc that forms when the radii come together. Find the madreporite, the small, orange dot on top of the disc. This is where water enters the water vascular system of the sea star. Feel the upper surface for the protective spines. Refer to figure 2.

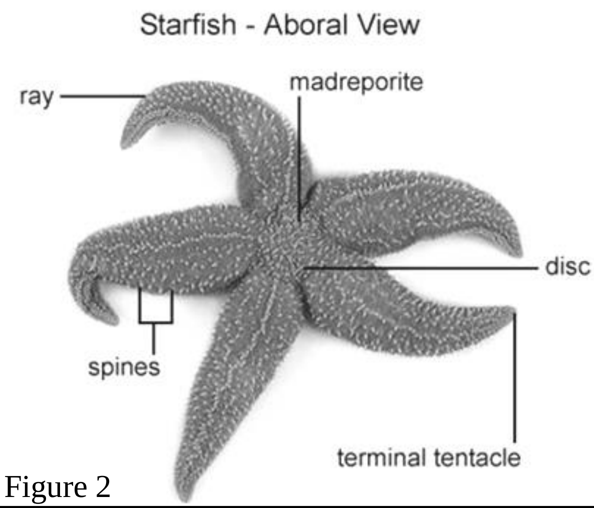


Figure 2

3. Locate each eye spot on the tip of each ray. The sea star is too primitive of an invertebrate to "see," but it can sense light and dark.

4. Turn the sea star over onto its ventral or oral side. Feel the numerous tube feet lining each ray within the ambulacral grooves. These are part of the water vascular system and aid in movement and feeding. Refer to Figure 3 below.

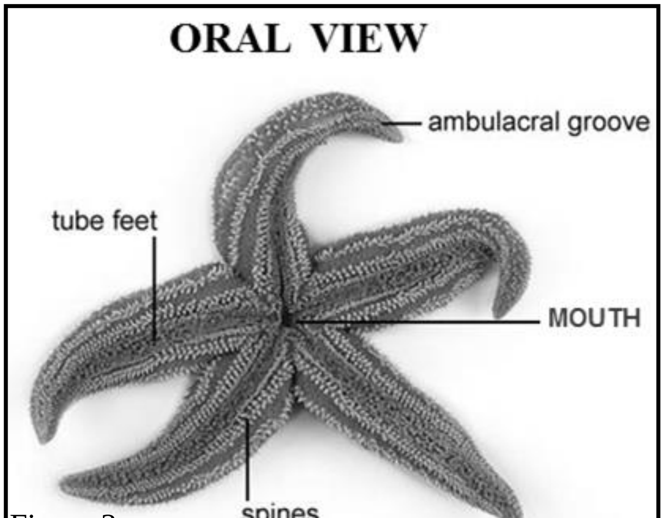


Figure 3

5. With the aboral side facing up, cut off the tip of one ray. Then make three slices along the ray, removing the flap of skin you created. Refer to Figure 4 for slice locations.

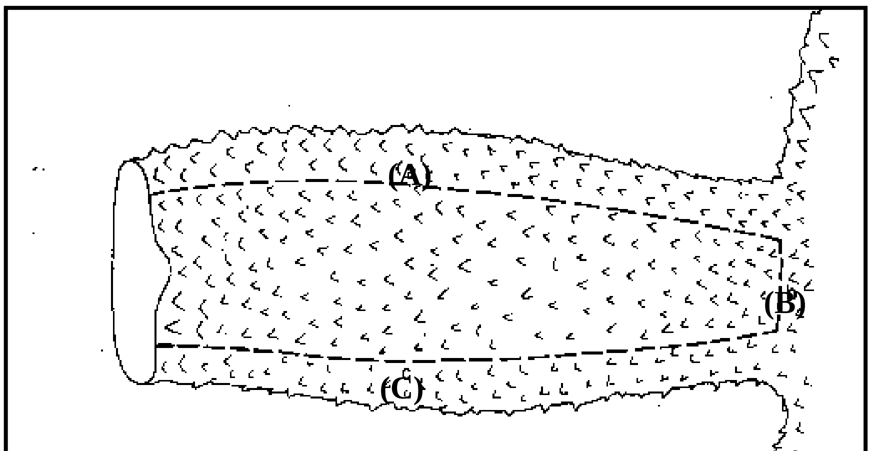


Figure 4

6. Inside the ray, locate the two long digestive glands called the pyloric caeca. These make enzymes to digest food in the stomach. Refer to Figure 5 below.

