Who's Living Here?

Key Concepts

1. Species diversity is a measure of the complexity and health of an ecosystem.
2. The beach at Seal Rock Campground contains a diverse assemblage of animals and plants.
3. Careful observation provides information useful in establishing food web relationships.
4. Sampling techniques are useful tools for studying the beach ecosystem.

The intertidal beach ecosystem at Seal Rock Campground is home to an amazing diversity of animal species. While oysters are the most obvious animal, careful observation yields a great many surprises.

In "Who's Living Here?" students observe the variety of beach species and gather data to calculate a diversity index. Diversity in this case means the variety of animal species present in the study area. This type of diversity is called "species diversity" as opposed to ecological diversity or genetic diversity. Ecological diversity is defined as the variety of ecosystems and plant and animal communities that interact with each other while genetic diversity is the variability in genetic make-up among individuals of the same species. Each of these types of diversity is critical to life as we see it at Seal Rock Campground.

In discussing diversity and these Seal Rock Campground activities, it is helpful to spend some time with the concept of "microhabitat", the specific part of a place where an organism lives. Oysters and clams may both live in the intertidal beach ecosystem but in very different parts. Since microhabitats are where organisms live, changes which may seem small when one looks at the whole beach can have profound effects on individual organisms. While the destruction of an ecosystem affects all of the microhabitats with in it, it is also true, although often less obvious, that the destruction of microhabitats can lead to the destruction of an entire ecosystem

In "Oysters in the Rough" students closely observe single oysters. Oysters are a dominant animal on the Seal Rock beach. In the past, the native Olympia oyster (*Ostrea lurida*) inhabited the area. Today most of the oysters on Seal Rock beach are Pacific oysters (*Crassostrea gigas*), originally introduced from Japan in the 1920's. The native oyster does exist in Hood Canal but is rare in the northern parts. Today, at Seal Rock Beach it is most likely to be found attached to the underside of a Pacific oyster.

While most of Puget Sound is not warm enough for oysters to reproduce and grow, warm inlets having less tidal exchange, such as Quilcene Bay, provide ideal oyster habitat. As a result, the Hood Canal, and especially the Quilcene/Brinnon area, is one of the world's

largest producers of oysters and oyster "seed," or spat. Numerous small and large companies along the shore supply countries as far away as Japan and Chile.

Oyster shells provide habitat for a host of other animals. Ironically, one of the greatest threats to the health of commercial oyster beds is an oyster shell inhabitant, the drill snail. Two types of drill snails feed on northwest oysters: the Japanese Drill Snail (*Ocenebra japonica*) and the Atlantic Oyster Drill (*Urosapinx cinera*). As their names imply, neither is indigenous to this area. They probably arrived on imported oyster spat or seed. The Atlantic drill has been found in only one place in British Columbia, while the Japanese drill has been found in several locations, including Dosewallips State Park and private oyster beds just south of Seal Rock. Fortunately, when the Atlantic drill reproduces, the resulting larvae do not swim, a fact which prevents the snails from spreading easily. To prevent accidental spreading of the drill snail, it is illegal to remove oyster shells from the beach.

Oyster drills are a paragon of patience. The drill begins by first drilling on the oyster shell for about a minute. The "drill", which might be better compared to a rasp, is called a radula and is a horny band set with teeth in the snail's mouth. Next it extends its foot into the tiny hole, leaving it there for 30-40 minutes while a gland in the foot secretes acid that breaks down the shell. Then the snail drills again, repeating the cycle until a hole large enough to admit the proboscis is made. The proboscis, a stretchy, fleshy part of the drill, is extended into the hole and the oyster's soft tissues are broken apart and eaten. It takes about 8 hours for a snail to get through an oyster shell 2 mm. thick.

Oysters are particularly sensitive to adverse changes in water quality and serve as a measure of the health of a body of water, alerting humans to changes in water quality before anyone realizes there is a problem. Failing sewage systems, chemical-laden runoff from city pavements and suburban shopping malls, agricultural fertilizers and wastes, and other toxins flowing into Puget Sound have resulted in the closure of more than 40% of Puget Sound shellfish beds.

