

LONG BEACH
Marine
INSTITUTE

**Fishy Friends
and
Fishy Foes**

Teacher Introduction

Field Study Parameters

Objective

The purpose of this field study program is to introduce participants to the marine animals and their relationships and to instill in them an appreciation for marine fauna in the near-coastal waters of Southern California.

Academic Thrust

This field study program incorporates academic material from the subjects of marine ecology and marine zoology. The level at which this material is covered is dependent on the age and preparation of the participants.

Activities

This program includes marine organism hands-on analysis. The field study includes a brief talk and multimedia presentation by a marine naturalist. The naturalist and students then proceed to analyze the collection. Collection I consists of a bottom sediment sample taken with a Peterson Grab Sampler for the purposes of separating benthic infauna from the sediments. Separation occurs by use of two eight-foot containers with built-in strainers and is conducted by the participants. Collection II consists of a sample collected by an otter trawl net. The bottom specimens are sorted by the naturalists and presented to the participants for analysis.

Field Trip Itinerary and Organization

The field study program is organized in the following manner:

- 0:00 Safety and orientation (conducted by vessel captain)
- 0:10 Board excursion vessel, seated in conference room
- 0:15 Lecture and Presentation (conducted by naturalist)
- 0:45 Examine benthic infauna
- 1:05 Examine trawl samples
- 1:30 Disembark

The itinerary above is an approximation. Some portions may be extended or contracted according to the circumstances of the time. In the case of classes larger than 50, a group rotation may take place, and the program may run long.

Field Study Subject Matter

Marine Ecology

Ecology is the study of the interrelationships of living things and their environment. Ecology is a word popularized by the pioneers of the environmental movement in the late 1960's and early 70's. Marine ecology is an attempt to understand how marine organisms relate to one another and their habitat. Marine plants, animals and physical phenomenon, such as water chemistry and wave action, make up what is known as a marine ecosystem. You can think of an ecosystem like a mechanical device such as an automobile or a computer. Like a car or computer, an ecosystem has many interdependent parts. However, an ecosystem is infinitely more complicated, and a marine ecosystem is even more difficult to understand because it is under water. Exploring the ocean, even the shallow parts, is a difficult and expensive task.

One cannot discuss marine ecology without considering the marine habitat. The ocean, like the earth, is an immense biosphere made up of many different habitats. There are deep-water habitats over 40,000 feet deep. Pelagic, or "open water," habitats exist between the surface and the sea floor and contain plants and animals that never see the bottom of the ocean and, perhaps, never come to the surface. In near-coastal waters, there are many types of coastal habitats. Habitat, the physical place where an animal and plant lives, can be a part of a larger community. For example, the coral reef community may contain several habitats including a soft sandy seabed and the coral itself.

Coastal habitats and communities in Southern California are many and varied. Tide pools are found among the rocky intertidal. Mud flats are found in bays and estuaries. Sandy beaches rocky reefs and kelp forests all provide unique habitat for marine plants and animals. Even boats and pier pilings are habitat for some creatures and algae. We find in all cases that the plants and animals that inhabit a particular community are intensely dependent on the physical characteristics of the habitat. Kelp plants cannot grow without a secure place of attachment, usually provided by the large rocks of a California reef. Sea anemones and sea urchins require a shallow place of attachment found along our rocky shores. Cusk eels and stingrays need loose sand or mud arranged in a large flat habitat to take advantage of their unique abilities to burrow and hide.

Understanding how animals relate to their habitat in this way is the thrust of ecology. Our field study will focus on a particular habitat near shore in about 30 feet of water. The seabed near Belmont Shore in Long Beach is a mixture of fine grain sand and silt (or mud). In this soft substrate, as it is properly known, burrows a large variety of invertebrates. An invertebrate is any animal not belonging to the phylum chordata, or animals without backbones (or notochord). Examples of these invertebrates are clamworms, innkeeper worms, brittle stars, clams, crabs and ghost shrimp. Their survival depends on a stable soft sea floor in which they can burrow a shelter and sift for food. These invertebrates become prey animals for the fish and rays that swim and hide atop the silt and sand.

The fish that are typically found on a soft substrate are flatfishes and rays. Flatfishes are peculiar fish that are oriented on their side. On one side of the fish can be found both eyes and coloration that matches the sea floor. The other side of a flatfish is blind and contains no coloration (pigment). As the fish lies flat on the sea floor, the compressed body shape helps it hide while both eyes on the "up" side of the fish enable it to see everything nearby.

The rays have what is known as a "depressed" body shape which means they are somewhat

flat from top to bottom (not side to side like the flatfishes). The eyes of the rays are situated on the dorsal (top) side of the animal. These characteristics among others help the ray hide from predators and hunt with stealth.