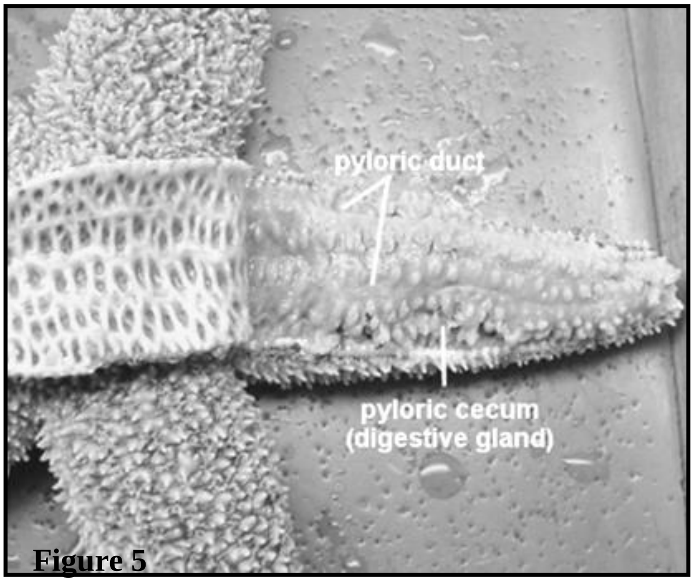


Figure 5

7. Cut and remove a circular flap of skin from the central disc. Observe the stomach underneath. Refer to figure 6 below.

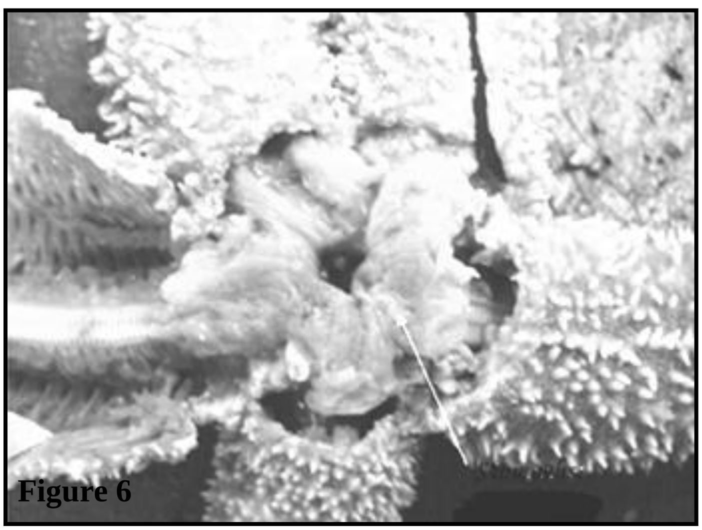


Figure 6

8. Remove the pyloric caeca from the dissected ray and locate the gonads underneath. These may be small if the sea star was not in breeding season. Remove these to view the water vascular system.

9. Cut off another tip of a ray to observe the tube feet more closely. View how the tube feet are attached to the ray through a zipper-like ridge that extends the length of the ray. Locate the bulb-like top of the tube feet called the ampulla. These create suction like an eyedropper or pipette. The bottom of the tube holds the sucker.