Speaking of toxins, shellfish (oysters, clams, mussels) can become contaminated by "Red Tides". The term, which refers to the accumulation of poisons in the body of the shellfish, is misleading because it is not a tide and is often not red. The situation develops when certain microscopic planktonic animals called dinoflagellates, reproduce rapidly due to favorable water conditions. *Alexandrium cantanella* (formerly known as *Gonyaulax*), the major culprit in this area, and the other "red tide" dinoflagellates produce a powerful nerve poison which does not necessarily harm the shellfish but which is concentrated by the shellfish as they feed. When ingested by people, these shellfish cause Paralytic Shellfish Poisoning (PSP) which can lead to death.

Materials:

For each student:

- campsite map
- "Who's Living Here?" activity pages
- notebook with a firm back
- paper for rubbings
- pencil, crayon or oil pastel for rubbing
- 10 meter long cord (marked in 1 meter intervals with the first meter also marked in decimeter intervals)

(Materials continued on next page...)

Materials - cont.

For each team:

- Oopa-Hoopa (see construction diagram below)
- Animal ID cards
- Additional materials for Part V, "Oysters in the Rough", are listed below

Teaching Hints

Five activities focus on the diversity within the intertidal beach ecosystem of Seal Rock Campground. The first two activities parallel similar activities conducted in the forest ecosystem. In the first, students examine diversity of beach animals in a one square meter plot to obtain data to calculate a diversity index for their study area. In the second activity, students conduct a hunt for additional animals and animal signs under the shells and rocks of their study area. In the third activity, students examine a clump of oysters looking for the niches it provides for other animals. In the fourth activity, students determine the ratio of living oysters to oyster shells and search for oyster spat and young oysters on the shells within their study area. The final activity is structured, in part, as a teacher demonstration in which a few oysters are harvested and their biology and physiology are studied. Students also learn about harvest regulations and problems faced by both oysters and people. Part V is adapted from the Seal Rock Trail Curriculum Guide Grades 6-8 by Libby Palmer.

For Parts I to IV of this activity, you may wish to assign the study area in which each team works or you may choose to number your teams and have the first team work 10 m north of the southern beach access (or some other reference point), the second team work 20 m north and so on. In Part I, students flip a hoop with a 1 square meter area (see directions below) and study the animals within the hoop. Note that in "Looking Closely....", students tossed the hoop while here they simply roll it out of their hands with a gently flip. The object of the hoop exercise is to provide students with an opportunity to take samples as a way of studying a large and complex system. Before students begin, go over the parameters cited in the student pages, explaining how to do subsamples within the hoop in case the hoop lands on a large number of similar, small animals.

In Part II, students expand their search for animals by looking under rocks and shells and in the sand. Remind your students of proper beach etiquette which includes replacing rocks and shells and filling any holes they may make. Although your students will do much more synthesis back in the classroom, question 3 of Part II provides them with an opportunity to pull together some of their observations.

Part III requires students to be extra observant as they search a clump of oysters searching for animals and animal signs. The animals to be found are often small and extremely well camouflaged. Question 5.c. calls for an opinion based on what they have learned about diversity to date.

In Part IV, students collect the necessary data then calculate the ratio of living oysters to oyster shells. They then search for oyster spat and young oysters on the shells within their study area. Finally, they speculate on upland activities that affect the ability of oysters to thrive on Seal Rock beach.

In Part V, students share their knowledge about oysters, learn about regulations, locate and examine a legal limit size oyster, and observe the insides of an oyster via a teacher demonstration. The instructions for Part V follow:

Part V -Oysters in the Rough

Note: You will need at least one shellfish license so that you can harvest a few oysters for detailed examination. Purchase a license before the day of the field trip at stores near harvest beaches or from the Department of Fish and Wildlife at (360)-902-2457.

