OCEAN News

Teacher's Guide

Issue 5 - Marine Biodiversity

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&

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Bamfield Marine Station
Public Education Program

The *Ocean News* is a project of the Bamfield Marine Station Public Education Program. This Program also instructs visiting student and adult groups during hands-on marine science field trips to the Station, lasting from two to seven days. These are carried out during the period of September to May. For information on the Public Education Program please contact the Bamfield Marine Station at (604) 728-3301.

If you have any feedback about the *Ocean News* learning resource materials, we'd love to hear from you. Please contact: *Ocean News* Coordinator, Bamfield Marine Station, Bamfield, B.C. V0R 1B0.

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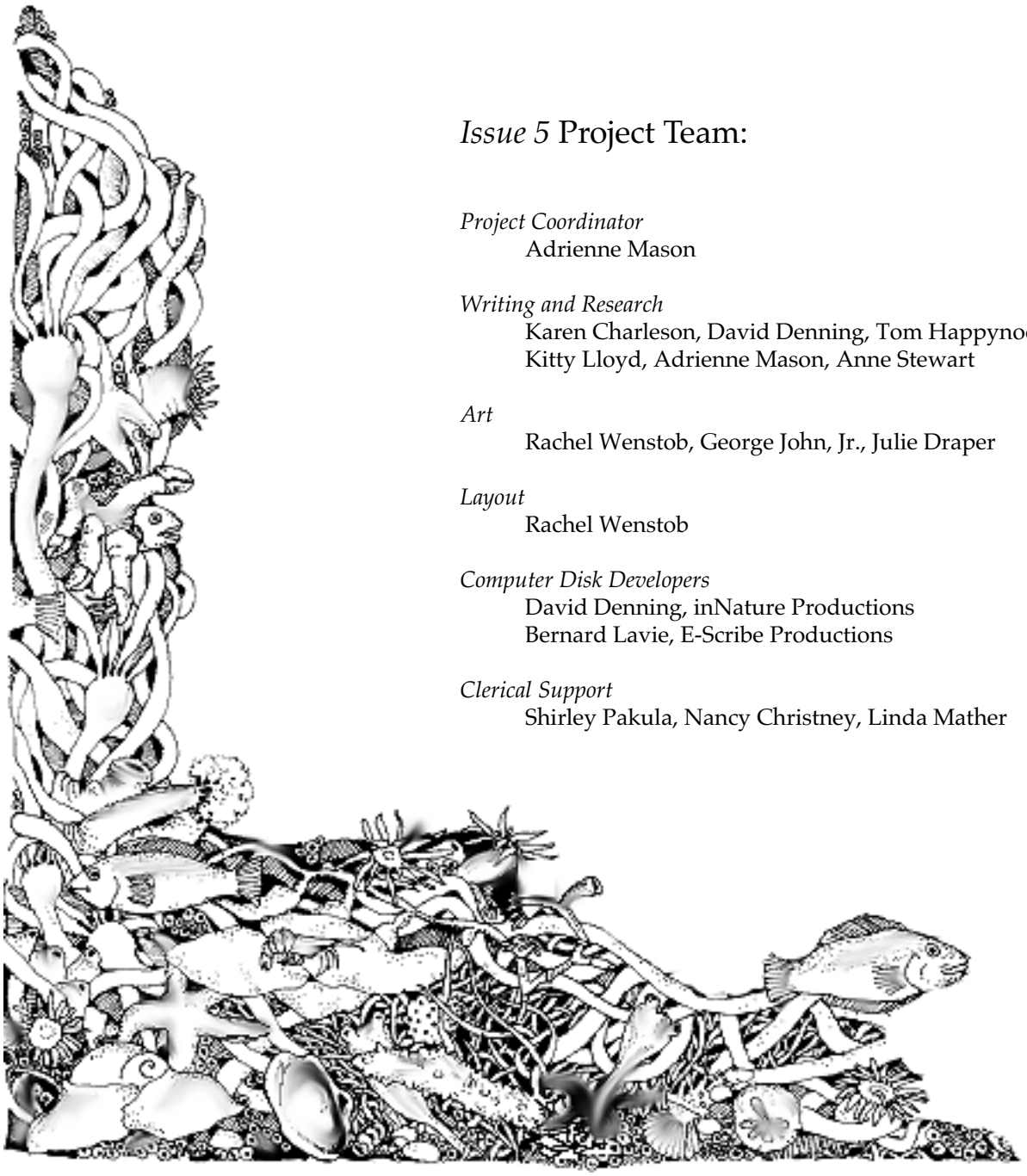
Issue 5:
Marine Biodiversity



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Beach Sand Surprises

Ocean News Reference: Bizarre worlds beneath the beach - page 4; Habitat diversity - page 5.