10. Embedded in the soft body wall are skeletal plates called ossicles. Refer to Figure 7 below.

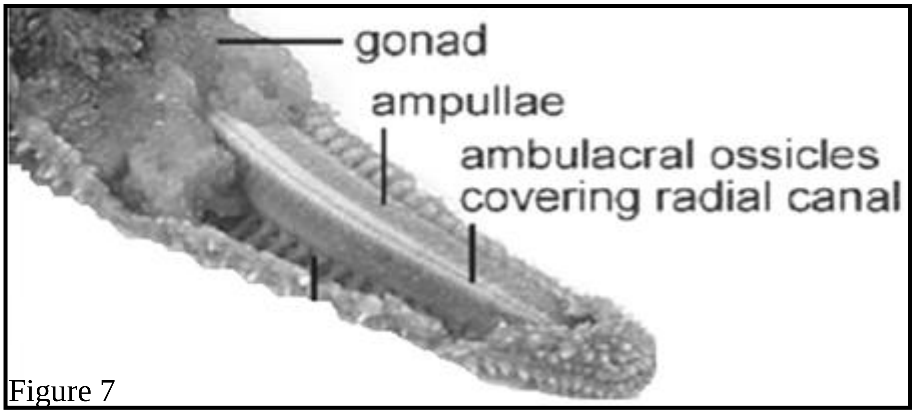


Figure 7

11. Referring to Figure 7, locate the radial canal. Each ray contains the radial canal and all five connect to a circular canal called the ring canal under the central disc. A short canal, called the stone canal, leads from the ring canal to the madreporite where water enters the body cavity. Refer to Figure 8 below.

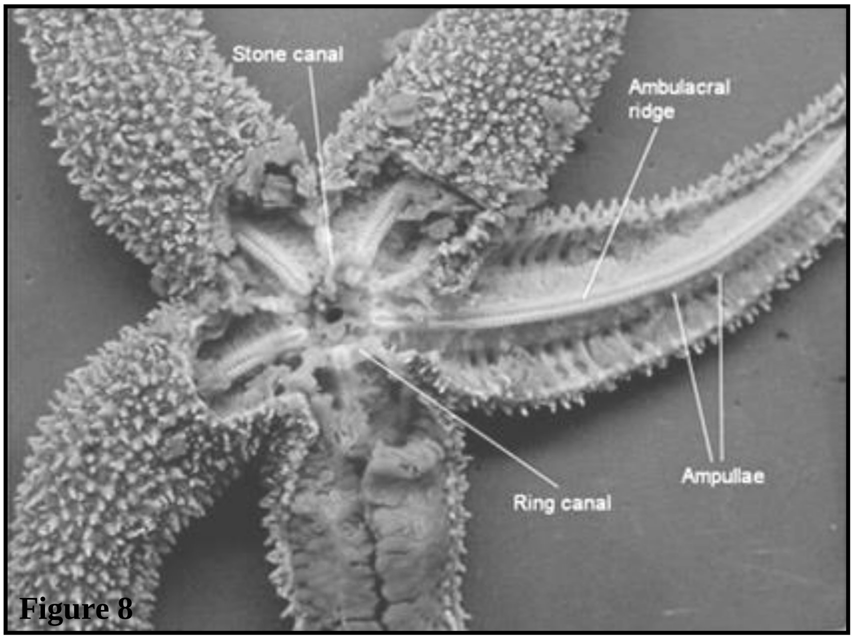


Figure 8

12. Label your organs on the student morphology sheet. Below your morphology diagram, state the name of the organ and its purpose to the sea star.

Key Words:

Aboral surface	Oral Surface	Madreporite
Central disc	Rays	Water vascular system
Eye spots	Ambulacral grooves	Pyloric caeca
Tube feet	Ampullae	Ossicles
Radial canal	Stone canal	

Background Information:

Adapted from Biology Junction

Sea stars are part of the Phylum Echinodermata, known for their radial symmetry and spiny skin. Known to date, there are over 6,000 species of echinoderms, which also include sand dollars, sea biscuits, and sea cucumbers. Radial symmetry, the main characteristic, means these species have a central body disc and radials (arms, rays, tentacles, or body chambers) coming from it. Many echinoderms, especially sea stars, have tube feet to not only help them adhere to hardened structures, but to capture and feed on prey as well.