Also call the PSP Hotline (Red Tide), 1-800-562-5632 to be sure the beach is safe. It is impossible to tell if shellfish are contaminated by looking at them or by tasting them. Neither boiling not soaking removes the poison. Since a single shellfish may contain enough poison to kill an adult, the only reliable method is to call the hotline number (1-800-562-5632) before harvesting any shellfish. Washington State Department of Health regularly samples and tests beaches for the presence of the red tide organism, *Alexandrium cantanella* (formerly known as Gonyaulax).

Materials

- "Gifts from the Sea. A Guide to Harvesting Seafood from Puget Sound" booklet (Washington State Department of Health)
- Shellfish Identification/Harvest Limits Sheet (Washington State Parks and Recreation Commission)
- Shellfish harvest license

For each student:

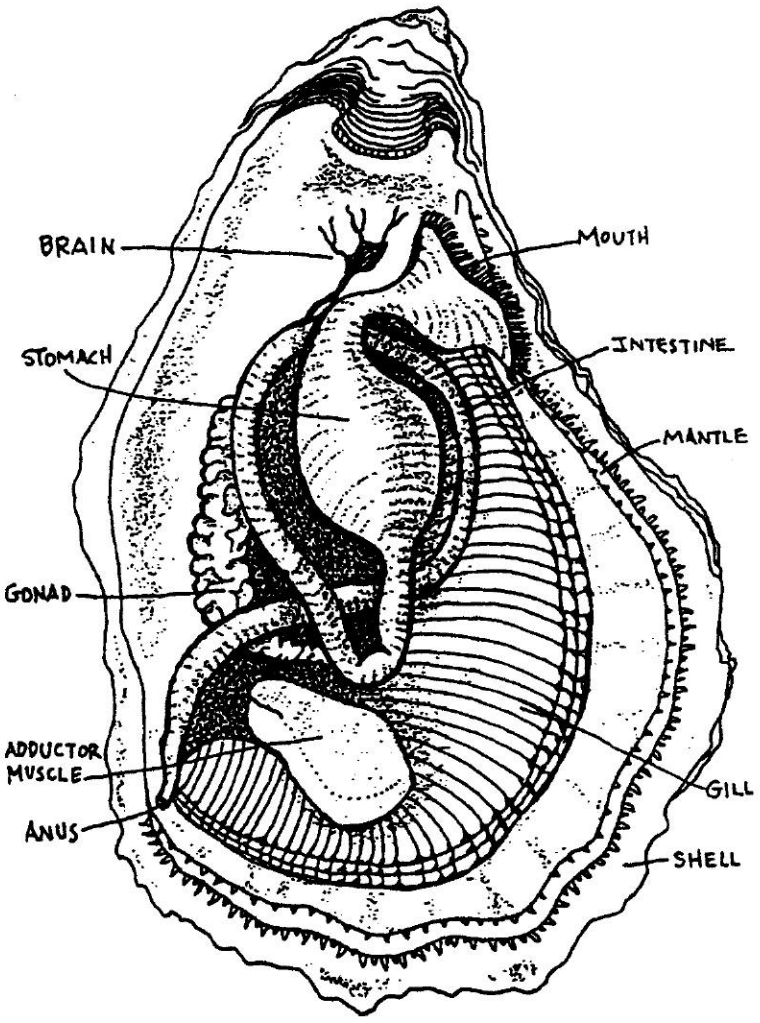
- 10 meter long cord (marked in 1 meter intervals with the first meter also marked in decimeter intervals)
- Magnifying lens or Discovery Scopes (borrowed from U.S. Forest Service)

