Unit Three: How do Organisims Interact?

Organisms are not isolated in their environment. Organisms must interact with other individuals of their own species, with other species, and with their physical environment. The study of the interactions between organisms and their environment is called ecology (Greek: oikos- house; logia- study). The study of ecology can encompass all aspects of biology; from physiology to behavior, because any change within an organism has the potential to affect its relationship with the environment. Likewise, ecological interactions can be studied at many different levels; between an organism and its environment, between an organism and a group of organisms, or between two groups. In this unit we will cover many of the important concepts within ecology.

Lesson 1: Quadrat Craze

50 minutes

Concepts & Objectives

QUESTION

How can a scientist find out how many organisms live in area?

UNDERLYING CONCEPT

Scientists can learn a lot about an area by having a clear idea of how many and what kind of organisms live there. It's very difficult to literally count all of the organisms in a large area or zone so scientists use tools (such as quadrats), identification, and estimation as important keys in determining this answer.

SKILLS

- Using a grid
- Problem solving
- Categorizing
- Estimating

METHODS

Spread out a 12-bean soup and macaroni mixture on table. Students will use home-made quadrats to mark out a section. By categorizing and counting what is in the quadrat area they will estimate the number and variety of "organisms" on the table.

OBJECTIVES

Students will be able to:

- Categorize objects
- Estimate a number in an area
- Apply the grid principle to multiplication skills

MATERIALS NEEDED

- 1 package of 12-Bean dry soup mix
- 1 package each of 2 or 3 varieties (and colors) of pasta (macaroni)
- small plastic bags (to hold one mixture for each group or team)

- wire coat hangars, each one shaped into a square ('quadrat')
- Quadrat Craze Data Sheet (included in lesson plan--choose appropriate sheet for your grade)
- stiff paper or ruler to scoop mixture together for clean up

Vocabulary & Background

VOCABULARY

- Identification- finding out what something is
- Categories- groups of similar things
- Community- group of living things that live in a certain area
- Organisms- any individual living thing
- Estimation- a rough idea of the size of something

BACKGROUND INFORMATION

How can a scientist determine the quantity and type of organisms living in an area, and why is it important? Identification and estimation are important keys in determining these answers. Having a clear idea of how many and what kind of organisms live in a specific area can tell scientists a lot. For example, they can record data on several occasions and learn about how populations and communities may change over time. With such information they can find answers to many other questions and also create new questions to explore.

Scientists use a variety of methods and tools to find answers to questions. Some tools and methods are very sophisticated while others are simple and uncomplicated. In the above example, it is obviously very difficult to count every organism in an entire area (or community); in this case quadrats and simple mathematical computations are often the tools and methods of choice. A quadrat is a square of a determined size (usually 1 meter or 1/2 meter square) which is placed on a portion of the area/community to be studied, in a tidepool zone, for instance. By counting how many organisms are in the quadrat and multiplying that by the number of quadrats that would fit into a certain area, estimates can be made about population sizes for each kind of organism that lives in an area. Another way to gather information about the organisms in the quadrat is to measure them and determine their actual size (length) and ranges of sizes. This will give an idea of the likely range of sizes for individuals within a given category. In the following activity students get an opportunity to use similar skills in their classroom.

INTRODUCTION

T: How many trees (or bushes or .....) are around our school (your neighborhood, park, etc.)?
T: If there are too many to count easily, how else could we find the answer?
T: Would we need to use some math?

Activity

Today we are going to talk about some of the tools that scientists use to study organisms. One of the most important tools that a scientist uses is Math. So today's activity will involve some addition and multiplication. Another tool that scientists use a lot is identification, finding out what something is, and categorization or putting things into similar groups. A third tool that a scientist might have to use is estimation. Let's say that you have a very large community area and you want to find out how many of a certain kind of organism live within the community. You could count all of the organisms in that area, but that would probably take a very long time (say the trees in our school area, park, or neighborhood). Or you could count the organisms in a smaller area within the community and then estimate (roughly figure) the total number in the whole community from that.

(Teacher can do a simple diagram on board, draw large square with lots of 'x's for the trees. Then outline a smaller square within the big one. Have the students count the 'trees' in the small square and decide how many of those small squares it would take to fill up the big square and multiply by that number. Early elementary grades could use smaller quantities and practice addition.)

Next introduce the quadrat (a real one if available, or the coat hangar shaped into a square). This is one more tool that a scientist would use for this kind of study. It is a square of a known size or area (the area is the amount of space that is covered by the quadrat). This area can be calculated by multiplying the length of the quadrat by the width. A scientist would put this over an area of the community and count the organisms in it. Then she would estimate the number of these quadrats that would fit in the total community. Then, using multiplication (or larger groups of numbers and addition for pre-multiplication grades), we multiply the number of each organism by the number of quadrats.

So today we are going to study a make-believe community that has many different kinds of organisms:

- What is a community? *(Answers will vary: a neighborhood, ...Real answer: a group of living things that live in a certain area)*
- What is an organism? *(Answers: a body with organs, ... Real answer: a term for any living thing)*
- If grade appropriate: What is a population? *(Answers: a group of people, many animals..... Real answer: the group of a single species in a community)*

We are going to identify some of the organisms in this community and then estimate their total number within the community.

ACTIVITY

1. Divide into pairs or groups of 3.

2. T: Pass out a plastic bag which contain a mixture of 12 bean soup and macaroni (be sure to have at least 8 different things in each bag) to each group. Also hand out Quadrat Craze Data Sheet. [Choose Data Sheet I (students not yet introduced to fractions) or II (students understand fractions).]

3. Students spread the "community" of beans and pasta on a table or desk top. Two teams can work independently on the same 'community'.

4. Students are to identify 8 categories of "organisms." It is up to the teams how they want to categorize the organisms; it can be done by: color, shape, pasta, beans or a combination of those. They can decide on real or made up names.

5. Write this on the Quadrat Craze sheet. It has 4 columns: one for the name of the category, one for a description of what it is, the third column is for the number within the quadrat. (Ex: BB, black beans, 12)

6. Estimate the total number within the community. Do this by counting how many quadrats would fit into the whole community (table top) and multiply that number by the number of 'organisms' in the category. Place this number in the last column of the sheet. This can be simplified for younger students by using a smaller number of categories, and a smaller area (desk top) for the total community (so it takes only 2 or 3 quadrats to cover the whole 'community') and then use addition.

7. Have each team report on their 'findings'.

DISCUSSION

- Why are there differences between estimates of teams at same table? *(Different objects may have clustered together due to weight, texture, etc.)*
- How is this similar to differences in the natural world/wild? *(Animals and plants may group together because of better food sources, temperature, and other conditions.)*
- What are the problems of estimation? *(It is a rough 'guess' and not completely accurate.)*
- What are some of the problems using quadrats? *(You are only covering a certain area and the next area might be very different.)*
- Would scientists use just one quadrat count? (*No, With older students discuss how) scientists would normally count several quadrats in an area and then calculate an average (appropriate to grade level: discuss averages)*

Extensions

- Add rulers (with metric and standard measurements) to your "materials." Pick a

"category" or grouping and put them into "size classes" (grouping by size). For example: How many organisms in the quadrat (or category) are greater or smaller than a particular size chosen by the teacher (example 2cm). Also, students can count how many of the objects in the chosen category are: less than 1 centimeter, how many are between 1 and 2 centimeters and how many are over 2 centimeters in length (teacher can choose relevant sizes). Which are the smallest and largest in each size class? Write down the results.

Ask these additional discussion questions:

- Are individuals in the same group or category more similar in size to each other or to individuals of other groups? (This will depend on the original groupings that the students have made; if "green" was a group category, then there may be as much variation in size within the group as between groups.)
- Why are there different sizes in the same group? (Some beans may have had more 'food' as they grew, the pasta may have been cut differently. In the natural world some organisms are more successful at competing for food or are surrounded by more favorable conditions (environmental factors))

- If the "rulers"/'size' Extension is chosen, then additionally one can have students: Make a size distribution graph: On graph paper plot the number of individuals that are in eachsize class. On graph paper, write the size classes on the x-axis (horizontal axis) and the number of individuals on the Y-axis (vertical axis). For each size class, plot the number of individuals that you observed in that class. The resulting graph is known as a size distribution for that category of organism.

- For older elementary students use the multiplication grid provided and practice multiplication tables. Explain that it is essentially a quadrat on paper, broken into smaller parts.

- Use the quadrat to introduce fractions: Divide a quadrat into 4 quarters. (The quadrat can be made out of PVC, rope, string, etc.) Ask students to count how many organisms are in one quarter, 2 quarters, 3 quarters and 4 quarters (to demonstrate how 4 quarters make a whole).

- Introduce the concept of density: the number of organisms per unit area. For example: "There are 24 snails per square meter in the community."

- After doing the "Quadrat Craze" activity in class, repeat it in the school yard, at a tidepool, at a touch tank, at an aquarium, etc.

Quadrat Craze Data Sheet

Name: _____

Category	Description	Number in Quadrat

Quadrat Craze Data Sheet II

Name: _____

Category	Description	Number in Quadrat	Fraction (% coverage)

Quadrat Craze: Multiplication Tables

Name: _____

1	2	3	4	5	6	7	8	9	10	11	12
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Lesson 2: Kelp Forest Reading Area

3 - 5 class periods

Sea Grant
University of Southern California

Concepts & Objectives

QUESTION

What makes up a kelp forest environment?

UNDERLYING CONCEPT

The kelp forest is a unique habitat supporting many organisms.

SKILLS

- Designing
- Planning
- Conceptualizing
- Measuring

METHODS

Students will create a “kelp forest reading center” in order to learn about the ecosystem of a kelp forest.

OBJECTIVES

Students will be able to create a walk-through kelp forest in the classroom.

MATERIALS NEEDED

- Rope
- Green trash bags
- Thin wire
- Glue
- Small Styrofoam balls (optional)
- Thin rope or green yarn
- 2 or 3 rocks (as many rocks as kelp plants)

Vocabulary & Background

VOCABULARY

- canopy - The masses of blades and stipes at the top of the kelp that are seen on the surface of the ocean.
- holdfast - The anchoring system of the kelp.
- blade - The “leaves” of a kelp plant.
- stipe - The “stem” of a kelp plant.
- air bladder - A small balloon at the base of each blade that helps to keep the stipe and the blades of the kelp to float near the surface of the water, where the sun is.Categories- groups of similar things
- Community- group of living things that live in a certain area
- Organisms- any individual living thing
- Estimation- a rough idea of the size of something

BACKGROUND INFORMATION

Kelp Forest

Kelp is a type of marine algae, or seaweed. Seaweeds come in three color variations, red, green and brown. Kelp is a kind of brown seaweed that grows to be very large. Although kelp resembles a kind of weed or tree, it is quite different from plants that grow on land. First of all, kelp has no roots. Kelp does have a way to anchor itself to the bottom of the ocean floor, but this anchoring system, called the holdfast, does not take in nutrients like plant roots do. The “leaves” of a kelp plant are called blades and the “stem” is called the stipe. Another structure unique to kelp is the air bladder, which looks like a small balloon at the base of each blade. The stipe of the kelp is very flexible and cannot stand up on its own - the air bladders help the stipe and blades of the kelp float in the water, which allows the kelp plant to grow up toward the surface of the water, where the sunshine is brightest.