Background:

Read *Bizarre worlds beneath the beach* on page 5 of Ocean News.

Materials:

- shovel
- large (20 litre) bucket filled 2/3 with fresh water
- fine mesh sieve (preferably 60 - 80 microns) (Note: You can make a sieve by using silicone cement to glue Nitex screening over the end of a 15 cm long, 10 cm diameter piece of PVC tubing.)
- small bucket (such as an ice cream pail)
- small squeeze bottle filled with sea water
- jar for sample
- pipette
- petri dishes
- microscopes, both dissecting and compound scopes are useful

Procedure:

Note: At the beach, this activity must be done fairly quickly. (You can also bring in the sand sample and carry out the extraction in the school yard).

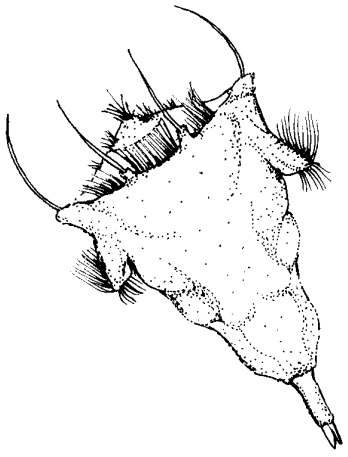
1. Take a shovel-full of fresh beach sand from an intertidal area of a sandy beach and add it to the bucket 2/3 filled with fresh water.

2. Swirl the water and sand vigorously for 20 seconds. (This dislodges the animals from the sand). As the sand settles, pour off the liquid through the sieve keeping as much of the sand as possible in the large bucket.

3. Turn the sieve over and wash the animals off the top off the sieve and into the small bucket using a squirt bottle filled with salt water.

4. Take the sample back to the classroom for microscope examination. Using a pipette, place some of the sample in a petri dish and view through a dissecting microscope. Select some animals and prepare wet mounts for viewing under the compound microscope.

Students can be encouraged to draw the animals they see. Keep in mind that few of these animals have been studied to any great degree, and it is quite possible students might find an animal entirely new to science.



Main ideas:

Life exists in a wide variety of habitats, many of which have only recently become the focus of serious investigation. One such habitat, the tiny spaces between sand grains on a sandy beach, holds a rich diversity of tiny animals.

Objectives:

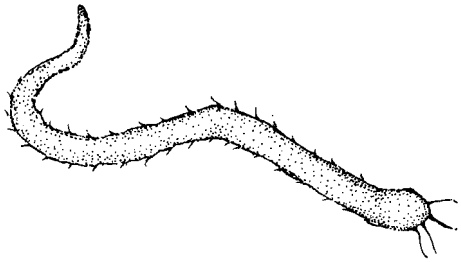
Students will:
- discover the diversity of life living in beaches
- think about diversity in other unusual habitats

Vocabulary:

interstitial - a small space between two things (e.g. grains of sand)
meiofauna - animals that live between sand grains; meio=small; fauna=animals

Discussion:

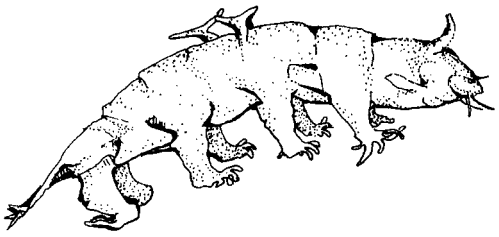
1. Have the class brainstorm to create a list of the different types of habitats, large or small. Both terrestrial and marine habitats should be considered. (The poster from Ocean News shows a good cross-section of west



coast marine and coastal habitats.)

2. Discuss each habitat in terms of the possibility of finding new species there. For example, how likely would new species be found in: a tropical forest canopy?; the soil?; the Arctic tundra?; a meadow?; temperate old growth forest?; second growth forest?; the deep ocean?; etc.