Whether the animal is a burrower or has cryptic coloration and body shape, you will see on your sea creature safari how the animals collected in the sediment sample and in the trawl net are related to their soft, flat sediment habitat. Understanding this relationship allows us a glimpse into the science of marine ecology.

Marine Zoology

Zoology is the study of animals. In this field study, we will be exploring a bit of marine zoology, or the study of marine animals. Everyone enjoys meeting new animals, but it is only meaningful if we have some understanding of these animals, their particular habits and requirements for survival. Only in understanding marine organisms through such sciences as marine zoology can we adequately protect them and their environment. In this section, species of animals that dominate the soft sediment substrate of the San Pedro Breakwater bay area will be discussed.

The organisms we will encounter may be categorized as benthic infauna and benthic epifauna. The infauna are animals found within the sediments. Generally, these are burrowing organisms that make their homes in hollowed crevices and tubes in the soft, stable precipitate of the bay floor. We collect these animals by use of a Peterson grab sampler that is lowered by use of our hydraulic crane and winch. Once the sampler makes contact with the soft sediment, it automatically closes, capturing about one cubic foot of sediment and any organism trapped there. The fine silt of the San Pedro Breakwater bay area is a stable dense silt ideal for a variety of tube worms, clams, brittle stars, shrimp, sand fleas and burrowing sea stars.

Upon retrieval of the sediment sampler, the mud is carefully placed in a separator. The separator consists of a stainless mesh fixed to a sluice over which pumped seawater runs. The investigators then wash away the sediment in order to expose, collect and examine the infauna.

The epifauna are animals that are found attached or resting on the seabed, irrespective of depth. These include benthic fish such as halibut, sole, turbot, sanddabs, lizardfish, skates and rays. They also include mussels, scallops, shrimp, prawn, sea stars, snails and a host of other notable invertebrates. The epifauna are collected by use of an otter trawl net. The otter trawl net is hauled behind the research vessel over a pre-selected area of the bay and directed downward toward the benthos. As it creeps along the seabed, whatever slow-moving or attached organisms in its path are enveloped between the otter boards and concentrated in the cod-end of the net. After perhaps 20 to 30 minutes of trawling, the crew retrieves the net and sorts the organisms for discussion and analysis. The epifauna is placed in display tubs that are plumbed with the seawater pump system installed on the research vessel.

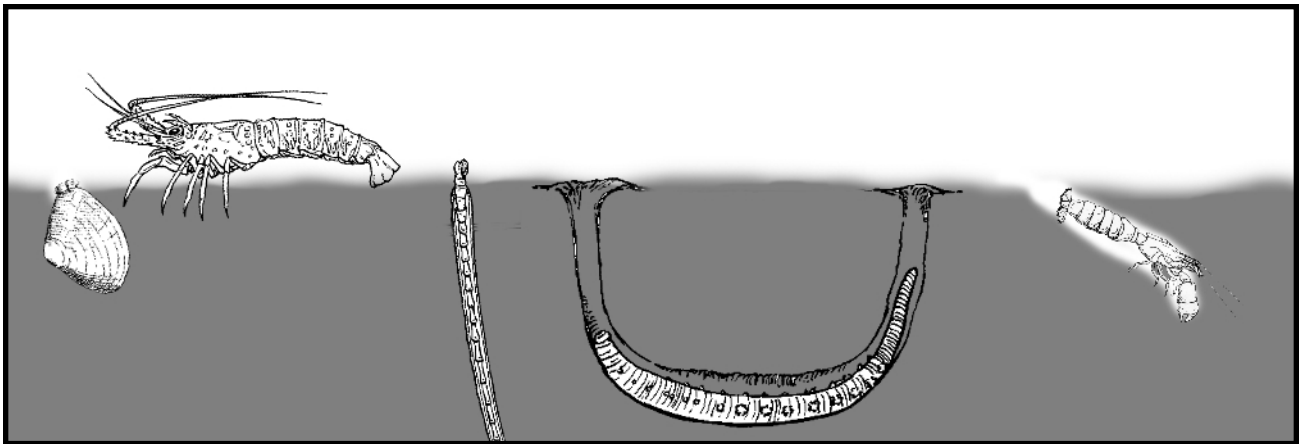
By use of these two methods, students are introduced to the processes of marine zoology. The depth with which the subject is handled is dependent on the level of preparation and participation of the students and chaperones.