What to Do

1. Gather everyone at the high tide line. Briefly review the beach activities already completed. Then, ask how many students eat oysters. Cooked or raw? Do other family members eat them? Is anyone in their families involved in raising oysters? Have them share any interesting local information about oysters.
2. Read the part about oyster harvest in "Gifts from the Sea. A Guide to Harvesting Seafood from Puget Sound". Stress the importance of leaving oyster shells on the same beach from which they were taken. Note that there are two primary reasons for this regulation:
   - many shells contain oyster spat (young oysters) and removing them will kill the spat.
   - leaving shells helps prevent the spread of oyster drill, a snail that eats oysters and poses a serious threat to the health of this important economic resource.
3. Show them the sample shellfish harvest license, explaining that it must be clearly displayed on clothing when harvesting. Students must not harvest any oysters unless they have a license.
4. Ask students to find a legally harvestable oyster larger than 8 cm (3" is the limit), to look at it carefully and measure its length and width, position on rock (top, bottom, sides) and position (vertical, horizontal or slanted). In her or his notebook, have each student:
   - Describe and record the number of barnacles, tubeworms, limpets, mussels, snails and other creatures living on his or her oyster shell.

- Note the presence of any seaweed, baby oysters or holes in the shell, and
- Use the magnifying lens or Discovery Scope to take a close look.

5. Gather everyone together at the water's edge and find a completely submerged oyster that has its shell slightly open. Explain that it is eating, taking in microscopic plankton and ejecting the water and waste materials. Now open a few legal size oysters (which you will keep) so that students can examine the animals inside. Locate the gills and discuss their function. Identify the stomach and digestive system. Discuss the oyster's reproductive system as well.



6. Conclude with a discussion using questions such as the following:

   a. Think of your oyster shell as a city. What are the different neighborhoods? What do they share? How do they interact with each other, if they do? In what ways does it resemble a big city? In what ways is it different?

   b. Let's speculate - what might be reasons for the wavy surface of oyster shells? Clam shells, by comparison, have a smoothly curved surface. Could you design an experiment to test your theory?

c. How can we help ensure that future generations will be able to continue to harvest oysters from the beach?

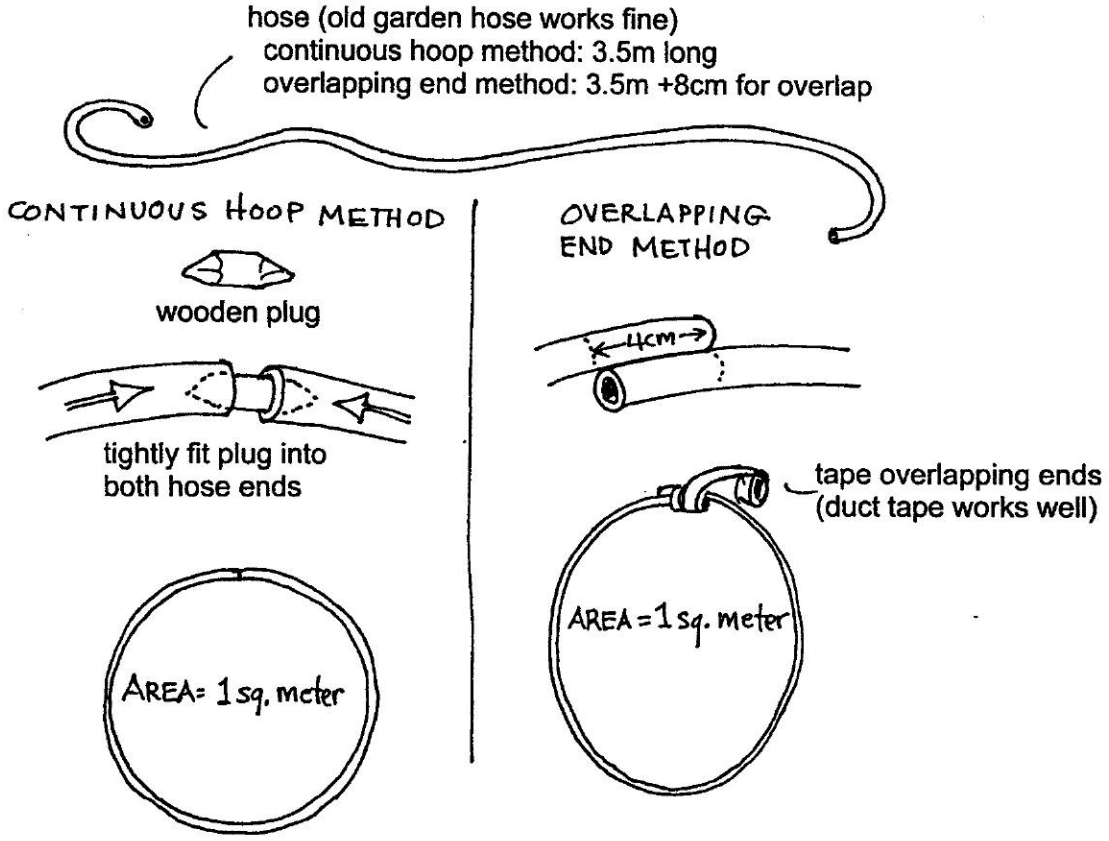
Essential Academic Learning Requirements in Science

