



Open Ocean

Concepts

How are the physical structures of open ocean organisms suited to the physical habitats they live in? How do these structures help to capture and process the food they eat?

Standards Addressed

HCPS 5.1, 5.3, 5.4

Duration

Prep: 1 hr
Activity: 2 periods (45 minutes each)

Source Material

PRISM & MARE

Vocabulary

Adaptation
Habitat
Dorsal
Ventral
Pectoral
Mantle
Caecum
Gonad

Lesson 4: How Are Open Ocean Organisms Structured for Their Environment?

Summary

Students learn how open ocean organisms in Hawaii are adapted to the habitat they live in and the role they play in that habitat. Organisms that swim long distances will have well formed fins while those that drift may have no fins at all. Students will create their own superfish, a fish that is perfectly adapted for its environment. Students will also dissect a squid to examine the features and adaptations of an animal that supports a large commercial fishery.

Objectives

1. Describe how an open ocean organism’s structures are adapted to the physical environment of the habitats they live in.
2. Hypothesize and illustrate how an organism’s structures would look and how they would help the organism thrive in that environment based on what we know about that organism.
3. Explore how an organism’s structures are adapted for its environment.

Materials

Superfish (Fish adaptations) worksheet (2 pgs)
 Squid worksheet
 DAR or other fish posters
 Crayons
 Scissors

Teacher’s guides of squid anatomy
 Squids
 Dissection Trays (Paper plates)

Paper Towels

Making Connections

This session brings some of the organisms of Hawaii’s open ocean into the classroom. The lesson brings the concept of food webs to the table in front of the kids to show that these animals have adapted to prey on specific foods, avoid predators, and thrive in their liquid environment. The lesson also directly stresses the fact that fisheries play an important role in those food webs. After-all, where did those organisms come from?

Background

Ocean animals are adapted (specialized) to live in a certain part of the ocean. Although the ocean may all look the same, there are many different types of habitats there. For example, some organisms (phytoplankton, macroalgae, and marine plants) need



sunlight to live, so they are found in the photic (light) zone. Others are adapted to live on the bottom or float in mid-water. We will explore these adaptations by dissecting a market squid, which has many unique adaptations, and have the students create their own superfish.

Preparation

1st Period:

1. Buy a box of market squid (calamari) at the grocery store. There are usually more than 25 to a box and are about 5 dollars in the store.
2. Assemble Paper Plates, Scissors, and Paper Towels (one per student) as a dissection kit.
3. Print a teacher's guide of the squid's anatomy and review dissection procedures. You may want to practice the dissection if you have never done this activity.
4. Print squid worksheets. One per student.

2nd Period

1. Post Division of Aquatic Resources Fish Posters (As a Hawaii educator you are entitled to an entire set) or print some fish diagrams (see www.divekauai.com/images/fish-guide2.jpg).
2. Print one set of superfish worksheets per student (2 pgs).

Procedure

1st Period: Squid Dissection

Students may work in pairs or on their own, although students in pairs may assist each other in the dissection. Go through side 1 (external features) of the squid worksheet. Have the kids label five features/adaptations on the squid and how they might be useful. You may want to discuss what an adaptation is: Any feature or behavior that helps the organism live in its environment. Remember these squid live in waters about 300 ft deep, have many predators, and no hard skeleton to protect them. Features may include

Tentacles: two different kinds, one for grasping and one for eating

Suckers: for holding prey

Siphon: for propulsion

Eyes: large, organized like our eyes, polarized

Big streamlined body: for protection and speed

Fins: to steer

Mucas: for streamlining or protection

Mantle: Outer casing that surrounds all of the internal organs

Pen: Hard spike in the mantle for protection

Explain that the students should not destroy their squid and not begin the dissection until instructed because they are fragile animals. Hand out squids! Have the students identify any external features they may have missed and draw them on their handout. These may include the black dots (chromatophores) and/or the mouth including the beak, which is made of chitin (the same thing your fingernails are made of).

Ask students to turn over their handouts to the internal features of the squid. They should label the internal features on their handout as they learn them from their dissection. Make sure the



squids are oriented ventral side (light side) up. Students should then use their scissors to carefully cut the mantle down the midline of the squid from above the eyes to the tip of the squid. You may want to model how this is done. Give the students a few minutes to talk about what they see and then focus them on labeling and describing the internal features of the squid. These may include.