Student Preparation

Habitat

Habitat is defined as the place where an animal lives made up by its physical properties. The ocean contains many different habitats, and the Southern California coastal area contains many of these including the rocky intertidal, sandy beaches, rocky reefs, kelp forests, estuaries and many others. The rocky intertidal has hard rocks, crevices, and tide pools and it exists between high and low tide. Sandy beaches have shifting sands and surf and water runs through it very quickly. Kelp forests contain giant kelp attached to rocks and are located in water to a depth of just over 100 feet where swell, surge and sunlight play a important role. Each of these habitats is a place where animals live made up by their physical properties (like rocks or sand) and the ocean actions that happen around them (like waves and tides).

The soft seabed where you will find the animals we will see is no exception. It is made up of a fine-grained mud that has settled to the bay bottom after being carried by rivers and streams from far inland or settling from the remains of dead marine plants or animals.



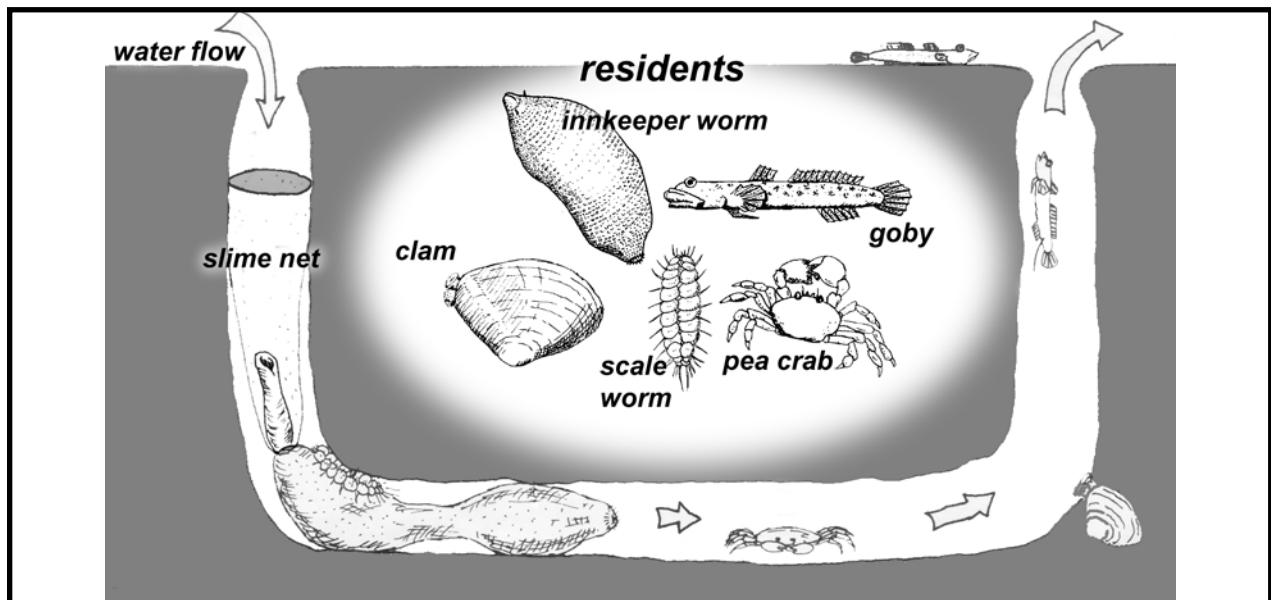
The habitat where we find the animals we will see is best described as a soft muddy sea floor located in shallow water. Understanding the habitat is very important when conducting scientific surveys of plants and animals because of the close connections living things have to their environment. It is hard to learn much about an animal or plant when it is away from its habitat. A fish, for example, can be described as it swims in a laboratory aquarium, but its behavior will be different than it would be in the sea. Only when it is observed among other animals and plants in its natural habitat can it be fully understood.

Mud Dwellers

Animals that burrow into the soft muddy seabed are called **infauna**. These animals make their home in burrows in the soft, pliable mud. Here they have a chance at survival by staying out of reach of predators. Some animals have precise digging tools and build complex tunnels. Some take advantage of existing burrows and share them with the builder. Still others create mucus sheathing or tubes in which they live, creeping out only to feed or to mate. Some are predators themselves, using clever trapping devices or chasing their prey within the layers of mud or sand.

Discovering their tools for survival is our top priority. Whatever the animal's name, their physical description and behavior are most important to us so that you can better understand the scientific method. It is OK if an animal can not be identified. Instead, try to notice the things about its body that help it live in its habitat.

By burrowing, the animals conceal themselves from enemies, escape waves and surge and place themselves in the middle of their food supply. Burrows and tubes must be flushed with fresh seawater in order for the animals to get oxygen. Sometimes the animal has a siphon or external gills or, in the case of some burrowing worms, tentacles to extend beyond the burrow or tube for a source of dissolved oxygen.