Kelp is very good at growing - the giant kelp off the coast of California can grow up to 2 feet per day! Like land plants, kelp uses energy from sunlight to make its own food. This process is called photosynthesis. Sunlight is captured by the plant and the energy particles in sunlight (photons) are used to drive a chemical reaction that produces sugar. This sugar is the food for the plant. In a land plant, usually only the leaves are capable of photosynthesis, but all parts of the kelp plant can photosynthesize. A kelp plant starts out as a single flat blade attached to the bottom and then grows into a mature plant. Giant kelp can get to be over 150 feet long! Kelp sometimes grows in dense patches of many individual kelp plants - these dense patches are called kelp forests, because they resemble a forest of trees.

Sea urchins (red, white and purple ones), certain types of snails, (sea hares, Norris snails and abalone), and a few fish species (like the halfmoon and the opaleye), regularly feed on kelp. There is another animal that eats kelp, humans! Have you ever eaten ice cream, chocolate

milk, apple pie or salad dressing? If so, then you have eaten kelp! Unlike other kinds of seaweed, like red algae, which are used directly as food, kelp is not usually eaten directly by humans. Instead, certain compounds are extracted from the kelp and then used in other foods. Algin is one of these compounds and is used to help make different ingredients stick together and form gooey gels. Algin and other compounds from kelp are also used in other products used by humans, like paint, cosmetics and some drugs.

Kelp Forest Habitat

In addition to providing food for some organisms, kelp is an important habitat for many organisms. The structure of giant kelp (Macrocystis) affects which organisms live where. Let's start from the top to the bottom:

Canopy

Did you know there are nurseries in the kelp forest? The canopy of the kelp (the mass of blades and stipes at the top of the kelp that are seen on the surface of the ocean) can go down a meter or more below the surface. The canopy slows the water currents, making this the perfect spot for tiny organisms like floating (planktonic) eggs, larvae and very small organisms to gather. The organisms grow easily here due to the warmth and light and are protected from hungry predators by the thick kelp growth. The canopy is often called the nursery or brood area for nearshore fishes and invertebrates. Small senorita fish and the tiny topsmelt like to dine in this area.

Below the canopy

Below the canopy the waters are filled with fish life. Surfperches may feed in a variety of places in the canopy, in the water between the plants or around the holdfasts (on the bottom). Most fish prefer the area of the kelp forest where their prey lives. Kelp bass find the middle of the kelp forest to be a good hunting area, while Sheephead, a boldly colored fish, like to feed on the algea invertebrates that live among the kelp stipes and tend to hang out towards the bottom of the kelp forest. A variety of species of rockfishes feed on other fishes and invertebrates near the bottom.

Holdfast and rocky bottom dwellers

More little creatures live down here! It's the spot where a variety of attached (nonmoving) invertebrates live: sponges, sea anemones, sea squirts, and barnacles. Among these attached animals, motile or moving animals can be found...by the millions! Brittle stars, snails, and small crustaceans are abundant. The large amount of plant material attracts plant-eaters (herbivores) like sea urchins, sea hares and abalones. Sea stars, such as sea bats and sunflower stars, also are found in the kelp bed, often eating sea urchins, other sea stars and many other invertebrates.

Some animals like sea otters and sea lions hunt through all areas of the kelp. Sea lions consume vast quantities of fish, and find all areas of the kelp forest to be an abundant "fish market." Also, many small animals, and certain types of algae actually live inside the kelp plant, making the kelp holdfast their home. The inside of the holdfast provides protection from predators and from strong ocean currents. Animals that you might find in a holdfast include

worms, baby sea urchins, snails, brittle stars, tiny crustaceans, and maybe even mussels or barnacles.

Activity

INTRODUCTION

View pictures, videos or online sites that illustrate a kelp forest. (The Sea Grant online site for kelp is given in the Extensions section of this activity.) Engage in a teacher directed discussion of what kelp is like, how it differs from land plants, and what it would be like for an animal to live in that habitat. Students can also do more in-depth research projects on kelp and kelp forest inhabitants as part of this overall activity

ACTIVITY

1. Choose a spot in your classroom to designate as the “kelp forest” area. The space that you choose does not need to be a large one, a 6’x 6’ space is fine.

2. Suspend rope from the ceiling (this will be the stipe) and attach kelp blades that the students cut from heavy green trash bags. A piece of thin wire glued up the middle of the “blade” will allow the students to bend the blades, this will make the kelp more life-like, and can also be used to attach the blade to the “stipe.”

3. For additional realism, small Styrofoam balls painted green can be strung onto the wire at the base of the blade before it is attached to the stipe.

4. Holdfasts can be made from many strands of thinner rope or green yarn, attached to the base of the stipe and then glued in a tangled mass to a rock or two.

RESEARCH

After the students create their classroom kelp forest, they can research the animals that live in the kelp forest, and then make them from various materials to inhabit the kelp forest. Don’t forget the tiny crabs, shrimp, worms, and sea stars that hide in the holdfasts.

LITERACY

The reading room can be the center for all types of reading. Of course, any marine science books and/or stories and books relating to the ocean would fit perfectly into this reading area!

Extensions

- Students can have reading and research projects that make use of the resources in the reading room.
- Throughout the year or semester as new information is gained, continue to make additions to the kelp forest.
- Use the reading room kelp forest as a comparison to other marine environments; interesting comparisons can also be made to terrestrial forests.
- Refer to the zonation activities and create an extended zonation map to use as a wall decoration for the kelp forest.
- For an interactive kelp activity, see, www.usc.edu/go/seagrant; click on Education, next click on Online Activities, then click on “Help With Kelp”

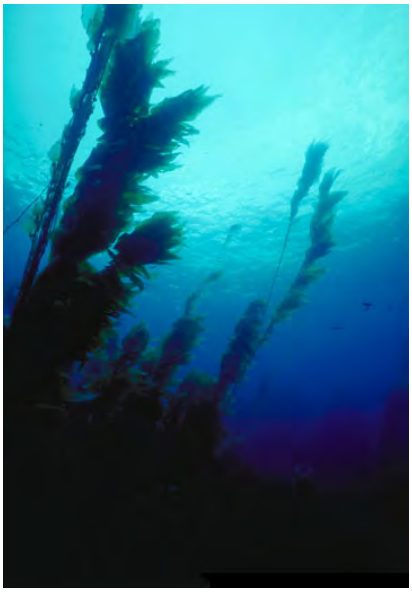
Help With Kelp

WHAT IS KELP?

What's that waving back and forth in the ocean? It looks like a tree - a tree in the ocean?! No, it's kelp! Kelp is a type of marine algae, or seaweed. Seaweeds come in three different color varieties, red, green and brown. Kelp is a kind of brown seaweed that grows to be very large. Although kelp resembles a kind of weed or tree, it is quite different from plants that grow on land. First of all, kelp has no roots. Kelp does have a way to anchor itself to the bottom of the ocean floor, but this anchoring system, called the holdfast, does not take in nutrients like plant roots do. The other parts of the kelp also have different names. The "leaves" of a kelp plant are called blades and the "stem" is called the stipe. Another structure unique to kelp is the air bladder, which looks like a small balloon at the base of each blade. The stipe of the kelp is very flexible and cannot stand up on its own - the air bladders help the stipe and blades of the kelp float in the water, which allows the kelp plant to grow up toward the surface of the water, where the sunshine is brightest.

HOW DOES IT GROW?

Kelp is very good at growing - the giant kelp off the coast of California can grow up to 1 or 2 feet per day!! Like land plants, kelp uses energy from sunlight to make its own food. This process is called photosynthesis. Sunlight is captured by the plant and the energy particles in sunlight (photons) are used to drive a chemical reaction that produces sugar. This sugar is the food for the plant. In a land plant, usually only the leaves are capable of photosynthesis, but all parts of the kelp plant can photosynthesize. A kelp plant starts out as a single flat blade attached to the bottom and then grows into a mature plant. Giant kelp can get to be over 150 feet long! Kelp sometimes grows in dense patches of many individual kelp plants - these dense patches are called kelp forests, because they resemble a forest of trees.



Who Eats Kelp?

☐ worms

☐ snails

☐ clams

☐ crabs

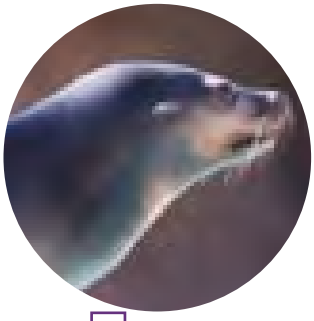
☐ lobsters

☐ sea urchins

☐ sea stars

☐ fish

☐ sharks



☐ seals

☐ sea lions

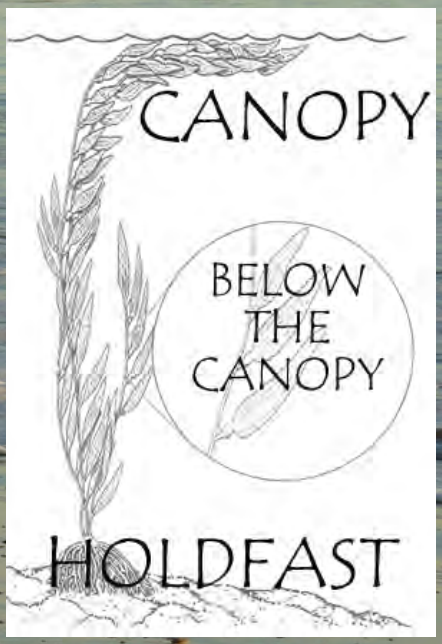
☐ otters

☐ humans

worms	no
snails	yes, Sea hares, Norris snails and abalone.
clams	no
crabs	yes Kelp crabs live on and eat kelp.
lobsters	no
sea urchins	yes Sea urchins (red, white and purple ones too!)
sea stars	no
fish	yes Fish like the halfmoon and the opaleye.
sharks	no
seals	no
sea lions	no
otters	no
humans	yes, Have you ever eaten ice cream, chocolate milk, apple pie or salad dressing? If so, then you have eaten kelp!

The Living Forest

In addition to providing food for some organisms, kelp is an important habitat for many organisms. Can you guess which organisms might live in a kelp forest? Let's start from the top to the bottom. The structure of giant kelp (Macrocystis) affects which organisms live where. The blades and stipes of the kelp are handy homes or 'hanging out' places for other small species. A variety of fish live in the whole water column from the top to the bottom and are attracted to sections of the kelp where their favorite meal lives or spends time hanging out.