1. The student understands and uses scientific concepts and principles. (1.1, 1.2,1.3)
2. The student knows and applies the skills and processes of science and technology (2.1, 2.2)
3. The student understands the nature and contexts of science and technology. (3.1, 3.2)

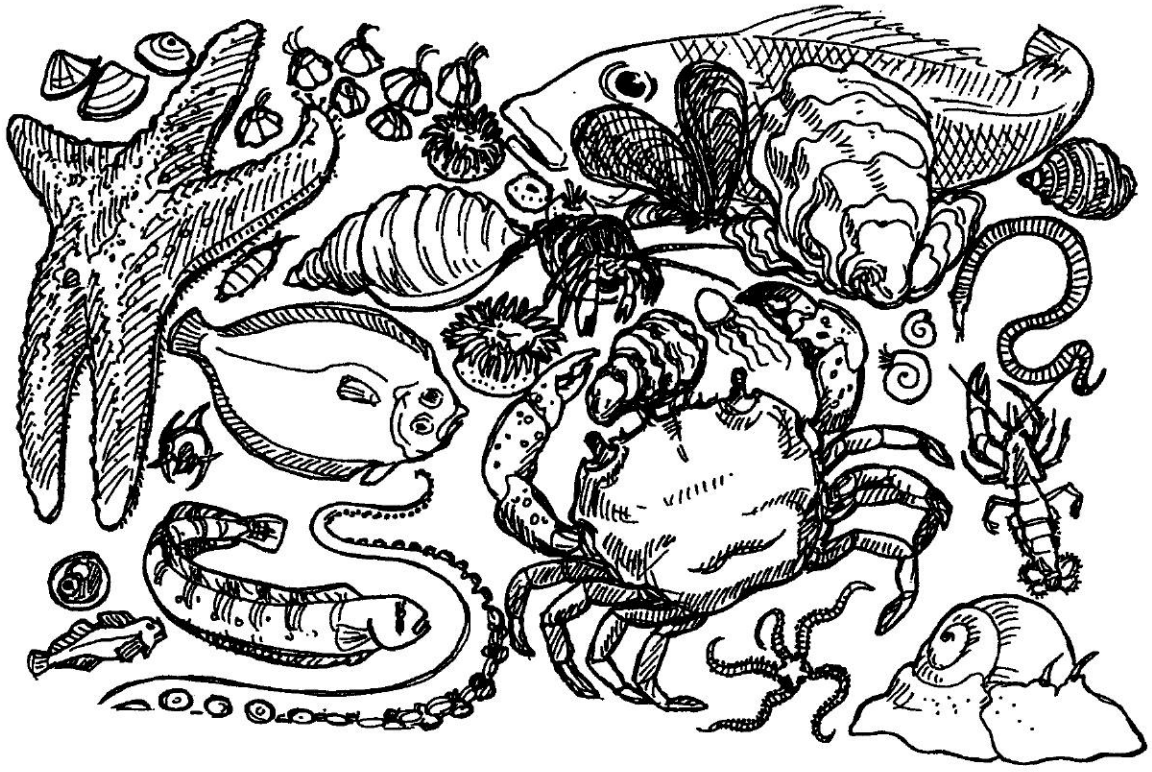
Answer Key

Answers depend upon experimental results.