The innkeeper worm, who shares its burrow with other animals seeking shelter, uses a slime net at the entrance to its burrow to capture food.

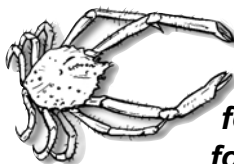
Bottom Dwellers

Animals that rest on the sea floor or remain attached there without burrowing into the mud or sand are called **benthic epifauna**. The epifauna have the problem of hiding from predators without burrowing or using rocks or plants to hide behind. Instead they must rely in strange defenses such as the ability to change color and pattern or by having poisonous spines.

Some animals, like the halibut and sole, have compressed body shapes and camouflage skin. Others, like octopus and squid, have the ability to generate an ink cloud or change their color and pattern. Still others, like the torpedo ray, are able to generate an electric charge.

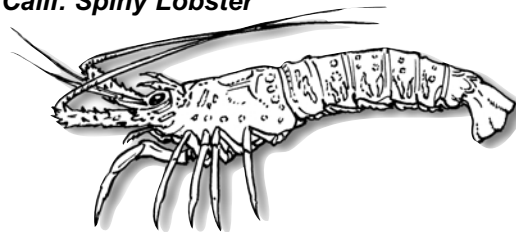
Discovering the epifauna's survival mechanism is how we understand their basic relationship with their habitat. Identification of the animals is largely based on what they look like and how their bodies are arranged, but survival behavior and defensive weapons may belong to animals that look very different.

The epifauna are far more active than the animals that bury themselves in the mud or sand. Where infauna usually stay in one place or move very slowly, the epifauna move with food supplies, seasons and to avoid animals that would eat them. Usually when the animals that rest or move about on the seabed are found still or partially buried, they are quietly waiting for predators to move away or they are waiting for something to eat to swim or crawl by. Most of the epifauna we will see feed on animals that burrow into the blanket of mud at the bottom of the bay.



Spider crabs blend easily with the source of their food: drifting debris found along the bottom. Some can even attach debris to their exoskeleton for better camouflage.

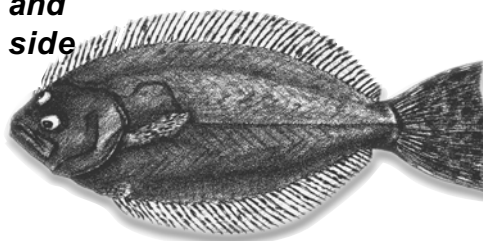
Calif. Spiny Lobster



Crustaceans, like the Spiny Lobster, have tough outer skeletons. The lobster also has rows of sharp, formidable spines.

Flatfish like the California Halibut are compressed, flattened from side to side and have two eyes on one side

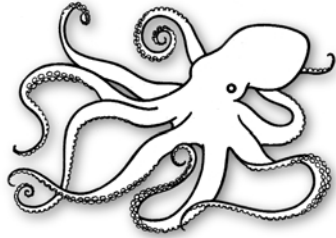
California Halibut



Also, their coloring helps them blend in with the sandy or muddy seabed.

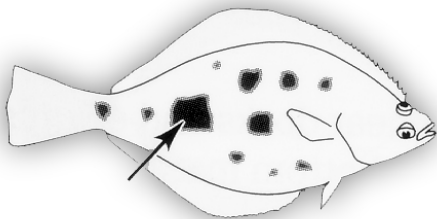
The Importance of Color

Coloration may help an animal hide by blending with its habitat, or color may serve to attract or warn other animals within the community.



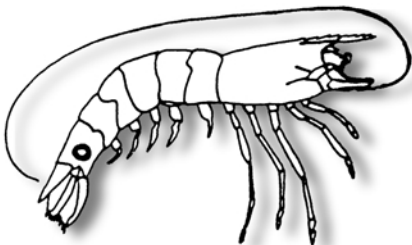
Cryptic Coloration

Cryptic coloration helps the animals blend in with their surroundings. The octopus changes color instantly from black to gray to red to match its background. It can also change the texture of its skin, becoming bumpy or smooth to blend in with rocks and seaweeds.



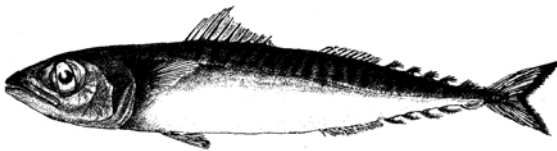
Disruptive Coloration

Spots and stripes break up the body shape of some fishes and conceal them against their backgrounds. This kind of camouflage, called disruptive coloration, is common in coral reef fishes, but also seen in fishes of Southern California.