Ink Sac: Used for spraying a cloud to confuse predators. If you have the students remove the sac, they may break it and write their name with squid ink.

Gills: These feather-like structures are the equivalent of our lungs.

Heart: Pumps the squids blood through the body.

Gonads: Males gonads are full of sperm and are very white while females may have clear to yellow eggs that look like tapioca pudding.

Caecum: The caecum is an oval structure next to the gonad. It is used in digestion and may have little bits of food in it.

Anus: This is located inside of the funnel, which the students may cut open if they like.

Brain: This may be found right between the eyes. Squids are very intelligent.

When you're done then clean up!!! For more information about squids and market squids (*Loligo opalescens*) in particular you may visit <http://www.thecephalopodpage.org/Lopal.php> . There is some cool video footage here.

2nd Period: Design Your Own Superfish

Discuss some common types of adaptations. You may review posters to look at different kinds of fish and hypothesize how these different shapes and colors help these fish live in their environment. These adaptations may come from the adaptation worksheet or your own experience. Common adaptations for fish include (also see worksheet):

Coloration: countershading, army camo, change color, look like algae

Mouth and Teeth: Large for large prey, what kind of teeth (relate to your own), flexible throat (can swallow big things?)

Fins: Fast long distance swimmer = large quick fins, quick turner, drifter

Bodytype: Torpedo, Compressed, Weird

Scales: Small, large, different shapes

Eyes: Deep environments –Big eyes. Most predators have protected eyes for when they feed.

Anything Special—poison spines, lights, regeneration

Explain the adaptations worksheet and go through any terms they may not understand. Explain that the students will be designing a fish that is the ultimate superfish for a particular kind of environment.

Have students count off into five groups and put group number on worksheet. Members of each group should work separately. Group numbers will determine what type of environment you will live in (see side #2 of adaptations worksheet). Have the students identify (from list) or create five adaptations for their fish that would help the fish live in its environment. Kids should draw their fish and explain their special adaptations. No robotics or electronics on fish but



encourage creativity! See an example of students work on this project in the folder for this lesson.

Assessment

HomeWork: Finish your superfish. Think about how your organism has specialized structures that may help it survive in the open ocean. They will present their superfish briefly in the next class so they should finish.

Key Concepts (what the students should know!)

1. Describe some adaptations that open ocean organisms might have to their environment.
2. What are some environmental constraints in the open ocean?
3. What is an adaptation?
4. How are market squids adapted to the marine environment.

Links

This is the State of Hawaii's Division of Aquatic Resources website. It has the addresses of the field office closest to you as well as a lot of great information concerning the marine environment.

<http://www.hawaii.gov/dlnr/dar/>

Notes



Fish Adaptations Worksheet

NAME: _____ GROUP#: _____

Directions: Draw a fish that can live in the habitat for your group. Describe 5 adaptations (fins, colors, mouth, etc.) that you gave your fish and why you gave them that adaptation (explain how that adaptation is useful). Label them on your fish and fill out the chart below. You should be creative and use your imagination, but you must keep it organic (no electronics or robotics).

Adaptation	Usefulness
1.	
2.	
3.	
4.	
5.	



Group 1

Feeds on fast surface animals, swims constantly in the open ocean water column, and must avoid predators such as marlins

Group 2

Drifts in the ocean so is very slow, is tasty and must avoid predation, eats plankton

Group 3

Lives in very deep water on the bottom, eats whatever it can find large or small organisms, may try to hide from predators

Group 4

Migrates from shallow water in the day to deep water at night, eats fishes and squids, doesn't have many predators

Group 5

Swims slowly in the water column, feeds on stinging jellyfish and poisonous fish, must avoid sharks and people



Some Common Adaptations of Marine Animals and Plants

Body Part	Adaptation	Purpose
Mouth	at the end of the snout, symmetrical	open water feeder
	angled downward/longer upper jaw	feeds on prey below it, bottom feeder
	angled upward/longer lower jaw	feeds on prey above it, surface feeder
	strong jaws - teeth	preys on other fish
	sucker-shaped	eats small plants and animals
	barbels	feeds off bottom, senses food in murky water
	duckbill jaws	grasps its prey
	no teeth	eats plankton
	very large mouth	surrounds prey
Eyes	both on the same side of the head	lies flat on the bottom of the ocean
	small	shallow water fish
	large	usually deep water fish
Fins	Large, forked caudal fin	strong, fast swimmer
	spines on fins	protection, more difficult to swallow, can be poisonous
	large pelvic fins	bottom dweller
	small pelvic fins	open water swimmer
Body shape	round	difficult to swallow, slow swimmer
	flat bottomed	feeds on the bottom
	long, eel-like	hides in rocks and weeds
	torpedo shaped	high speed swimmer
	flat from side to side	almost invisible from the front and rear, feeds above and below
	flat from top to bottom	hides on the bottom
	hump backed	stable in fast moving water