CANOPY

Did you know there are nurseries in the kelp forest? There certainly are. The canopy of the kelp, the mass of blades and stipes at the top of the kelp that are seen on the surface of the ocean, can go down a meter or more below the surface. Since the canopy slows the water currents, this is the perfect spot for tiny organisms like floating (planktonic) eggs, larvae and very small organisms to gather. The organisms grow easily here due to the warmth and light and are protected from hungry predators by the thick kelp growth. The canopy is often called the nursery or brood area for 'nearshore' fishes and invertebrates. Small senorita fish the tiny topsmelt like to dine in this area!

BELOW THE CANOPY

Below the canopy the waters are filled with fish life! Surfperches may feed in a variety of places in the canopy, in the water between the plants or around the holdfasts (on the bottom). However, most fish prefer certain sections of the forest and are usually found in the area of the kelp forest that harbors their prey. Kelp bass find the middle of the kelp forest to be a good hunting area, while Sheephead, a boldly colored fish, like to feed on the larger invertebrates that live among the kelp stipes and tend to hang out towards the bottom of the kelp forest. A variety of species of rockfishes feed on other fishes near the bottom, as well as on invertebrates.

HOLDFAST AND ROCKY BOTTOM DWELLERS

More little creatures live down here! It's the spot where a variety of attached(non-moving) invertebrates (animals without a backbone) live: Sponges, sea anemones, sea squirts, and barnacles. Among these attached animals, motile or moving animals can be found...by the millions! Brittle stars, snails, and small crustaceans are abundant. The large amount of plant material attracts plant-eaters (herbivores) like sea urchins, sea hares and abalones. Sea stars, such as sea bats and sunflower stars, also are found in the kelp bed, often eating sea urchins, other sea stars and many other invertebrates. Many organisms actually live inside the kelp plant! Many small animals, and certain types of algae, make the kelp holdfast their home. The inside of the holdfast provides protection from predators and from strong ocean currents. Animals that you might find in a holdfast include worms, baby sea urchins, snails, brittle stars, tiny crustaceans, and maybe even mussels or barnacles. During storms, kelp plants may be ripped up from the bottom and be washed ashore onto the beach. The tiny organisms that live in the holdfast will also be transported onto the beach, or they may fall off and land in a another habitat.

AND...

Some animals like sea otters and sea lions hunt through all areas of the kelp. Sea lions consume vast quantities of fish, and find all areas of the kelp forest to be an abundant "fish market." They find good shopping there! The sea otter, however, may spend almost its entire life in the kelp bed. While they also eat fish, their favorite meals are two invertebrates: abalone and sea urchins. If the population of sea otters gets too low, the number of sea urchins can easily increase; sea urchins eat kelp. Scientists have found that in Southern California kelp beds that were once inhabited by sea otters have gradually disappeared. Without their natural predators, sea urchins increased in number and moved through the kelp in an "urchin front," eating all the plants in their path. Even when the kelp beds were gone, young kelp plants could not get started due to the hungry urchins. So, the sea otter plays an important role in the health of the kelp forest habitat

Fun With Kelp: Recipes

Did you know that you probably eat a bit of the ocean every time you eat some of your favorite foods? A substance called algin is found in the cell walls of the kelp plant. Algin makes the kelp plant flexible enough to withstand the pressure of the ocean's movement. When it is processed, algin can be used to thicken, gel, and stabilize. For this reason, alginates are used in making pudding, ice cream, salad dressing and non-food items like shampoo, paint, toothpaste, and fertilizer. Make a batch of these delicious kelp cookies* to share with a friend.

SEAWEED SWEETS

You will need:

- 1 c. margarine (2 sticks)
- 1 t. almond flavoring
- 1 c. white sugar
- 1 t baking soda
- 1 c brown sugar
- 1 t. salt
- 2 eggs
- 1 t powdered kelp**
- 1 t. vanilla
- 3 c. flour
- 2 large mixing bowls & spoons
- measuring spoons
- baking sheets
- stove
- hot pads
- wire cooling racks

Follow these steps:

- In a large mixing bowl, combine the margarine, sugar, eggs, vanilla, and almond flavoring. Blend well.
- Combine the flour, kelp, salt, and baking soda in another bowl. Combine the ingredients in the two bowls and mix well.
- Drop the dough by teaspoonfuls onto greased baking sheets. Bake at 400 for 8 minutes. Lift the cookies off the baking sheets onto wire cooling racks. When cool, store in an airtight container. The cookies will be chewy, and will sat fresh for several days.

* Recipe by Erniew Mae Campodonico of Nipomo, California.
** Available at natural food stores.

HAND ROLLED SUSHI

You will need:

- Sheets of nori cut in half lengthwise
- 2 c. cooked rice, cooled to room temperature
- 1 T. rice vinegar
- 1 medium carrot, peeled and cut into 3 to 4-in pieces
- 1 medium cucumber, peeled and cut into 3- to 4-in pieces
- 1/2 c. soy sauce

- Slice the carrot and cucumber pieces into narrow strips.

- Add rice vinegar to cooked rice, stirring thoroughly.
- Take a sheet of nori in the palm of your hand and spoon a heaping teaspoon of rice onto its center and add carrots and cucumbers.
- Wrap nori around rice and vegetables to make a roll.
- Dip sushi roll in soy sauce.

LAVER SOUP

You will need:

- 1 c. dehydrated nori
- one 10 1/2-ox can beef consommé
- 2 c. water
- juice of 1/2 lemon (or less, to taste)

- Tear dried nori into pieces.
- Simmer in water until soft.
- Bring the water to a boil, then add the consommé and lemon juice. Heat just to boiling.
- Add a twist of lemon peel in each serving bowl.
- Serve with crackers of toast.

Fun With Kelp: Pressing

The study of marine plants, or seaweeds, attracts students and professional biologists alike. The larger plants of the sea are almost exclusively members of a diversified assemblage known as algae, and their study is known as algology. Some scientists are interested in their physiology (life processes), others work on ecology, distribution reproductive activities. Basic to much of this is the field of taxonomy, or identification and categorization of the many species. All of the other study areas rely on taxonomists to identify the plants upon which they do their observations or experiments.

In order to prepare the plants for examination and identification, there are several standard processes and procedures which must be followed. These methods are similar to those used by professional collectors. The plants are collected, preserved, mounted on special paper and dried. Then they are catalogued for future reference and identification. By using these methods, you may wish to begin a small personal collection, or merely to press some plants for framing or for greeting cards.

COLLECTION AND PRESERVATION

The greatest abundance of marine algae is found in the relatively shallow, sunlit nearshore waters (40 feet or less). They can be observed and collected using scuba or by snorkeling. A number of the more resistant species are in the large piles of seaweed found on the beach after a storm.

Once collected, the plant material may either be mounted and pressed while fresh (almost immediately), or preserved and kept in a suitable container, away from the light, for longer periods of time. The fresh material may retain slightly more color than the preserved, but drying will take longer. It is best to collect specimens in a plastic bag, then transfer them to a container of seawater and formaldehyde mixed in a 19:1 ratio. Small amounts of formaldehyde may be obtained at a drugstore, while large quantities can be ordered from a biological or chemical supply house. If specimens are to be kept some time before mounting, storage is best in a tightly closed metal can or in a glass jar, in the liquid, away from light.

MOUNTING AND DRYING

Mounting is easy, but also requires some special materials. The specimens are floated onto a special high quality, acid-free rag paper (herbarium paper) then pressed and dried in a plant press or by using weighted plywood. The addresses of suppliers are listed at the end of this activity.

- several specimens of fresh marine algae
- thin piece of masonite cut to fit the pan
- clean fabric to cover masonite
- shallow baking pan or plastic painter's drip tray or broad enamel pan
- newspapers
- corrugated cardboard

Fun With Kelp: Pressing Continued

- heavy white mounting paper--high quality acid-free paper is best (herbarium paper) *see suppliers below
- two 12” X 20” pieces of plywood
- bricks or rocks
- white glue (optional)
- rope
- seawater
- waxed paper

DIRECTIONS:

1. A small amount of tap water is placed in a painter’s drip tray and a piece of herbarium paper is laid in the bottom.. (If using a baking pan, also place the masonite in the pan and the herbarium paper.)
2. A fresh or pickled plant is floated in the water and allowed to settle down on the paper.
3. Place some sheets of newspaper on top of a piece of corrugated cardboard.
4. After it has been spread out and suitably arranged, the paper and plant are carefully slid out of the tray (and off the masonite, if it has been used), drained momentarily, and laid on the corrugated cardboard that has newspaper on top.
5. Waxed paper or clean fabric is placed over it, then another newspaper and top with cardboard, and then another paper with its specimen.
6. Place a piece of newspaper over the cloth and top with another piece of corrugated cardboard. You can stack several different specimens for mounting using this same layering procedure: cardboard, newspaper, mounting paper with specimen, newspaper, cardboard.
7. Place the finished stack between the two pieces of plywood. Tie together securely with rope and weight down with bricks or rocks. Place near a heater or a warm, open window.
8. After 24 hours, change the cloth, newspapers, and cardboard. After 48 hours remove the cloth. Change the newspapers and cardboard daily until the specimens are dry to the touch. Delicate plants will take about 48 hours to dry completely; coarse plants may take up to 5 days.
9. When the pressing is complete, the algae is usually stuck to the paper. If not, use white glue to fasten it permanently to the paper. Do some research about the specimens of algae. Label your specimens with the species name, place and date of collection, collector’s name.
10. Stored flat in albums or in herbarium cabinets.

SUPPLIERS

Unissource West Inc., Carpenter/Offutt Paper, Inc., Div. Herbarium Dept. 927 Thomas Ave., SW Renton, WA 98055-2931	Herbarium Supply 705 Bridger Dr, Unit D Bozeman, MT 59715-2292 Tel: 800.348.2338 Tel: 406.994.0006 Fax: 406.994.9211 Email info@herbariumsupply.com Website http://www.herbariumsupply.com

Lesson 3: Zonation & Distribution

1 - 2 class periods

Concepts & Objectives

QUESTION

Are organisms distributed evenly throughout all parts of the ocean? Can each organism live in any area of the ocean?

UNDERLYING CONCEPTS

Organisms are not distributed evenly throughout all parts of the ocean. Life in the ocean is most heavily concentrated in the coastal (nearshore) zones. Furthermore, every organism is limited in the area that it can inhabit. This results in a zonation of organisms, with certain species occupying certain zones. This is due to both physical and biological factors.

SKILLS

- Research
- Interpertation

METHODS

Students will be able to:

- determine/describe the habitat of a variety of common marine organisms.
- describe the major distribution pattern of marine life.