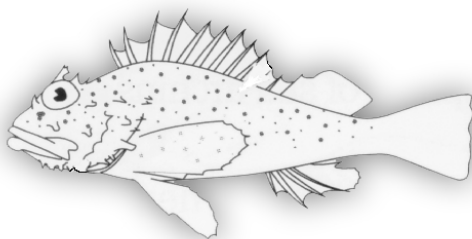
False Eye Spots

Unusual color patterns may hide vulnerable parts of an animal's body. The true eyes of a spottail shrimp are nearly transparent at the end of long stalks, but near the tail are two prominent "false eyes." A confused predator may attack these instead of the real eyes, allowing the shrimp to escape in the opposite direction.



Countershading

Many open water animals have dark backs and light bellies. This protective coloration is called countershading. Viewed from above, dark backs blend with the darkness of the deep ocean. From below, it is difficult for predators to see light bellies against bright sunlit surface waters.



Warning

Some animals are so well protected with spines, poisons, and armor that their coloration is warning for other animals to stay away. The California Scorpionfish has brightly striped fins with poisonous spines that it displays to would-be attackers.

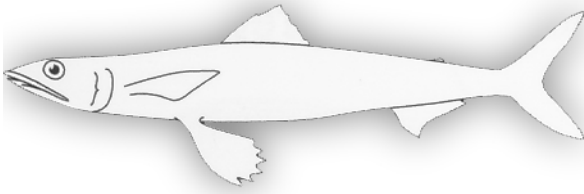
The Importance of Shape

Body shape gives important clues about where animals live, how they move and how they protect themselves or hide from predators.



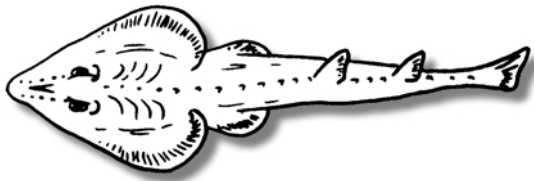
Fusiform: the swiftest of all fishes

Powerful tails help fusiform shaped fish chase prey and avoid predators. Many of them live in the open ocean and swim continuously, traveling thousands of miles in their lifetimes.



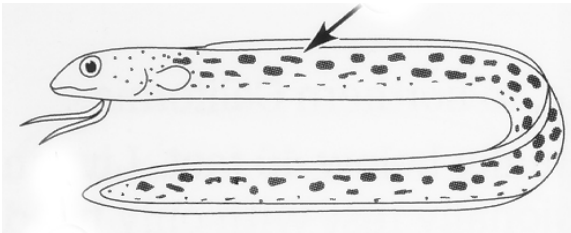
Rod: elongated, arrow-like fishes

These hunters ambush their prey. They float motionless until a smaller fish swims near. Then they lunge out with lightning speed to seize their victim.



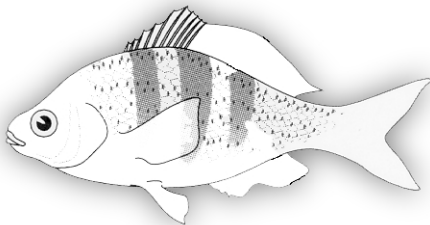
Depressed: flat, pancake-shaped fishes

They use camouflage instead of speed for survival. To escape predators, they burrow into the sand or mud. Many change the color of their skin to match their surroundings.



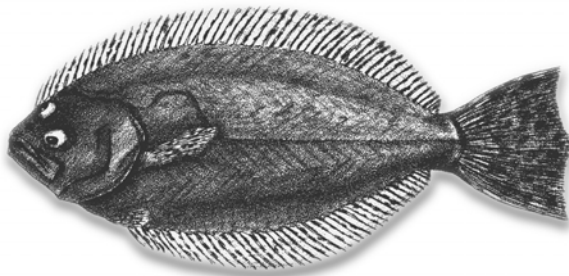
Ribbon: snake-like fishes

They are slow swimmers but move easily through cracks and crevices, under rocks and around aquatic plants. They are secretive, hiding from predators and ambushing prey that come too near their hiding places.



Compressed: fishes flattened from side to side

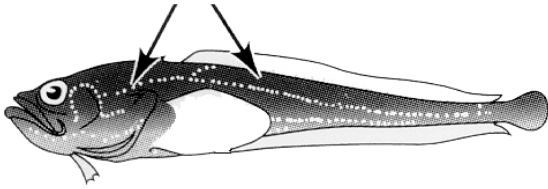
When viewed head-on these thin fishes almost seem to disappear. They are common in reef communities. Their compressed bodies allow them to make quick sharp turns and dart in and out of hiding places.