Body Part	Adaptation	Purpose
Scales	large	uses its scales for protection
	small	fast swimmer
Coloration	no markings	swims in the open water
	stripes	hides in seaweeds and grasses
	mottled	hides in rocks or on the bottom
	countershading - dark on top, light on bottom	less visible to predators above and below
	stripe through eye	helps to camouflage the organism by hiding the eye
	false eye spot	predator will attack tail giving fish a greater chance to escape
Special Adaptations	Poison/tastes bad	Protects fish from predators
	Regeneration	Allows the organism to growth new body parts when lost. This takes a lot of energy though.
	Lights	Helps to scare animals or attract prey
	No bones	Allows animal to fit through very tight spaces and to live in very deep areas
	Other	There are all sorts of other adaptations in the ocean.



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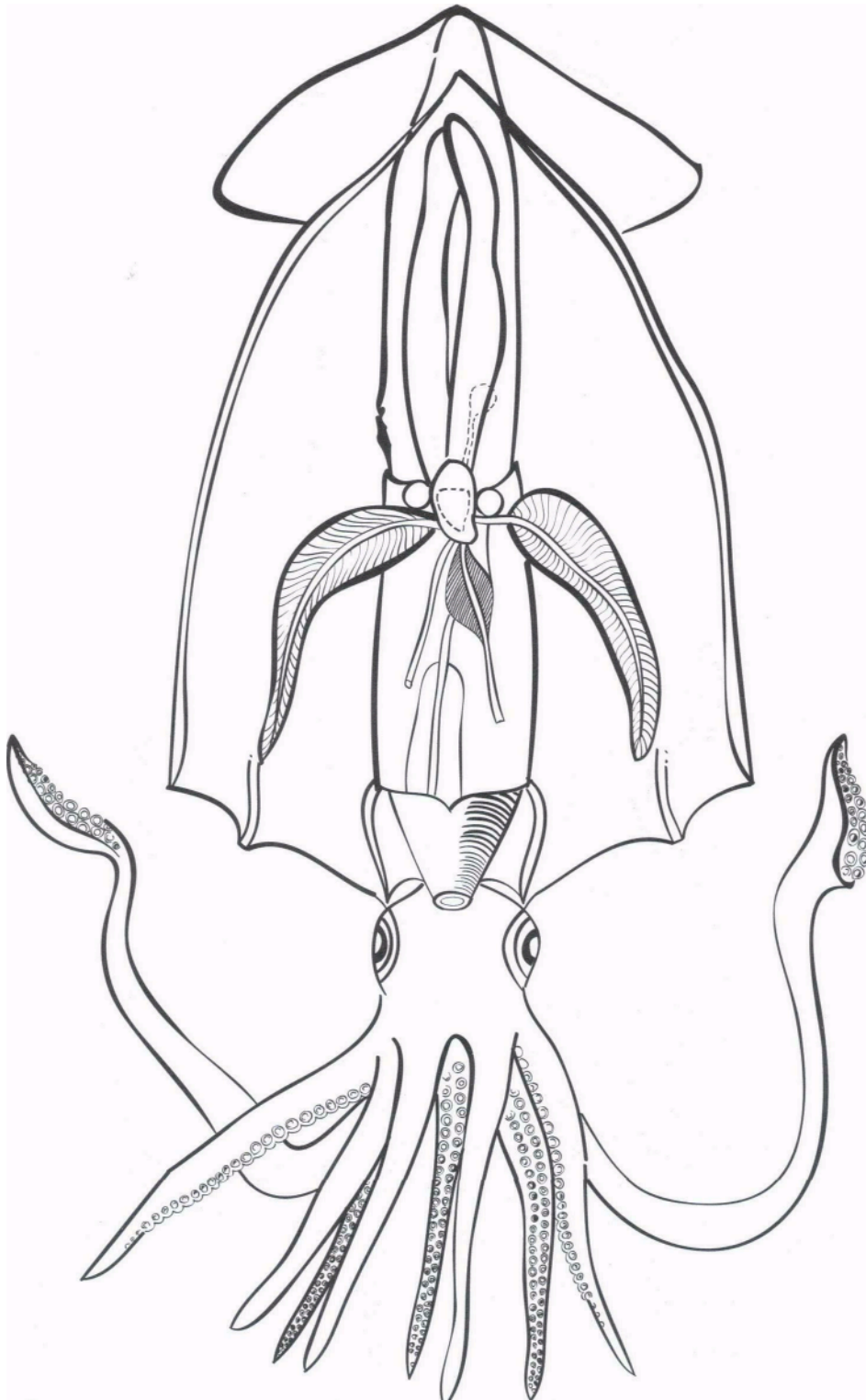
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INTERNAL SQUID ANATOMY