OBJECTIVES

Students will be able to:

- determine/describe the habitat of a variety of common marine organisms.
- describe the major distribution pattern of marine life.

MATERIALS NEEDED

- Butcher paper
- Crayons and markers
- Tape
- Organism cutouts
- 3” x 5” index cards (optional)
- Marine biology books or references (optional)

Vocabulary & Background

VOCABULARY

- zonation-describes the different zones or areas of the marine environment
- distribution-describes where animals live within these zones
- pelagic-all waters of the ocean benthic-extends from the intertidal, to the continental shelf, to the continental slope, to the deep ocean floor
- coastal (or neritic)-the nearshore ocean environment, that which occurs above the continental shelf
- oceanic-all of the ocean beyond the continental shelf, it is by far the most extensive
- littoral-includes the supratidal zone (or spray zone), intertidal zone, which occurs between the highest and lowest tides in an area, and the subtidal zone, which is always covered by seawater, and extends into the neritic zone

BACKGROUND INFORMATION

Distribution

To describe relationships in the marine environment, we must be able to define where different groups of organisms live in the ocean. Marine ecologists have divided the ocean into two major zones: the pelagic zone includes all the waters of the ocean, and the benthic zone includes the ocean bottom. The pelagic zone is further divided into the littoral, neritic, and oceanic zones (Figure 1). The littoral zone includes the supratidal zone (or spray zone). The littoral zone also includes the in tertidal zone, which occurs between the highest and lowest tides in an area. The final area of the littoral zone is the subtidal zone, which is always covered by seawater, and extends into the neritic zone. The neritic zone is the nearshore ocean environment, that which occurs above the continental shelf and is often called the coastal waters. The oceanic zone, by far the most extensive, is all the rest of the ocean beyond the continental shelf. The benthic zone extends from the intertidal, to the continental shelf, to the continental slope, to the deep ocean floor. The material that covers the ocean floor can range from mud or silt to large rocks.

Life in the ocean is not evenly distributed. Organisms are much more abundant is nearshore waters than in oceanic waters. Scientists often use the term biomass to indicate the total mass of all organisms in an area. Biomass is usually given as grams/m2 or grams/m3. Although the oceanic zone comprises 90% of the ocean's area, the neritic zone has ~ 40 times more biomass than the oceanic zone. The greater abundance of biomass in coastal areas is due primarily to the abundance of phytoplankton in this zone. Phytoplankton are the basis of most food chains in the ocean; they are at the "bottom" of the food chain. Phytoplankton are more abundant closer to shore because there are more nutrients (inorganic molecules needed to survive) here. Most organisms live closer to shore because this is where most of the food is.

Organisms in Groups

Ecologists may study the interaction of one individual organism with its environment, but more often, they study the interactions within groups of organisms. Groups of organisms are organized into distinct levels:

- A **population** is a group of individuals of the same species living in a particular place.
- A **community** consists of all the populations (plants and animals) inhabiting a given
- area.
- An **ecosystem** includes all of the communities and their physical environment within a large geographical area. Ecosystems are very important in ecology because they convey the concept that all organisms are a part of a system of interacting biotic (living) and abiotic (not living) factors. A change in one species in an ecosystem will effect all other species in that system in one way or another. Ecosystems have specific characteristics:
  - they have a source of energy, most often the sun
  - they cycle nutrients between the abiotic and biotic environments
  - they convert inorganic energy into organic molecules
  - they regulate the flow of energy from organism to organism

Activity

Using the butcher paper and large markers, make a map of the ocean floor like the one shown in Figure 2. Make sure that the map is large enough to paste many 3”x5” pictures of marine organisms about onto it. Discuss the major zones of the ocean and label them on your map. Hang your giant map at the front of the classroom.

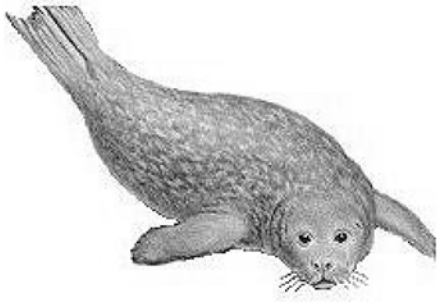
Hand out the organism cards to the students (2 per student for a class of 25). On the back of each card is a brief description of the animal and its habitat. Have each student come up to the front of the class and tape their organism onto the appropriate area of the map.

Extensions

- Students can research their organisms to find out the correct coloration, then color in the drawings with crayons or markers.
- You may paste the organism cutouts onto index cards to cover up the description on the back. Then have the students research each organism to find out where it lives. This will require an extra class period and marine biology reference books. You may want to try one of the following:
  - From the Sea to Shining Sea by; Amy L. Cahn
  - Life Starts in the Sea by; Andrea Lamas
  - One Small Square-Seashore by; Donald M. Silver
  - The Complete Aquarium by; Peter W. Scott
- Discuss the organization of organisms within groups and the concept of an ecosystem.

HARBOR SEAL

Coastal
Mostly Pelagic



HARBOR SEAL

PLANKTON

Pelagic
Coastal and Oceanic
Mostly Near Surface

PLANKTON
(zooplankton, phytoplankton)

OWL LIMPET

Coastal
Mid to Upper Intertidal
Rocky Shore

OWL LIMPET

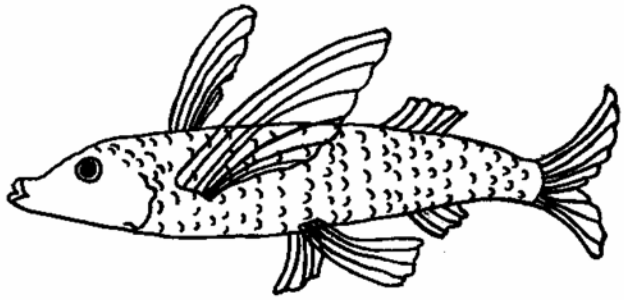
ACORN BARNACLE

Coastal
Rocky Shore
High to Low Intertidal
Benthic

ACORN BARNACLE

FLYING FISH

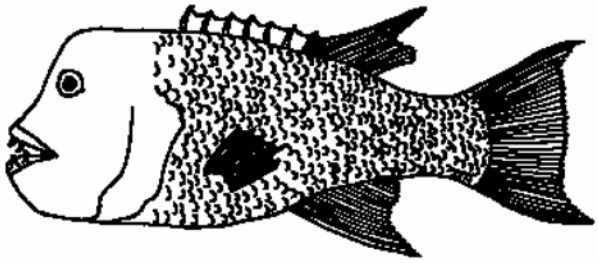
Oceanic
Pelagic
Shallow Water



FLYING FISH

SHEEPHEAD FISH

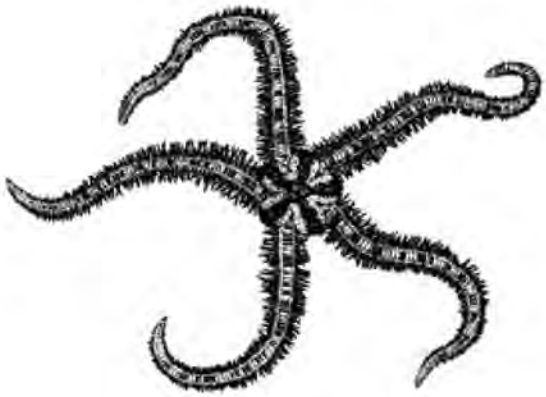
Coastal
Pelagic
30-60 Ft Deep
(in kelp beds)



SHEEPHEAD FISH

BRITTLE STAR

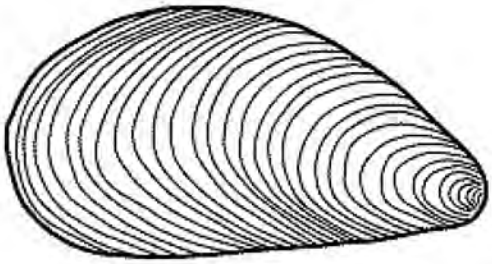
Coastal
Rocky Shore
Subtidal to 100 Ft Deep
Benthic



BRITTLE STAR

MUSSEL

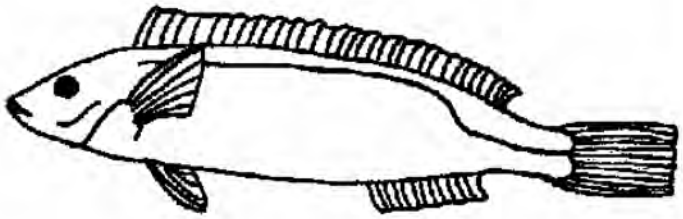
Coastal
Rocky Shore
Mid Intertidal
Benthic



MUSSEL

SENORITA FISH

Coastal
Pelagic
10-60 Ft Deep
(Often in Kelp Beds)



SENORITA FISH

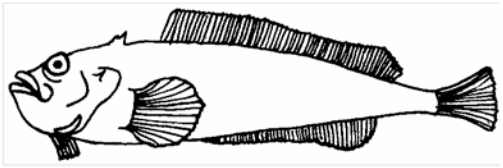
MORAY EEL

Coastal
Subtidal
Shallow Water

MORAY EEL

MIDSHIPMEN

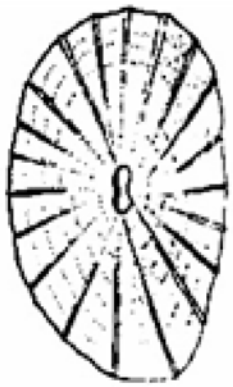
Oceanic
Deep Water
(>3000 Meters)



MIDSHIPMEN

KEYHOLE LIMPET

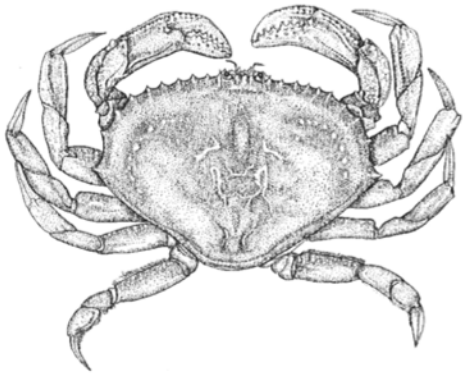
Coastal
Low Intertidal to Subtidal
Rocky Shore
Benthic



KEYHOLE LIMPET

CANCER CRAB

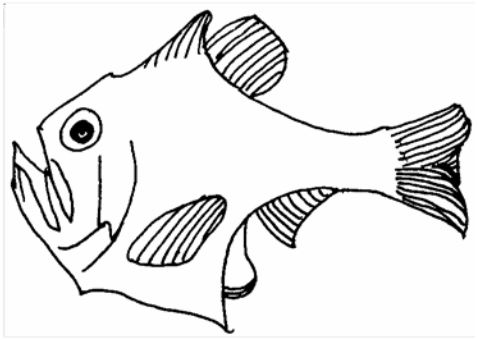
Coastal
Rocky Shore
Intertidal to 130 Ft Deep
Benthic