*Flounder, halibut and other flatfishes have compressed bodies, but they lay quietly on their sides on the sand or mud, acting much like fishes with depressed body shapes.

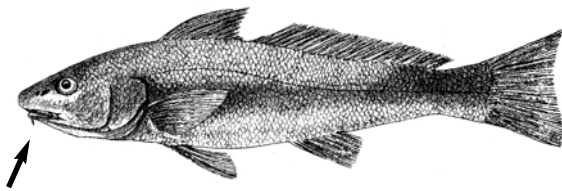
Special Body Features

Special abilities and body features help animals survive by serving as protection, attraction or as tools for capturing food.



Bioluminescence

Midshipman fish have their own built-in light system. By covering and uncovering pockets of glowing bacteria within special cells (called photophores) the midshipman blinks signals to other fish and confuses predators.



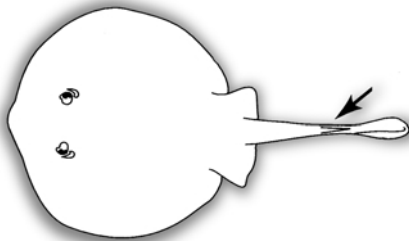
Chin Barbels

They look like whiskers, but they are not hairs. Barbels are feeling and tasting organs. In the murky bay waters, barbels help the California Corbina find its food. It touches and tastes the bay mud to detect snails, crustaceans and other foods.



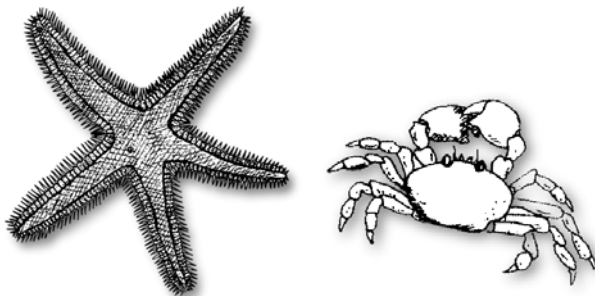
Electricity

Several fishes have special body organs that produce electricity. The electric ray (also known as the Torpedo Ray) sets up a low voltage electric field around its body that helps it detect food and navigate in muddy waters. If threatened, the electric ray may produce more powerful discharges that can shock and stun predators.



Spines

Many fish which are not fast swimmers have sharp or poisonous spines for protection. The scorpion fish have venomous dorsal spines along their backs. Stingrays have a poisonous dart on their tail.