3. Discuss the need to conserve a diversity of habitats.



Extension:

1. Have students do library research on other unique habitats. Some examples include:

- invertebrate life in the tops of old-growth trees (Reference: Life at the Top by Cameron Young, Canadian Geographic, 112(6): 83-91. 1992.)

- life in our homes (Reference: Behold the Mite by Kevin Scanlon, Equinox, 11(2): 34-39. 1992; The Secret House by David Bodanis, Simon and Schuster, Toronto)

- life in the soil (Reference: The Secret Garden by David Bodanis, Simon and Schuster, Toronto, 1992)

Splitting Up the Biodiverse World

Ocean News Reference: Meet a marine scientist, page 2 (Interview with a taxonomist)

Main ideas:

Biologists use dichotomous keys based on either/or choices about characteristics, to identify organisms.

Objectives:

Students will:
- use classification and categorization skills to develop a dichotomous key
- use dichotomous keys to identify objects

Vocabulary:

taxonomy - systematic classification and naming of organisms
dichotomous key - a key for identification based on either/or choices about characteristics. Dichotomous keys have repeated forking.

Materials:

- 15 - 20 pieces of 'junk' for each pair of students (any assemblage of small things that will easily fit on a desk top: film canister, pencil, marble, stone, feather, shell, bottle, cup, paper clip, chalk, etc.) (One good option for marine studies is to use a collection of shells and other beach finds.)
- large sheet of paper and markers
- sample of a dichotomous key (included here)

Procedure:

1. Show the students an example(s) of a dichotomous key used to identify taxonomic group or species. Discuss what keys are used for and why it is important to be able to identify, classify and name living things.

2. Have students create their own dichotomous key for their 'junk'. Ensure that students understand that most divisions in a dichotomous key should be divided into whether something has a particular characteristic and whether it does not. For example: the first division could be: natural object or not a natural object. See the dichotomous key below for one example.

3. When students have finished creating their dichotomous key have other students use it to 'identify' the items in the students' collection of junk.

Extension:

1. Have one group of students create a dichotomous key for the students in the class, based on characteristics of the individual, rather than her/his clothes or other temporary feature. Does the key work, i.e. can it be used to distinguish each individual in the group?

2. Have students use a dichotomous key to identify ('key out') species of organisms available to you in your class. For example, native trees of British Columbia can be 'keyed out' using: *Trees, Shrubs and Flowers to Know in B.C.* by C. P. Lyons. Sea stars can be keyed using: *The sea stars of British Columbia* by Philip Lambert.

KEY TO COMMON MARINE INVERTEBRATES (BY GROUP) IN COASTAL CANADA

1. a. animal is usually buried in mud (sand) or attached to rock — go to 2
   b. animal free-living, not attached or buried — go to 14

2. a. wormlike; moves in mud (some worms crawl on surface) — go to 3
   b. not worm-like — go to 4

3. a. hard-surfaced, segmented worm; may have sharp spine-like structures and gills (often bright red) or tentacles — **polychaete worms**
   b. soft; not segmented; no gills or spines — **ribbon worms**

4. a. animal is hard to the touch — go to 5
   b. animal is soft to the touch — go to 9

5. a. with 2 hard 'cup-shaped' shells that close together; usually buried or attached to rock with threads, or firmly cemented to rock by one shell — **bivalves** (clams, mussels, oysters, rock scallops)
   b. not with two hard shells — go to 6

6. a. animal is a colony, usually with tens to hundreds of tiny individuals living side by side either in a hard, thin coating on a surface or as a branching or lacey upright structure. (It may require a strong hand lens or microscope to detect the individuals) — go to 7
   b. not a colony; individuals are separate, attached at base; may live in aggregations, but these are merely individuals living in restricted space attached to rock — go to 8

7. a. surface covered in regular star-shaped openings; bright purple or pink in colour — **hydrocorals**
   b. tiny (use magnification!) circular or oval openings on surface; spines and other structures sometimes around openings. May be encrusting, erect branching or sometimes lacey — **bryozoans**

8. a. short, soft tentacles surround central mouth; animal lives in a hard 'cylinder' — **solitary corals**
   b. 'volcano-like' shell attached to rock surrounds beak-like plates; feeding appendages (with fine hairs) stick out between plates when animal feeds — **barnacles**

9 a. encrusting, rounded or clump-like; usually not attached by stalk — go to 10
   b. attached by column, tube or stalk; may be in fleshy clumps — go to 11