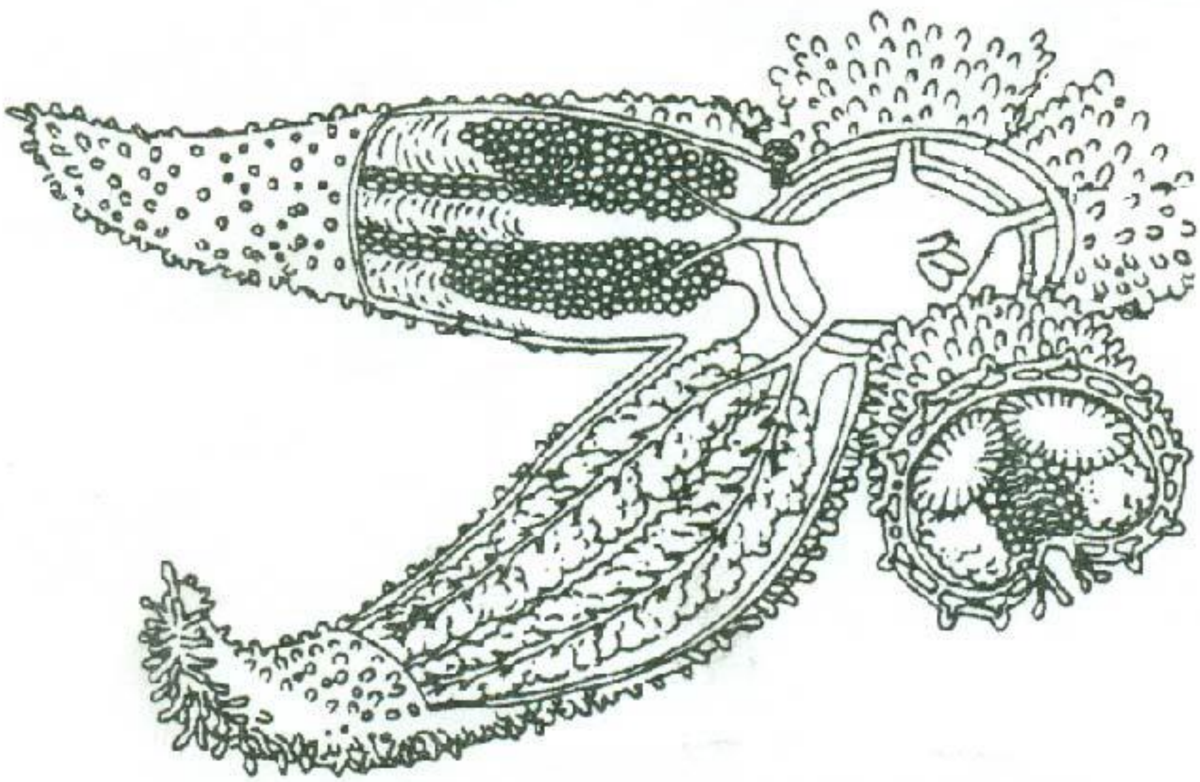
Although sea stars are often called starfish, they are not a species of fish at all. They lack vertebrae, fins, and most of the advanced organs that fish have, and rather than swim freely in the water column, they tend to crawl about close to the bottom. Taxonomically, there are two sub-groups of sea stars: Asteroidea, the true sea stars and sun stars, and Ophiuroidea, the brittle and basket stars. The difference in the sub-groups is due to the connection of the radials to the central disc, where Asteroid radials connect to each other before connecting to the disc and Ophiuroid radials do not connect to each other before connecting to the central disc.

The spiny skin of most echinoderms has a unique function. Some growths are used to absorb oxygen from the water and are called dermal branchiae (or skin breather). Some growths have adapted pincer-like organs called pedicellaria, which assist in keeping the skin of the organism clean and free of parasites and encrusting organisms.

On the tip of each radial of a sea star’s body is an organ called an eyespot, which is light sensitive. Even though they do have advanced eyes, these eyespots can detect light and dark and from which direction the light is coming from. Although they do not have a functioning brain, like their more advanced cousins, the octopus and squid, they can detect motion from predators and direction of prey species.

Student Morphology Sheet – Sea Star Dissection

Label the diagram with the proper internal organs.



Use the space provided below to explain what each organ's function is inside the sea star. Use the back of the page if necessary.

Fish Dissection

Adapted from Oregon Institute of Marine Biology

Procedures:

1. Review both the external and internal anatomy of the fish, so you have a clear picture of what you will be seeing and identifying during the dissection

2. After getting all the dissecting materials and donning safety gear, your teacher will hand your group your own fish. You will have approximately 10 minutes to identify the external organs.