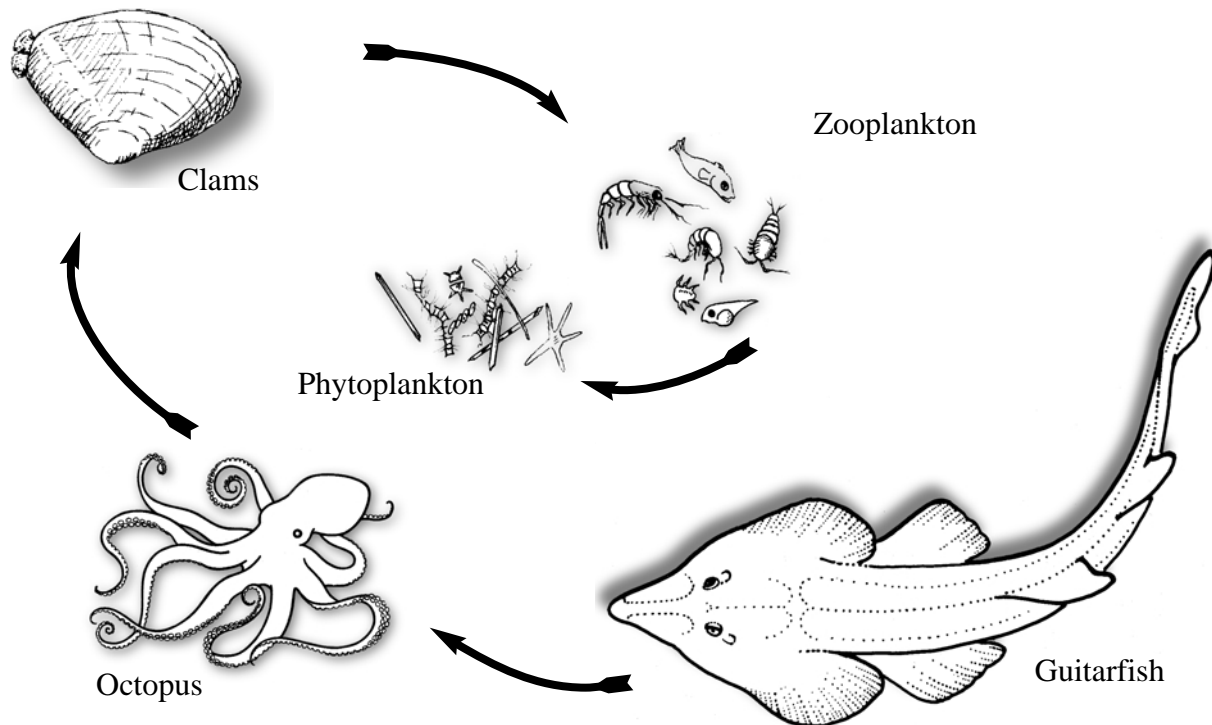


Arms & Tentacles

Some sea animals, like sea stars and octopus, have arms equipped with suction tubes or discs for catching and holding their food. Crabs and shrimp have pinching claws on the ends of their appendages. Jelly fish and sea anemones have tentacles equipped with stinging cells to catch their food.

Food Chains

All living things in the sea depend on each other for food. The food chain begins with sea plants called phytoplankton. A huge variety of tiny animals, called zooplankton, feed on the phytoplankton. These animals include shrimps, copepods and jellyfish among others. Some of the most common fish, such as sardines and anchovies as well as many filter feeding invertebrates, like clams, feed on zooplankton. These fish and invertebrates are eaten by others, such as larger fish and predatory invertebrates like sea stars and octopus, which in turn are eaten by the larger predators of the community. This pattern of eating is called a food chain. Food chains occur in all parts of the seas (as well as on land), combining into an intricate oceanic food web.

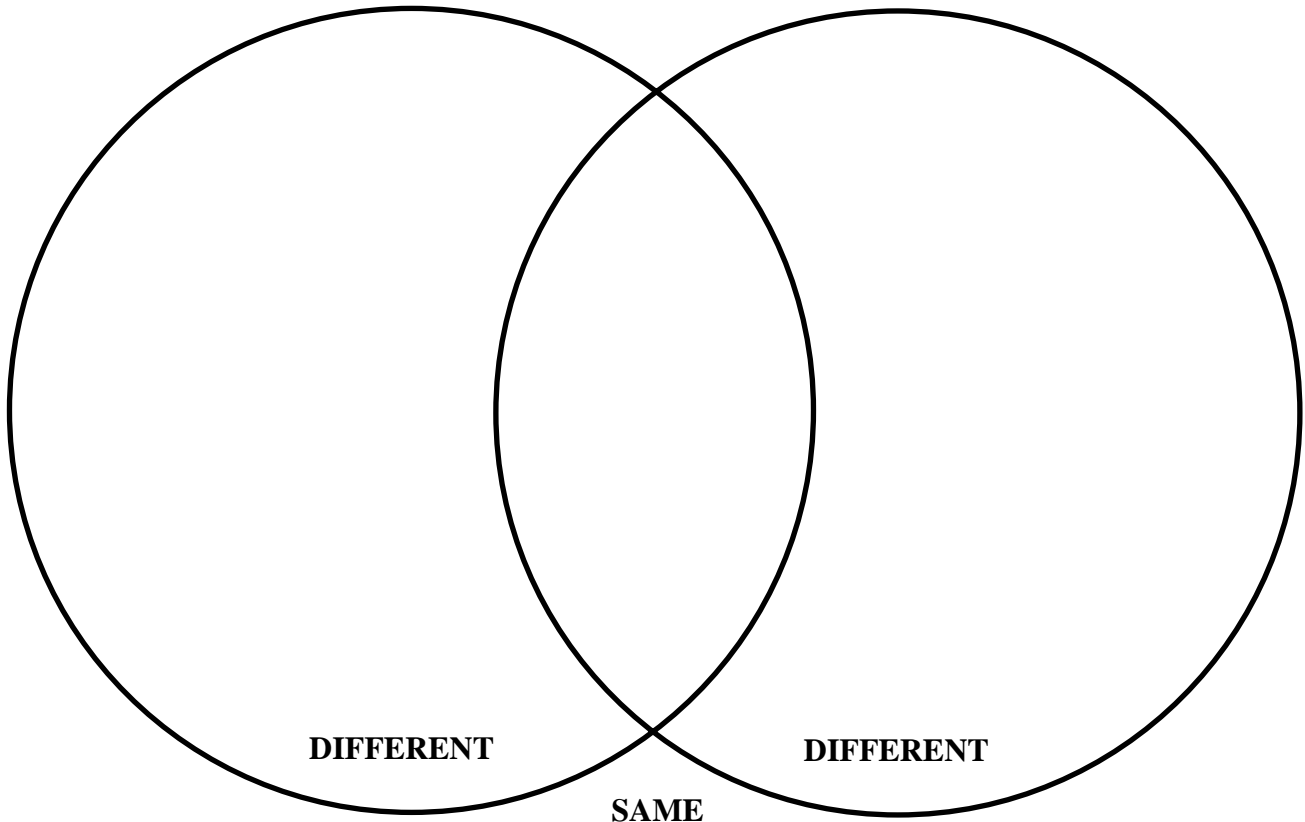
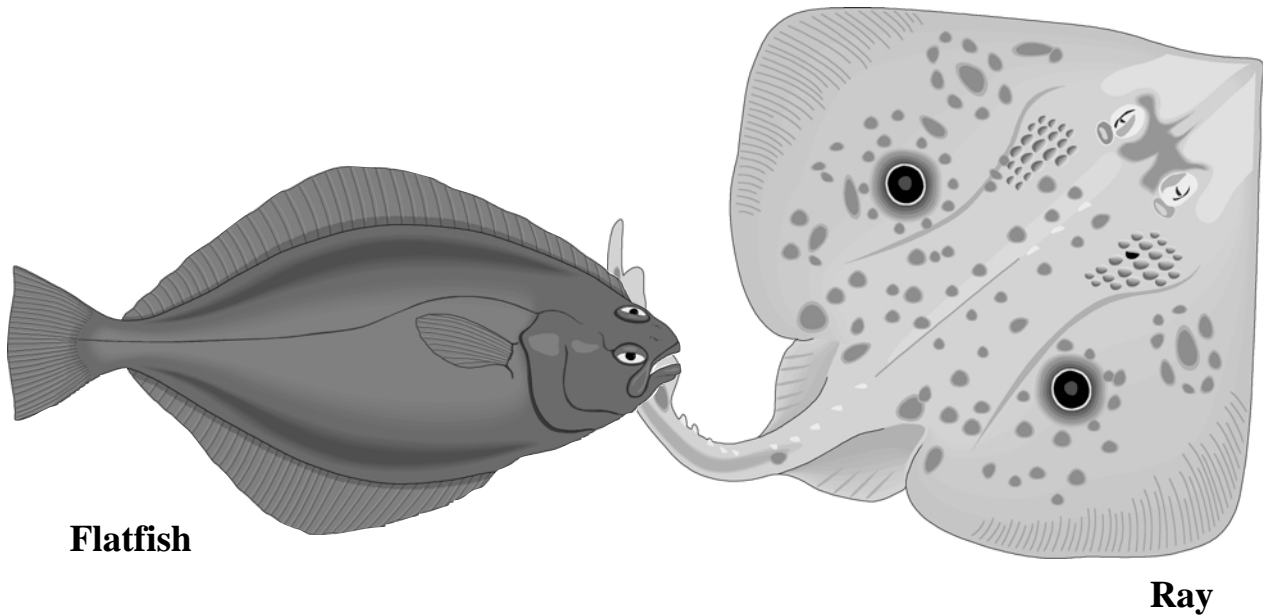