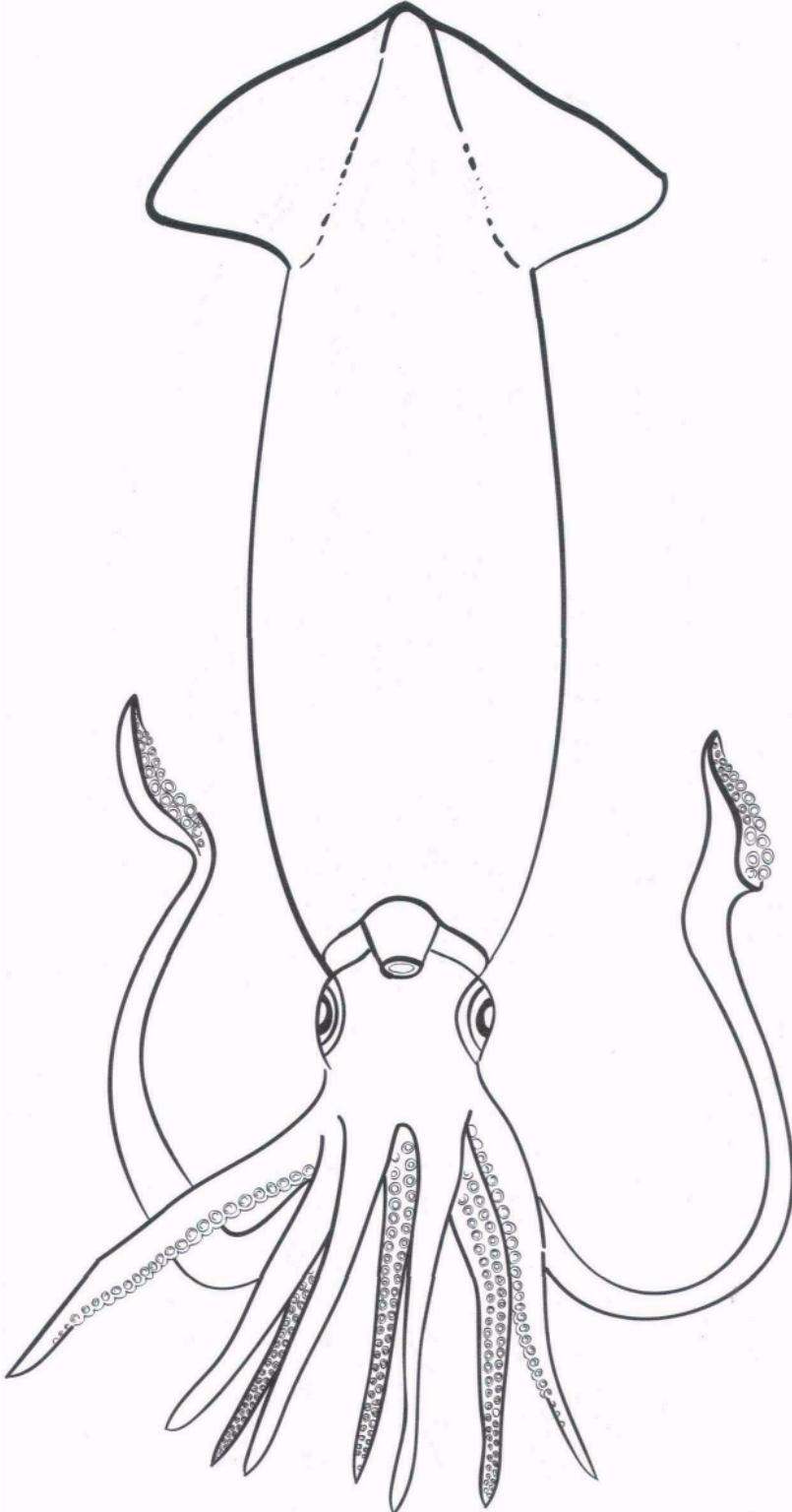


Label the internal parts of the squid that you identify



External Squid Adaptations

Name _____



Label the squid with five features that you observed. Explain below how each feature may help the squid to live in the ocean.