Making A Oopa-Hoopa



Who's Living Here?



Part I - Neighbors

Seal Rock beach is sure a great place for finding oysters and oyster shells. What else lives on the beach? Let's look a little closer while collecting data to create a diversity index to compare the richness of life here with that in the forest. Diversity in this case means the variety of species of animals present in your study area.

Your challenge is to measure the species diversity in one square meter of Seal Rock beach.

Here's what you'll need:

- Oopa-Hoopa
- beach animal ID cards
- campsite map
- notebook with a firm back
- paper for rubbings
- pencil, crayon or oil pastel for rubbing
- 10 meter long cord (marked in 1 meter intervals with the first meter also marked in decimeter intervals)
- square of butcher paper
- optional: magnifier

Here's what to do:

1. Record the time right now. _____ (By knowing the time and date, you'll be able to figure out the height of the tide)

2. Stand at the water's edge of the study area assigned by your teacher. Turn to face the campground, take 3 steps up the beach. Now, turn right.

3. Your Oopa-Hoopa is used a little differently on the beach than in the forest. Take your Oopa-Hoopa and hold it at "3 o'clock" and "9 o'clock". Look carefully to make sure that your team members are behind you and that no one is in the line of fire. Then, call out "Oopa-Doopa-Hoopa", close your eyes and flip your Oopa-Hoopa forward one turn. **Be careful and be aware!**

4. Now that your Oopa-Hoopa has landed, count the total number of each species of animal found within the hoop. Use the Animal ID cards to help you name the animals. If you can't identify a particular animal, ask your team members for help. If they can't help you, make a sketch (or do a rubbing of its shell if it has one) so that you can ask for help later. In the meantime, give the animal a descriptive name or a number. Here are some parameters, or guidelines, for counting:

   - do not count animals that are beneath the hoop itself,
   - only count live animals (look closely to make sure the animal is alive, we'll count shells later),
   - if your hoop contains hundreds of the same species (for example, periwinkle snails), estimate the number of animals, rather than count each one. Here's how: First, count the number of animals in a small section of known size. Second, estimate how many of those small sections of animals there are inside the loop. Finally, multiply the number of animals per section times the number of sections. For a plot with 26 snails per 10 cm x 10 cm area and 20 such areas inside the hoop, it works like this:

$$\frac{26 \text{ snails}}{(\text{per } 10 \text{ cm} \times 10 \text{ cm area})} \times \frac{20 \text{ (10 cm x 10 cm area)}}{1 \text{ meter plot}} = \frac{520 \text{ snails}}{1 \text{ meter plot}}$$

5. Collect your data in a table such as this:

Species name	Total of individuals
1.	
2.	
3.	
etc.	
Total species =	Total individuals =

Looking at the data...

While you'll be calculating the diversity index for your area when you get back to school, let's look at a few things now.

1. Which animal species was **most** numerous?

2. Did the most abundant species also cover the greatest **area** within your plot?

3. Which animal species was **least** abundant?

4. What factors might cause these animal species to grow in different locations within your plot?

5. Why is diversity or variety of the animals at Seal Rock beach more important than the sheer number of animals?

6. What can be done to ensure that the diverse collection of animals found on the beach continues to thrive?

Part II - The Underground

Not all of the animals in your area live on the surface, many live under rocks or shells, or in the sand. Within the area of your Oopa-Hoopa, carefully examine these areas by moving rocks and shells gently to one side. Look for shore crabs, worms, small fish, anemones, etc. Look for signs or parts of animals, too, such as holes made in the sand, or siphons. Record your findings, then carefully replace the rocks and shells to their original locations.