Use the food chain illustrated above to answer the following on a separate sheet of paper.

1. Describe the food chain above.
2. If there was a decrease in the zooplankton population, what would happen to the clam population?
3. What would happen to the phytoplankton population? Why?
4. If the octopus population became endangered, what would the result be?
5. What does it mean when “The death of one species in the food chain upsets the rest of the chain?”
6. Draw another food chain (land or ocean). Explain and give an example for each step.

Animal Comparison

A Venn diagram is a great way to compare things. Use the one below to compare rays and flatfishes. Fill in the circle below the ray with characteristics common only to rays. Fill in the circle below the flatfish with characteristics common only to flatfish. Where the circles overlap, fill in characteristics both animals share.



Adopt an Animal

Choose an animal from one of the two lists below. Learn as much as you can about your choice using nature books, encyclopedias, textbooks or the Internet. Clip pictures or drawings to help you readily identify them in the field. Try not to choose the same animal as those chosen by your friends. This is called “specializing,” and it will help you learn more as a class.

Common Animals

bony fish
 California halibut
 California tonguefish
 spotted turbot
 hornyheaded turbot
 diamond turbot
 fantail sole
 white croaker
 California corbina
 shiner surfperch
 specklefin midshipman
 plainfin midshipman
 California lizardfish
 California scorpion fish

Common Animals

rays
 batray
 round stingray
 thornback
 torpedo ray
 shovelnose guitarfish

invertebrates
 California spiny lobster
 spottail shrimp
 spider crab
 spiny sandstar
 moon snail
 two spotted octopus

animal name: _____

min/max size: _____

color(s): _____

diet: _____

habitat: _____

interesting facts: _____

*paste picture
or drawing here*