CANCER CRAB

HATCHET FISH

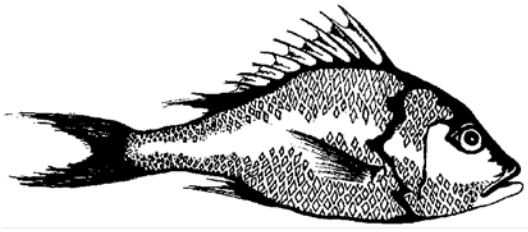
Oceanic
Pelagic
Deep Water
(>3000 Meters)



HATCHET FISH

SARGO

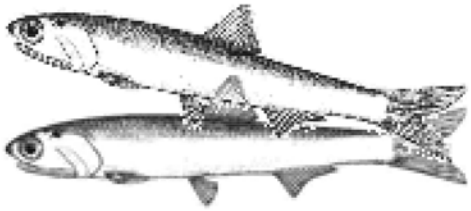
Coastal & Oceanic
Pelagic



SARGO FISH

ANCHOVIES

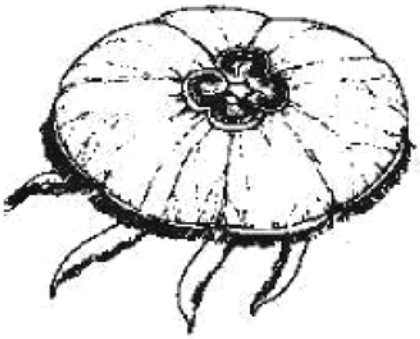
Mostly Coastal
(Oceanic Sometimes)
Pelagic



ANCHOVIES

MOON JELLY FISH

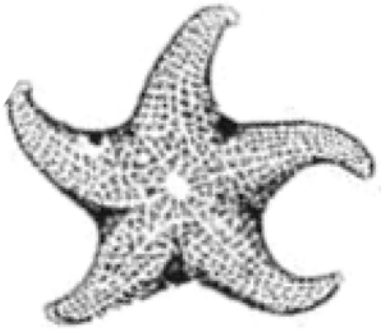
Coastal
Pelagic



MOON JELLY FISH

SEA STAR

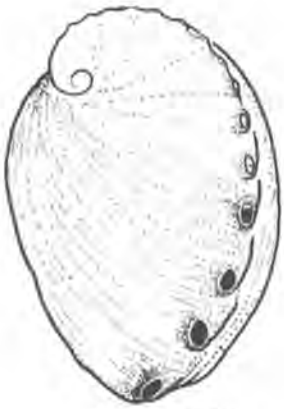
Coastal
Rocky Shore
Mid Intertidal to Subtidal
Benthic



SEA STAR

ABALONE

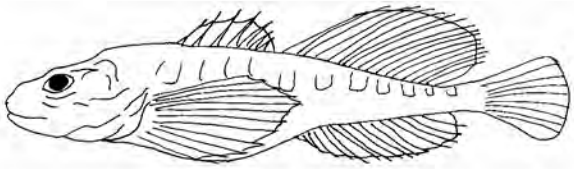
Coastal
Subtidal to 500 Ft Deep
Benthic



ABALONE

SCULPIN

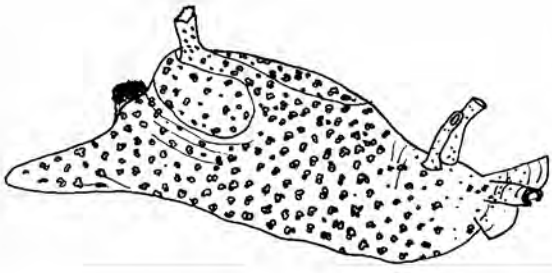
Benthic
Subtidal 20-30 Ft Deep



SCULPIN

SEA HARE

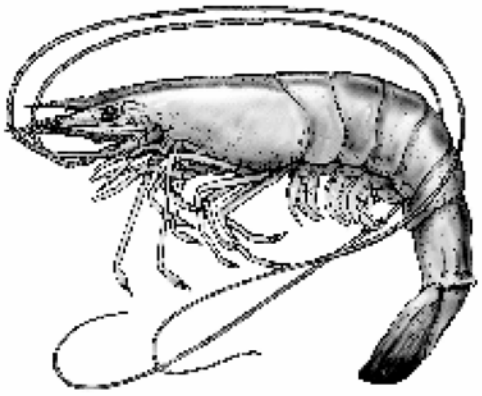
Coastal
Low Intertidal to 60 Ft Deep
Rocky Shore (Sheltered)
Benthic



SEA HARE

RED STRIPED SHRIMP

Mid to Low Tidal (tide pools)
Rocky Shores



RED STRIPED SHRIMP

AGGREGATING ANEMONE

Coastal
Rocky Shore
Mid Intertidal to Shallow Subtidal
Benthic

AGGREGATING ANEMONE

GIANT KELP

Coastal
Rocky Bottom
Subtidal 20-1000 Ft Deep
Benthic

GIANT KEP

GREY WHALE

Coastal and Oceanic
Pelagic
Shallow to Very Deep

GRAY WHALE

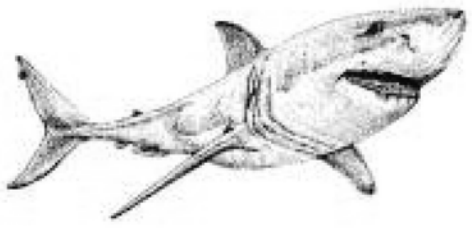
SEA LION

Coastal
Pelagic and Benthich
Rocky Shores

SEA LION

GREAT WHITE SHARK

Coastal and Oceanic
Pealic
Shallow to Very Deep



GREAT WHITE SHARK

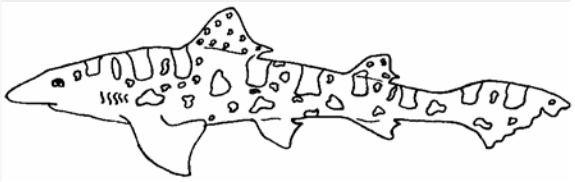
FEATHER BOA KELP

Coastal
Rocky Shore
Mid-Intertidal
Benthic

FEATHER BOA KELP

LEOPARD SHARK

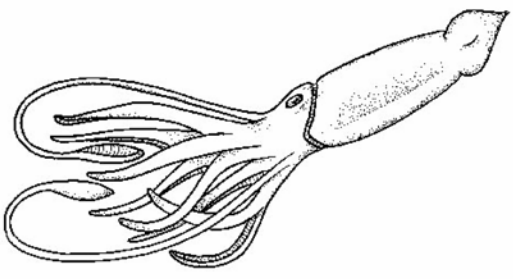
Coastal
Subtidal
Sandy Bottoms
Mostly Benthic



LEOPARD SHARK

SQUID

Coastal and Oceanic
Pelagic
Shallow to Very Deep



SQUID

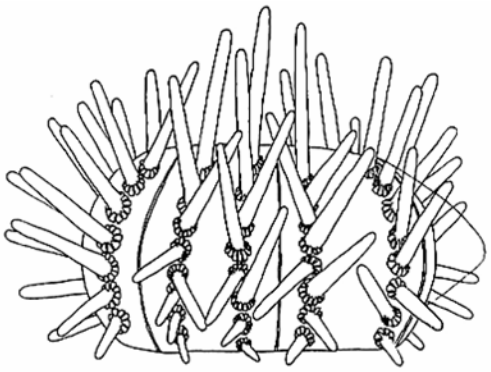
CORALLINE RED ALGAE

Coastal
Rocky Shore
Mid Intertidal to > 50 Ft Deep
Benthic

CORALLINE RED ALGAE

SEA URCHIN

Coastal
Rocky Shores
Low Intertidal to 500 Ft Deep
Benthic



SEA URCHIN

Copy Organism pages and cut along gray outline. When each Organism is cut out, fold in half to create a "flash card" with picture on one side and information on reverse.

Lesson 4: Zonation & Distribution II

1 class period

Concepts & Objectives

QUESTIONS

What is the underlying cause for the uneven distribution of life in the ocean? Why are organisms concentrated closer to shore?

UNDERLYING CONCEPTS

Life is concentrated in coastal areas because phytoplankton, which are at the bottom of the food chain, are concentrated here. This is due to the high amounts of nutrients available in coastal waters.

SKILLS

- Research
- Interpertation

METHODS

Use the internet to view and compare maps of phytoplankton found in different geographic areas.

OBJECTIVES

Students will be able to describe the distribution of phytoplankton in the ocean.

MATERIALS NEEDED

- Internet access

Vocabulary & Background

VOCABULARY

- nutrients- organic molecules that help organisms grow
- herbivores- animals that only eat plants or algae

- carnivores- animals that eat other animals
- pigments- molecules that a plant uses to gather sunlight for photosynthesis
- chlorophyll- the most abundant type of pigment in plants and algae
- satellites- a device that orbits the earth and has cameras and sensors to detect certain features.

BACKGROUND INFORMATION

Once your map is complete, it will become apparent that most of the marine life is concentrated nearshore. Although some very large animals live in the oceanic zone, their numbers are small in comparison to the size of it. Ask the students to describe the trend they see.

This trend is due mainly to the abundance of light and nutrients in the coastal zone. It is much shallower than the oceanic zone, sunlight penetrates all the way to the ocean floor. This is important because phytoplankton, which are at the bottom of almost all food chains, require this light for photosynthesis. In photosynthesis, sunlight is captured by the plant and the energy particles in sunlight (photons) are used to drive a chemical reaction that produces sugar. This sugar is the food for the plant. Why don't we see an abundance of life in the upper layers of the oceanic zone also? Because light is not the only important factor. Phytoplankton also require inorganic and organic **nutrients** like iron and nitrogen. These compounds are most abundant nearshore, because of runoff from the land. Without these nutrients, phytoplankton do not grow as well.

As we said above, phytoplankton are at the bottom of the food chain. This means that herbivores eat them, other animals eat the herbivores, and so on. The more phytoplankton that are available, the more **herbivores** there will be to eat them, and the more herbivores there are, the more **carnivores** to eat them. Ultimately, if there are lots of phytoplankton, there will be lots of organisms else too.

Because phytoplankton are so important, scientists have lots of ways of measuring their abundance. One fairly new method uses images of the ocean taken from satellites in space. Satellites take a picture of the ocean and send it back to earth electronically, like a television signal. These satellites have sensors in them that can detect the specific pigments that phytoplankton use for photosynthesis (the most common pigment is chlorophyll). They then convert the concentration of these pigments into a color. When a scientist looks at a satellite image of the ocean, he or she can tell how much phytoplankton is in the water by the color. Red usually means a lot of phytoplankton and blue/purple means very few phytoplankton. These colors are of course not the actual color of the phytoplankton, but instead are a "false color" used to relay information.