10. a. smooth, slimy or slick to the touch; no apparant openings at the surface; may have distinct patterns of structures beneath a transparent covering **compound tunicates**
    b. resembles velvet or velour; colour uniform; texture often coarse, sometimes with tiny glass spines; tiny openings on surface; often larger openings (2-10mm), not in pattern **sponges**

11. a. feathery in appearance (feathery appendages may be associated with a hard or leathery tube) go to 12
    b. not feathery in appearance go to 13

12. a. attached with a short stalk; flat branching, feather-like or similar to a fine bushy, tree-like structure **hydroids**
    b. branching of feathery appendages coming from a tube, may be retracted into tube **tube worms**

13. a. soft tentacles surrounding a central mouth; attached with a thick, soft column **anemones**
    b. bulbous and attached at a base, or attached by a stalk; two openings on 'top' **tunicate**s

14. a. without obvious hard parts go to 15
    b. with obvious hard parts go to 21

15. a. free-swimming (although it may stay close to bottom) go to 16
    b. bottom dweller (not attached - crawls or walks) go to 19

16. a. jelly-like, body transparent or nearly so; tentacles (if present) without suction cups; without complex eyes go to 17
    b. body usually firm, opaque (or milky white); tentacles with suction cups; with complex eyes go to 18

17. a. bell-shaped; usually obvious tentacles at margin of bell; swims by pulsing of bell **jellyfishes**
    b. spherical or egg-shaped; tentacles (when present) come from 2 'canals'; swims by beating rows of hair-like structures on surface **comb jellies**

18. a. with 8 tentacles **octopuses**
    b. with 10 tentacles **squids**

19. a. flat, a few millimetres thick or less **flatworms**
    b. cylindrical, domed, slug-like, or like a slug with tentacles go to 20

20. a. body cylindrical, cigar-shaped; with rows of tiny tube feet along the length (sometimes only on one side)	**sea cucumbers**
b. moves on creeping foot; like a soft dome or slug-like, or slug-like with tentacles	**nudibranchs**
21. a. bilaterally (left/right) symmetrical, not star-like or ball-like	go to 22
b. radially symmetrical, star-like or like a spiny ball	go to 30
22. a. moves on thin, pointed, jointed legs	go to 23
b. moves on flat, 'suction-cup like' foot	go to 27
23. a. body appears flattened from top and bottom	go to 24
b. body appears more flattened from the sides, may be somewhat cylindrical; animal may live in shells	go to 25
24. a. flattened body, often large (>10 cm); usually with large claws; abdomen folded under	**crabs**
b. flattened body, usually small (<3cm); without claws; abdomen short but extended out; sow-bug-like	**isopods**
25. a. animal occupies snail shell; with relatively large claws, abdomen coiled to fit in shells	**hermit crabs**
b. not living in shell, claws small, abdomen not coiled	go to 26
26. a. body distinctly flattened from the sides (laterally); animal small (<2cm); abdomen short; animal'flea-like' in appearance	**amphipods**
b. body elongate; abdomen extends behind	**shrimps**
27. a. shell in 8 sections (may be hidden under a leathery covering)	**chitons**
b. shell not in sections	go to 28
28. a. pointed, cap-shaped shell; may have opening at top	**limpets**
b. shell shaped like a rounded coil, cone, or flattened coil	go to 29
29. a. shell in flattened coil; may have several openings along margin	**abalones**
b. shell conical or rounded coil	**snails**
30. a. with five or more arms	go to 31
b. animals round and spiny	**sea urchins**
31. a. arms thick; with or without short spines	**sea stars**
b. arms thin, fragile	**brittle stars**

Genetic Diversity

Ocean News reference: Biodiversity: what is it all about?, page 1; Blueprints of life: genetic diversity, page 8; Meet Captain Kelp and his team, page 8

Main idea:

Populations of a species are genetically diverse, although this diversity is usually not easily observed. In this activity students begin to transfer the idea of genetic diversity from easily-observed instances to instances where it is not so easily observed.