3. Begin the dissection by cutting a slit from the anus to the gills along the ventral surface of the fish (under-belly). From there, cut a slit up the side of the fish alongside the gills and another up from the anus to the dorsal surface. This should create a flap of skin that can be lifted. Cut this flap off of the fish to better view the internal organs. Refer to Figure 1 below.

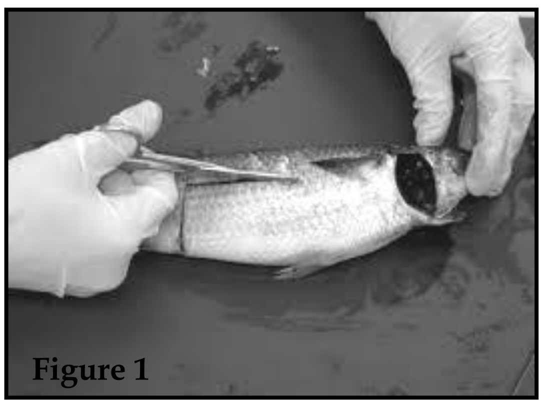


Figure 1

4. The largest and most visible organs will be the stomach and intestines. Stretch the intestines out to view how long they are. From there, you can observe the liver, the second largest organ.

5. You may use your textbook, as well as the external and internal anatomy diagrams, to identify each organ of the fish and answer the questions on the student morphology sheet. If you would like to view them more clearly, you may carefully cut each organ out and lay it flat inside the dissection tray next to the fish.

Key Words:

Dorsal fin	Pectoral fin	Pelvic fin
Anal fin	Caudal fin	Swim bladder
Gills	Gill rakers	Otoliths
Lateral line	Scales	Vertebrate

Background Information:

Adapted from New Wave of Learning

Fish come in all shapes and sizes and the species found in the estuarine watershed are just as unique. Their external features have been adapted for specialized depth, feeding, mating, and predator/prey response. Most fish are equipped with five distinct fins – dorsal (top), pectoral (front sides), pelvic (back sides), anal, and caudal (tails). The dorsal fins can be either spiny, smooth, or a combination of both. Pectoral fins are located behind the gills and are both smooth. The caudal fin can be either rounded or forked and assists the fish with steering through the water column.

There are four major body shapes to fish – elongate, torpedo, and either dorsal-ventral or anterior-posterior flattened. Elongate fish are also known as eel-like fish because their bodies are longer in length and resemble snakes. They usually have very small dorsal fins and their anal fins connect to the caudal fin to make it appear they have one continuous back fin. They may or may not have pectoral fins but if they do, the fins are small and translucent. The American eel can be found in small tributaries that feed into the bay and falls into this category.

Torpedo fish have very stocky bodies and pointed snouts. They are usually about as wide as they are long and depending on the species, will have all five fins present. Mouths of these types of fish are specially placed depending on their choice of prey. Examples of these can be striped bass, which have an upturned mouth to gather insects and small prey at the surface.

Dorso-ventrally flattened fish are also known as flatfish because they are flattened from top to bottom. These fish have mouths that have migrated to the bottom of their bodies and both eyes migrated to the top of the bodies during development. Their fins have attached and are located around the edges of their bodies. Examples of these fish are flounder, fluke, hogfish, and sole. Their teeth are adapted for crushing crustaceans, much like human molars.

Anterior-posteriorly flattened fish are those that are flattened from side to side. They also have all five types of fins. Examples of these fish are not known in New Jersey waters throughout the year, but occasionally during the summer months, several species of butterflyfish, angelfish, and surgeonfish will migrate from warmer waters in southern states.

There are also exceptions to these general body types. One example is the pufferfish. Their fins are very short and some species do not have pectoral or anal fins. Their bodies can expand into a ball shape when agitated by predators and some species have spines to act as a form of defense. Another example is the seahorse. This species is shaped like no other, with a rounded snout to suck in small prey like brine shrimp. Their tails are curled to assist in anchoring them to fronds of eel grass.