Activity

For this exercise, you will be visiting a site on the internet that posts “false color” image maps of phytoplankton in the ocean. By viewing these maps, students can observe that phytoplankton are most heavily concentrated nearest to shore. The directions for accessing one of these sites is given on the next page.

DISCUSSION

Have the students compare the maps for different areas of the world or different times of the year and relate their findings in a group discussion. Generally, the more sunshine and nutrients that are available, the more phytoplankton there will be. Point out to the students that there is almost always more phytoplankton closer to shore than there is in the open ocean.

Lesson 5: Food Web

2 class periods

Concepts & Objectives

QUESTION

What is a food web?

UNDERLYING CONCEPTS

Animals obtain the energy they need to live from food. Organisms are connected to other organisms through food webs. A food web is a diagram of “who eats whom” for the organisms in a given area.

SKILLS

- Interconnecting ideas and information
- Investigating.

OBJECTIVES

Students will be able to:

- Describe what certain organisms eat.
- Demonstrate the flow of energy through a food web.

MATERIALS NEEDED

- Marine biology books and resources
- Examples of Marine Food Webs
- Predator/prey lists
- Crayons
-

Vocabulary & Background

VOCABULARY

- food web- the interconnected food chains between organisms in a community
- predator- an animal that captures and eats another animal

- prey- an animal that is hunted and eaten by another animal
- parasitism- A relationship between two organisms in which one (the parasite) infects or attaches to another (the host), and the host organism is harmed in the process.
- herbivores- organisms that eat plants, algae or phytoplankton

BACKGROUND INFORMATION

Almost all animals must eat other organisms to obtain energy. Animals do not generally eat just one thing, nor are they eaten by only one thing. This means that each organism, through feeding, is interconnected to many different organisms. This interconnection is called a food web.

When an animal captures and eats another animal, it is a predator. The animal which is hunted is called the prey. Notice that an animal can be both a predator and a prey. For example, a small fish may eat certain types of snails, but he may also be eaten by an octopus. So the fish is both predator and prey. The key to survival is to be a successful predator without becoming a prey. (Some biologists consider herbivores to also be predators, and parasitism, in which one organism infects another and does it harm, is also considered to be a form of predation.)

Activities

INTRODUCTION

Let's talk about why we think organisms are distributed the way they are. First, we noticed from our zonation map that many more organisms live in coastal waters than in oceanic waters, even though the oceanic zone is a much larger part of the ocean. Let's list the things that might be important for an organism to be able to live in a certain area:

Shelter
Right temperature
Food
Etc.

The availability of food is the most important reason for why organisms are located mostly in the nearshore coastal area.

How many of you have heard of a **food chain**? Let's draw a simple food chain that is familiar to us:

Grass ▶ Cows ▶ Humans

Grass is a kind of plant, and plants make their own food. But animals can't make their own food, they have to either eat plants, like the cow, or they eat other animals, like a wolf, or a human. Some animals, like humans, eat both plants and animals.

In the ocean, it's the same thing, but the organisms are different. I am going to introduce a new word to you – **phytoplankton** (sound it out: fi-to-plankton.) Like the grass or the plants on land,

phytoplankton is the base, or bottom, of the food chain in the ocean. These are very tiny, microscopic organisms that make their own food just like land plants. To do this they need two things:

Sunlight – energy from the sun
Nutrients – things that help them grow

We find the most sunlight near the surface of the water (less than 200 meters deep), and many of the nutrients actually come from the land and are washed into it during rains. So the area with the most nutrients will be closest to the shore.

Let's go back to the food chain. Notice that the arrows are pointing toward the animal that is doing the eating. Scientists do this to demonstrate the flow of energy from the thing that is being eaten to the one that is doing the eating. We eat food because we need energy from that food. There are two words that you have already heard but let's discuss their meaning:

Predator – an animal that eats other animals/organisms
Prey – an organism that is eaten

Using our example of a simple food chain, we could add many more organisms to this food chain:

- What else eats grass? *(Teacher should provide 2-3 more examples of animals that eat food.)*
- What else might eat a cow? *(Teacher should provide 2-3 examples of animals that may eat a cow.)*

We call this a **food web** because it is a connection of many different food chains.

ACTIVITY 1

1. Place students into groups of 4-6 students. Each table will have their own marine food web to study (they will be passed out after instructions are given).

2. Teacher now passes out examples of marine food webs emphasizing the direction of the arrows and predator/prey roles. They must carefully study the pictures and the arrows will be explained.

3. Students will now create a simple chain from the web they are given, like the food chain with only one animal at each stage. Each student will explain their food chain.

4. The teacher will ask each of the students the following questions:

ACTIVITY 1 DISCUSSION

- What is the start of the food chain and why?
- Explain your food chain *(one type of animal at each stage).*

ACTIVITY 2

1. Divide students into pairs so that they may make their own food webs.

2. Pass out the predator/prey list.

3. Give each pair a picture of an organism (ideally one from the food chain activity in activity one).

4. Students should paste the picture onto a blank sheet and color it.

5. Using the predator/prey list, create a food web.

ACTIVITY 2 DISCUSSION

- Do the larger animals eat all of the animals smaller than them? (*Not necessarily, some eat only certain organisms.)*
- Do some animals have more than one type of prey? If so, what are they?
- Do small animals only eat what is smaller than them or can they eat animals larger than them?
- If they can, what type of features on their body allow them to eat larger animals? *(Special size of mouth, claws, beaks, etc.)*

ACTIVITY 3

1. Using the distribution map that you constructed in the previous exercise (Link to Zonation) you are going to draw in the food webs that interconnect the organisms on your map.

2. Assign each student two organisms from the map to research. Using books, magazines, the internet or any other source you like, have them find out what those organisms eat and what eats them. This will probably take 1 to 1 1/2 class periods. It is best to leave the organisms cards on the map because you will want them in place for the next part of the activity. Have the students write down the information on a separate piece of paper.

3. Next, have the students present their findings to the class. Using a large marker, draw a line on the map between an organism and the animal that eats it. If a particular prey or predator of an animal is not on the map, write it in, place a box around it, and draw a line between it and the other organism. Draw the lines with an arrow pointing toward the predator. This indicates the direction of the flow of energy from the prey to the predator. When you are done, your map will have many lines with arrows connecting all the organisms together and you will have created a food web.

ACTIVITY 3 DISCUSSION

Food webs are not the only way in which organisms interact with each other. When organisms exist in groups with others of their own species and of different species, many types of interactions can occur. Ecologists have categorized these interactions according to their purpose, they are competition, communication, and symbiosis:

- COMPETITION: What do we mean by competition (for a resource)? When two organisms are each using the same limited resource, they are competing with each other. Organisms may compete for food, space, mates or territory. There are two kinds of competition:

  - interspecific competition, in which the two organisms are of different species.
  - intraspecific competition, in which the two organisms are of the same species. Because individuals of the same species use resources in very similar ways, this type of competition can be much more intense than interspecific competition.

- COMMUNICATION: Can you name some reasons they might communicate? Animals may communicate with one another for a variety of reasons. We know that animals of the same species, such as dolphins, communicate with each other for mating, play, distress and hunting, but animals of different species may also communicate. This may be as simple as a color display to warn another animal to "back off" (like an octopus) or a posture to indicate that an animal is going to attack (sharks do this).

- SYMBIOSIS: Who can tell me what a symbiotic relationship is? Symbiosis is a broad term that generally means "living together." Usually, this applies only to organisms that live in very close proximity (often one inside the other) to each other for a substantial portion of their life histories. Symbiotic interactions can be beneficial, harmful, or nonconsequential to the organisms involved:

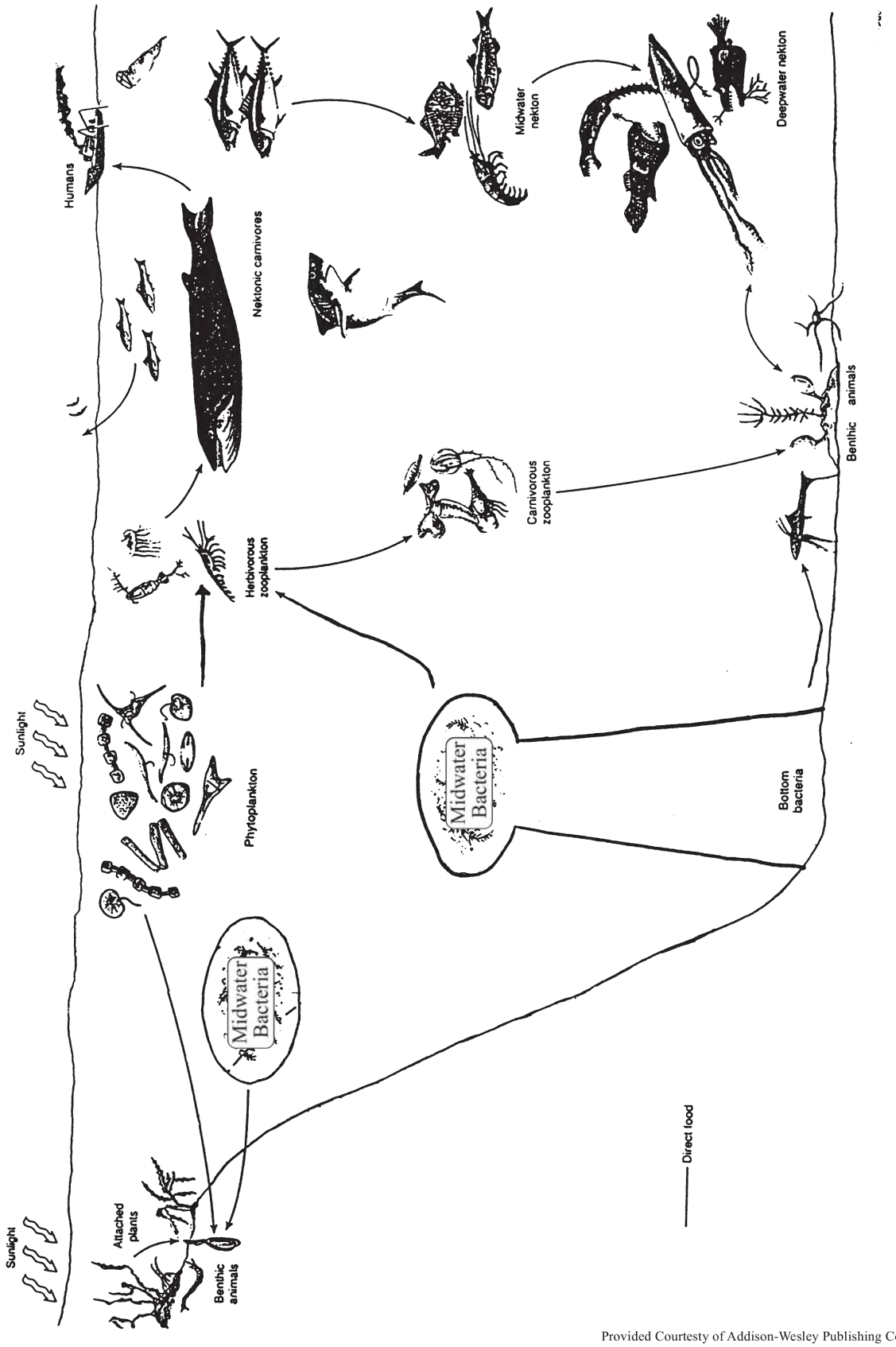
  - mutualism: A relationship both parties benefit. Most often, symbiosis refers to this type of interaction (examples: clownfish and anemone or coral reefs, which contain symbiotic algae).
  - commensalism: one party benefits and the other is unaffected (it is very difficult to prove such a case and many biologists doubt whether this type of interaction exists).
  - parasitism: one party benefits and the other is harmed.
  - When speaking of symbioses, the organism that lives inside the other organism is called the symbiont and the larger organism is called the host.