1: FEATURE _____

2: FEATURE _____

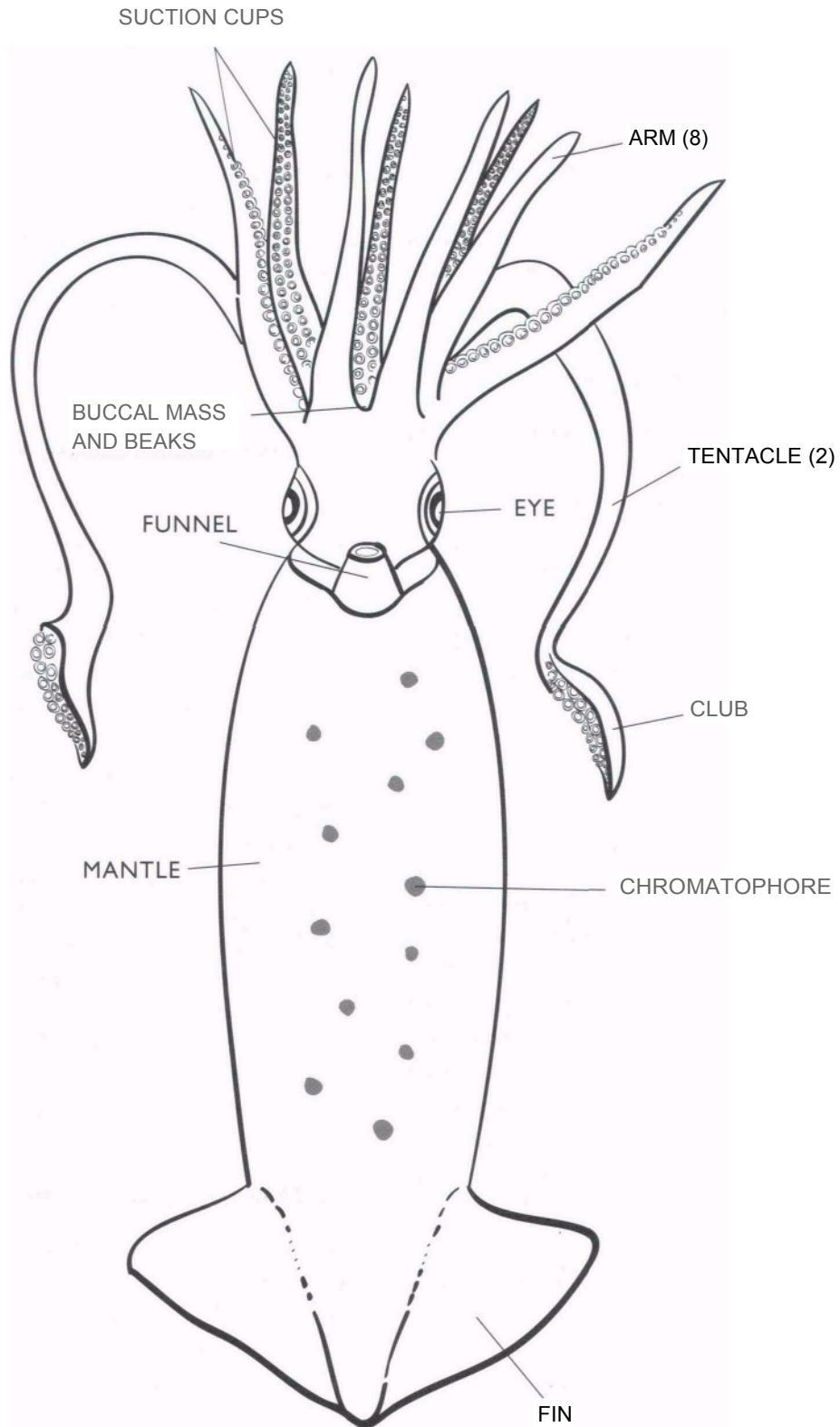
3: FEATURE _____

4: FEATURE _____

5: FEATURE _____



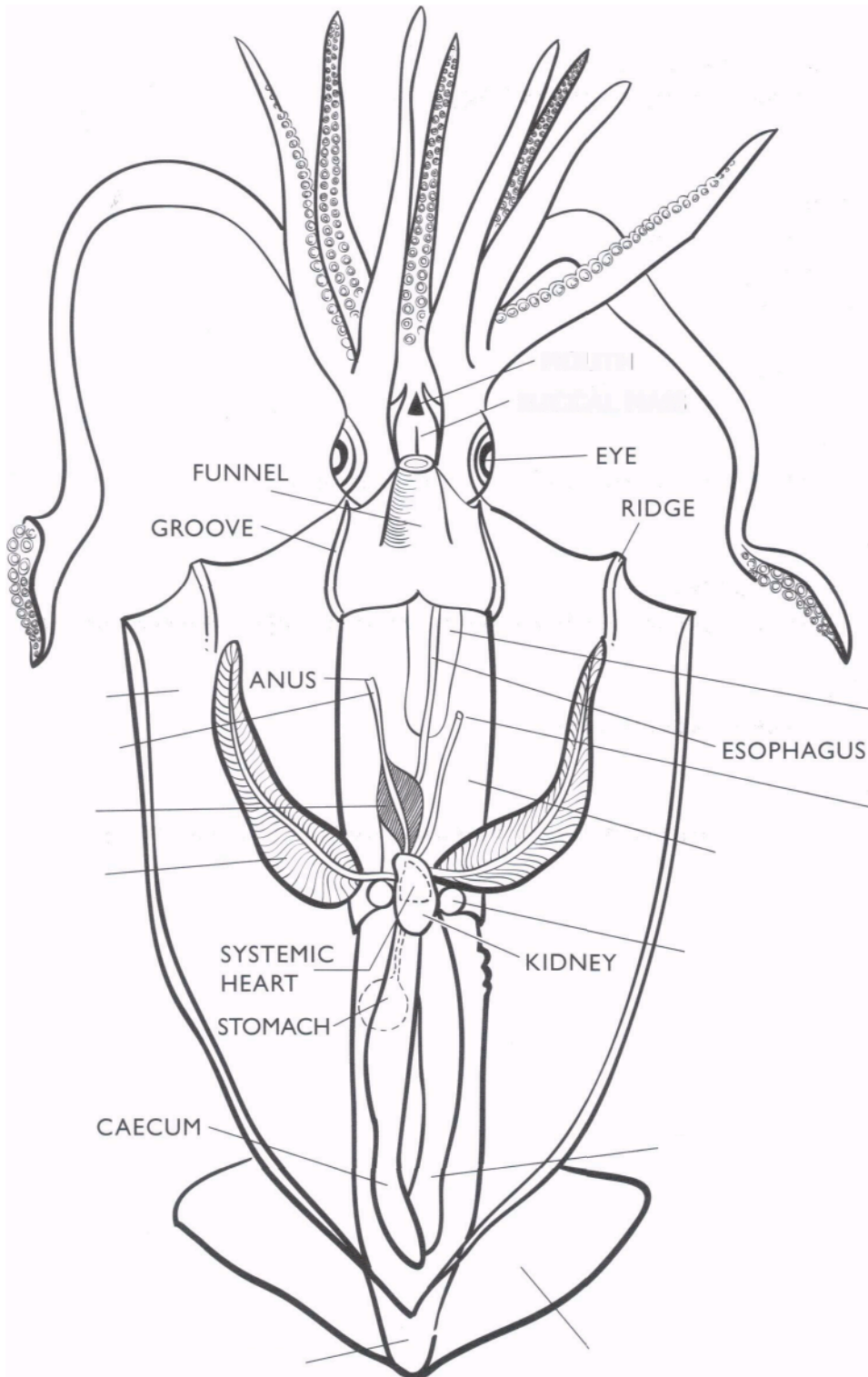
External Squid



From Lawrence Hall of Science
Lesson 4: Open Ocean Structures



Internal Squid





MOUTH
BUCCAL MASS

MANTLE
INTESTINE
INK
SAC
GILL

DIGESTIVE
GLAND
GENITAL
OPENING
FUNNEL
RETRACTOR
MUSCLE (2)
BRANCHIAL
HEART (2)

GONAD

PEN

FIN