The external shape of a fish helps with feeding and predator/prey response. The elongate fish as well as anterior-posteriorly flattened fish can hide more easily and can find prey in the cracks and crevices of rocks and corals. Fish with forked tails tend to swim faster than those with rounded tails, so they use speed to be better predators. Flatfish feed on the bottom and can bury themselves in the sand, using ambush as their predatory tactic.

Student worksheet on the following pages.

Student Morphology Sheet – Fish Dissection

1. What is the purpose for the slime layer on the fish's scales?

2. What does the lateral line do?

3. Describe the key features of the external anatomy of the fish specimen. How many dorsal fins does it have? Are they smooth, spiny, or both? Is the caudal fin sharply forked, slightly curved, or flat? Is the anal fin long or short?

4. What is the purpose of the operculum?

5. Write three or more observations of the gills and gill rakers.

6. State whether your fish is male or female and explain how you know.

7. Describe the color and the texture of the liver. Draw a diagram of the liver below.

8. Describe the heart and diagram it below.

9. Draw and label the main parts of the digestive system.

10. Describe how the swim bladder works.

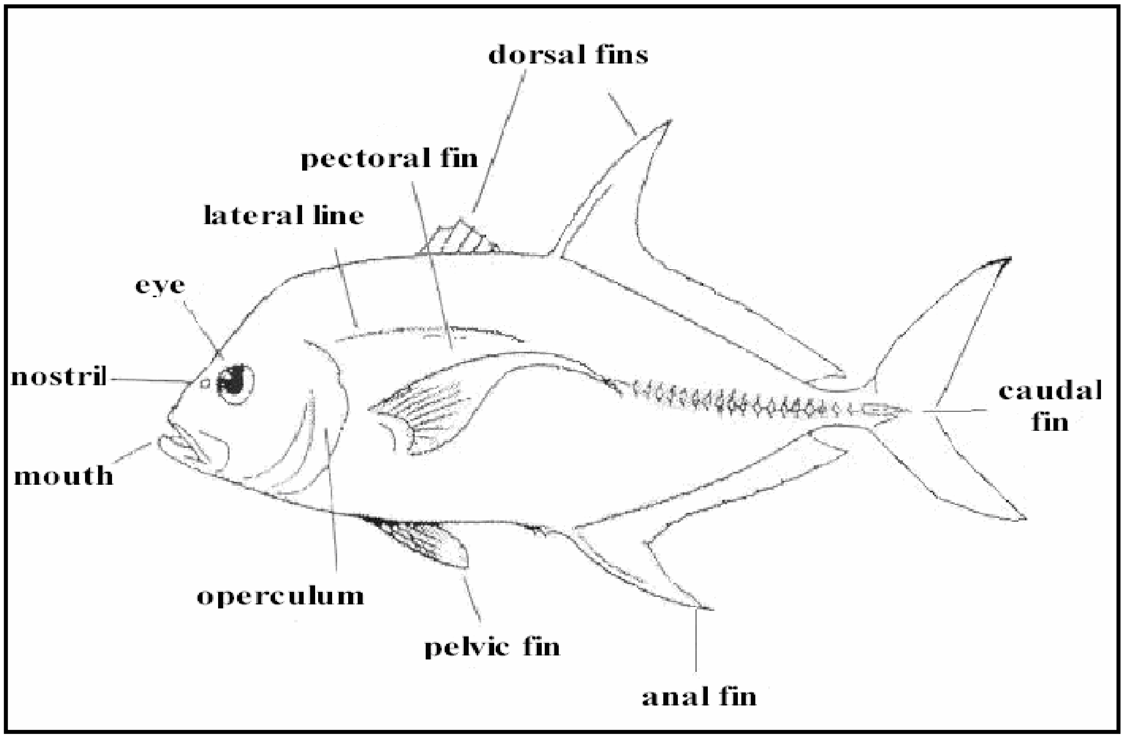
11. Describe and draw the fish kidney. What does it feel like? What is its purpose?

12. Sketch the skeleton of the fish, including ribs and vertebrae.

13. What sense organs are located in the head of the fish?

14. What is the purpose of the otoliths in fish? Draw one below.

External Fish Morphology Diagram



Internal Fish Morphology Diagram