1. a. What animals or animal signs did you find?

   b. How many different kinds of animals or signs did you find?

2. a. What do you think these animals eat?

   b. What makes you think so?

   c. What plants are available to animals living on the intertidal beach?

3. Use the plant and animal information you've gathered to create a beach food chain for your study area.

Part III - Get Off My Back

Oysters themselves provide many habitats for other animals. Oyster beds are usually made up of many, many oysters. The oysters cluster together and their rough shells make up untold numbers of hills, valleys and flat places. Many kinds of animals have found this varied terrain to their liking. Scientist H.W. Wells, identified some 303 different kinds of animals and plants sharing the environment of the oyster bed. Where do all of these animals live?

Study the picture above redrawn from the book The Oyster by Robert Hedeen. Look at all the places animals are living in the oyster bed. Now, see how many different animals you can find living in the oyster bed.

Here's what to do:

1. Choose a single clump of 8 to 10 oysters.

2. Carefully examine the shells and the spaces between the shells. Look for evidence of other animals.

3. Record where you find each animal, as well as the animal's name. Use the Animal ID cards to help you name the animals. If you can't identify a particular animal, ask your team members for help. If they can't help you, make a sketch (or do a rubbing of its shell if it has one) so that you can ask for help later. In the meantime, give the animal a descriptive name or a number.

4. Find and record an animal that is living in each of these "oyster habitats":
   - on an oyster shell
   - under an oyster shell
   - inside an old oyster shell
   - between oyster shells
   - in the crevices on an oyster shell

5. a. How many different animals did you find?

   b. How many different "oyster habitats" did you find animals living in?

   c. How important do you think oyster beds are to the diversity of Seal Rock beach?
   Please explain your answer.

Part IV - Dead But Not Gone

Seems like a lot of these oysters are dead, just shells. What is the ratio of living oysters to oyster shells? Let's do a quick count to see. Here's how:

1. Use the clump of oysters you examined in "Get Off My Back" as the center point for an Oopa-Hoopa circle. (Put your Oopa-Hoopa over the clump while you center the clump in the hoop.)

2. Now count the number of living oysters that lie within your circle. Remember, do not count animals that are beneath the hoop itself. Also, only count pieces of shell that are more than half of a shell. (You may have to guess on some of the broken shells. Look at several whole shells to get an idea of the curves that would be present on a piece of shell containing more than half of its mass.)

Record the number of living oysters on a data sheet in your notebook that looks something like this:

Number of Oyster Shells in Oopa-Hoopa	
Living	
Shells only	

3. You've guessed it... Now count the number of oyster shells that are not part of a living oyster. Add this number to your data sheet as "shells only".

4. But, wait, each oyster has two shells! You can handle it. Divide the "shells only" number by 2 to find out the number of oysters the shells represent. Record this number on your data sheet in a fashion that looks something like this:

Number of Oyster Shells in Oopa-Hoopa	
Living	
Shells only	
Shells/2= Dead oysters	

5. Get your eagle eyes out and examine all the oyster shells in your Oopa-Hoopa for baby oysters ("spat") or young oysters growing on the adult shells. Look carefully and count the total number of spat and young oysters on both the living and dead shells within your Oopa-Hoopa. Record the number on your data sheet in a fashion that looks something like this:

Number of Oyster Shells in Oopa-Hoopa	
Living	
Shells only	
Shells/2= Dead oysters	
Spat and Young	

6. a. Does your circle contain more shells or more living oysters?

b. How might you account for your observation?

c. Recall that each shell represents only half of an oyster. This means that it takes two shells to represent a dead oyster. Does your circle contain more living or dead oysters?

d. How might you account for your observation?

e. What percentage of shells is providing a home for spat or young oysters? (This is easy. Divide the number of shells with spat/young by the total number of living and dead shells and multiply the answer by 100.)

f. What are two activities that happen on the upland areas of Seal Rock Campground that affect the ability of oysters to thrive on Seal Rock beach?