Extensions

- Write up ideas of how humans fit in the web of life.
- Have students explore how a shortage or excess of resources may alter food webs.
- Challenge students to design a demonstration of a food web.
- As students learn about new organisms, have them place these organisms on the zonation map.

EVALUATION

- Journaling – Have students write down what they have learned
- Teacher will evaluate final food webs for accuracy and thoughtfulness.



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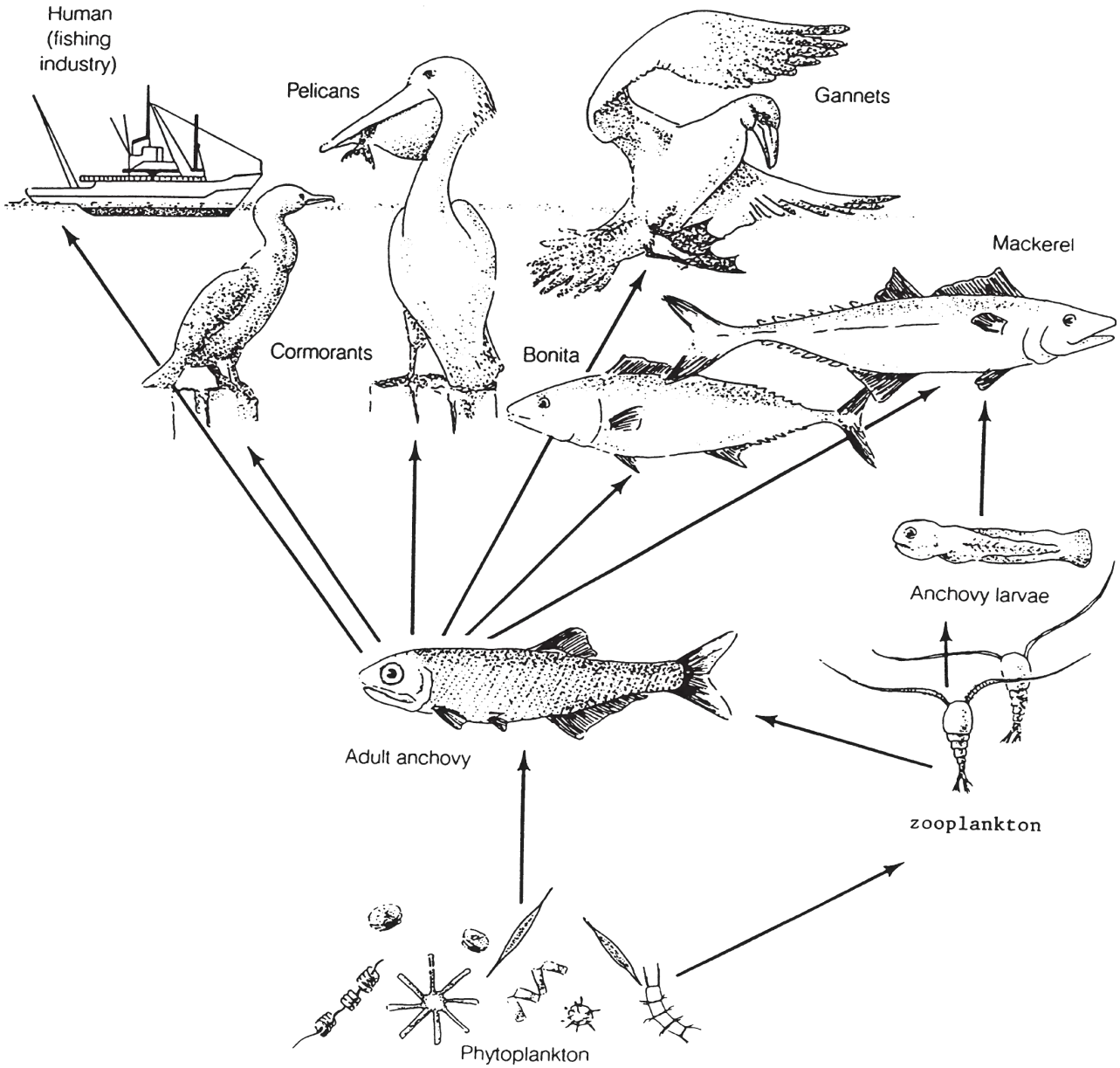

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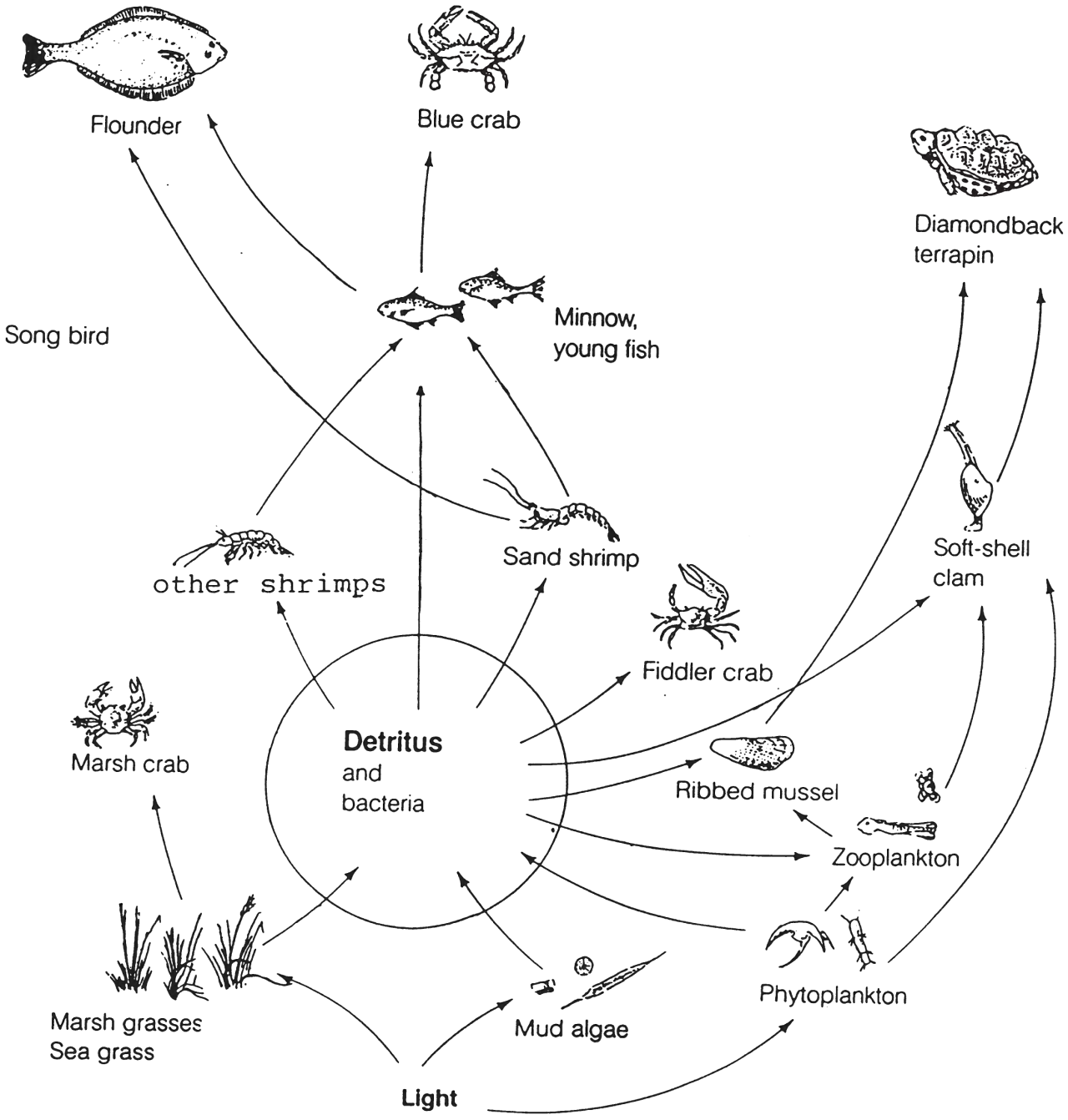

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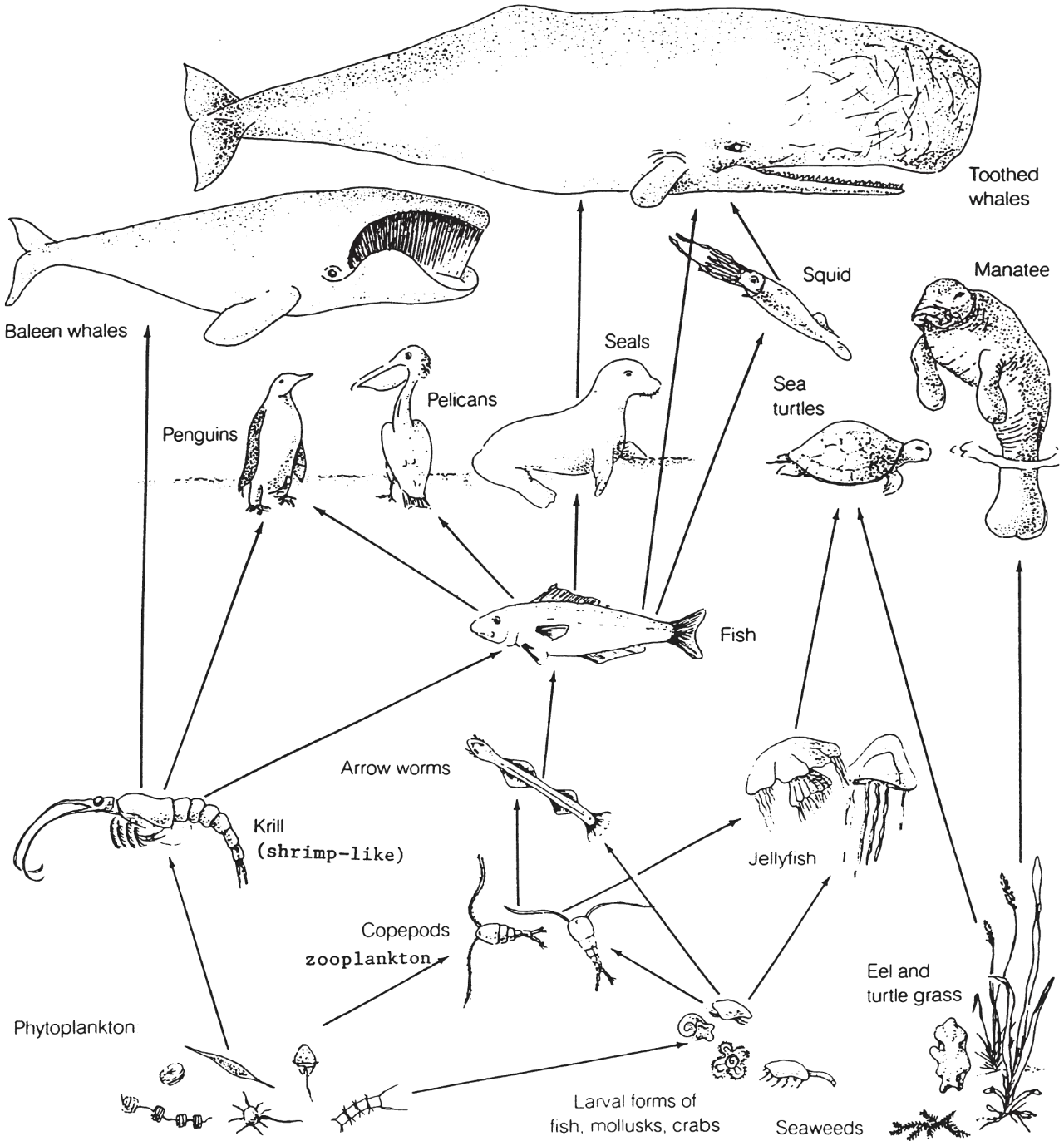

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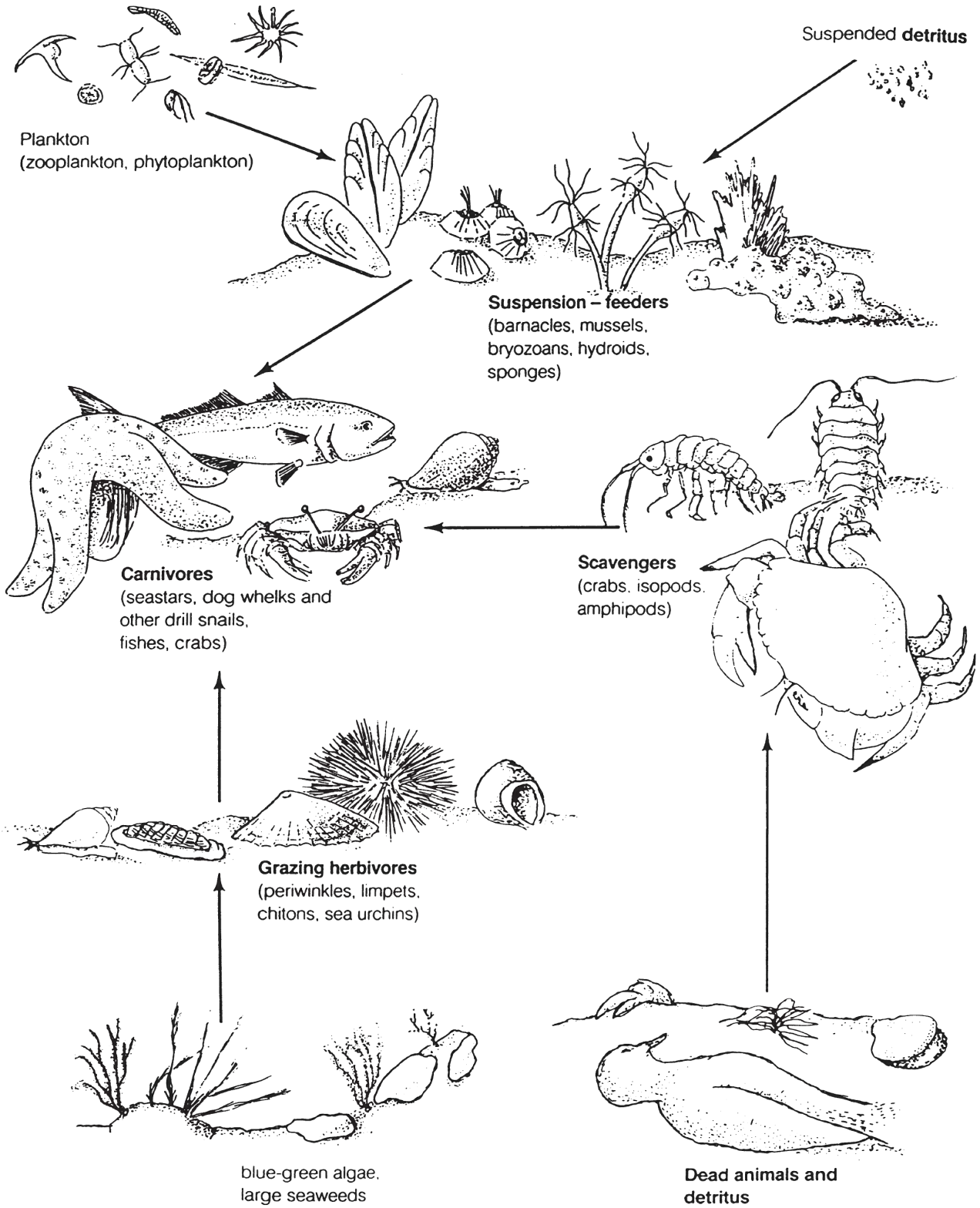

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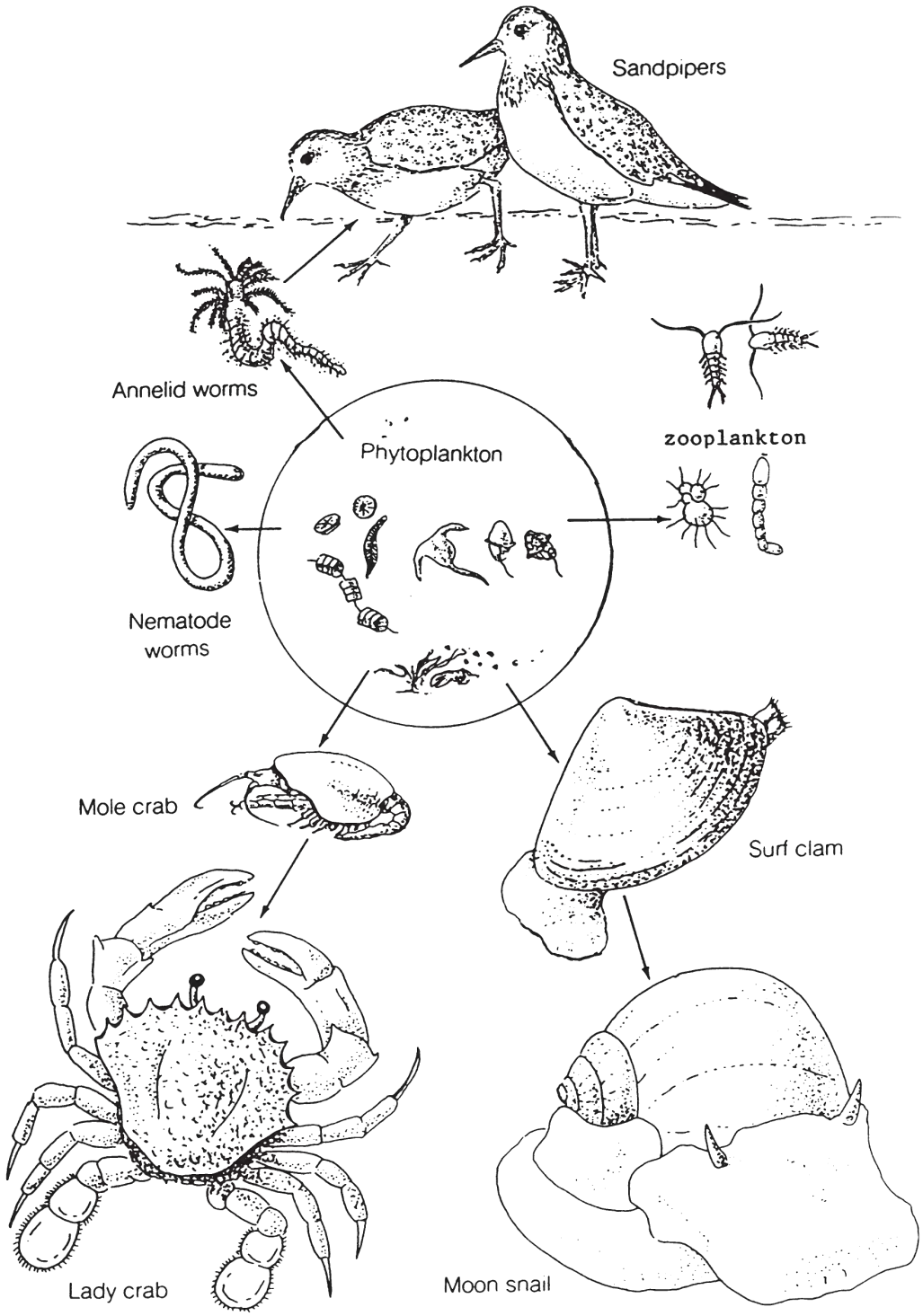

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Preadators & Prey

Predator	Prey
sea urchin	kelp
mussel	plankton
acorn barnacle	plankton
red striped shrimp	plankton
sea star	mussels, barnacles
brittle star	plankton
cancer crab	barnacles, worms
abalone	red algae
aggregating anemone	plankton
moon jelly fish	plankton
squid	shrimp, worms
anchovy	plankton
sargo fish	barnacles, shrimp, crabs
senorita fish	worms, kelp, shrimp, crabs
leopard shark	crab
great white shark	sea lion, seal, squid, leopard shark
seal	senorita fish, anchovy
sea lion	senorita fish, anchovy
owl limpet	barnacles, mussels
sea hare	kelp
flying fish	crabs, shrimp
bat star	algae, sea stars