Objectives:

Students will:
- write about physical and behavioural traits of a pet or familiar individual animal, inferring the genetic diversity that is behind these traits
- observe and write about genetic diversity in an organism that might be considered wild.
- compare genetic diversity in domesticated and wild organisms, and compare people's perceptions of this diversity

Background:

Any two individuals of a single species have genetic differences (unless they are from a clone derived from asexual reproduction). Over time, genetic diversity is usually essential to the survival of species. Also, disease-resistance, ability to handle environmental shock, and reproductive success of populations are dependent on their genetic diversity.

One important outcome of our cultural milieu is that we tend to think of humans as individuals (genetically distinct), but we don't tend to think that way about animals and other organisms. A crow is just a crow, and an earthworm is simply an earthworm. An exception to this broad generalization is the way people tend to feel about their pets. Pets are often recognized as individuals as much as humans are. In this activity, students start with a familiar pet (or favourite plant) and translate this 'individuality' into genetic traits. Then they investigate a small population of a 'wild' organism to find differences possibly due to genetic diversity. At the same time, they try to 'get to know' members of the population as 'individuals'.

(Physical and behavioural traits of an organism are often controlled by several genes and the expression of traits is often controlled by development. In other words, genetic control of traits is usually more complex than 'one gene controls one trait.' This will add to the challenging discussions around genetic control of traits, especially behavioural ones, which can involve both learned and genetic components.)

Materials:

- Genetic diversity report
- access to a pet (for observation only)
- small organisms (flower, snail, limpet, earthworm, sow bugs, lady bugs, etc.)
- observational tools such as magnifying glasses, microscopes, aquaria,
- a ruler

Procedure:

Part 1:

1. As a homework assignment ask students to write a Genetic Diversity Report on an individual organism (such as a pet or favourite plant):

a) As precisely as possible describe physical features of the individual that can be used to distinguish it from other members of the same species. For example, a student has a dog, Ralph, that is a member of the population of dogs called Dachshunds. This student's report should describe features (physical and behavioural) that help to identify Ralph as an individual (not just a Dachshund) out of all dogs.

b) Carefully consider each trait listed, and decide whether it is a genetic trait or not. An ear torn in a dogfight is not a genetic trait, nor is a blue collar with bells. Answering to the name 'Ralph' is not a genetic trait, because Ralph cer-

tainly learned it. When listing behaviours, students need to think about how much of the behaviour is genetic and how much is learned. (This, of course, will vary with the behaviour, and the interpretation). Remember, a behaviour is probably genetic if it played an essential role in the long-term survival of the species. For example, in dogs, quick speed or endurance or the ability to cooperate with other dogs are probably largely gene-controlled traits.

Part 2:

As much as possible, pair together students who have chosen the same species. In these pairs, have them discuss their reports and the traits they identified:

- Why do they feel these are genetic traits?

- What are the differences among the pairs in the types of traits noted on the reports?

- How many behaviors were considered genetic? How many of these would actually distinguish the pet as an individual?

Part 3:

1. Collect six to eight specimens of a single species of animal, plant or other organism. (Some good examples include: intertidal or pond snails; sow bugs; earth worms; mealworm beetles, buttercup flowers, etc.).

(* Note: collect only specimens that can tolerate some handling. Return all organisms when the activity is completed.)

Observe the organism closely using microscopes, hand lenses, rulers, and/or aquariums looking for traits that might be genetic and quantifiable or qualifiable. If possible, have students complete a Genetic Diversity Report on one individual in their population.

Discussion:

1. How much variation was noted in the population studied by each student? How difficult was it to find genetic diversity in 'wild' populations? Compare genetic diversity in pet species with that of wild species?

Extension:

Some visible genetic differences in people include skin colour, hair colour and texture, behaviour and size. People inherit one gene for a particular trait from each parent. Some traits are dominant, others are recessive (or 'hidden'). For example, dark hair is a dominant trait while light hair is recessive. Here are some human traits that are genetically controlled. See who in your class can:

- roll his/her tongue

- spread his/her toes

- wiggle small toe sideways

- bend the first joint of fingers without bending the other joints

- wiggle his/her ears

- flare his/her nostrils

Have the students see who in their family have these traits.

Genetic Diversity Report

(Use extra paper to complete questions where needed)

What is the genus of this individual? _____

What is the species of this individual? _____

If the individual has a name, what is the name? _____

How old is the individual (if known)? _____

Briefly describe what (if anything) is known about the parents and lineage of the individual?

_____

_____

How would you tell your individual animal apart from others of the same species? Are these genetic traits?

_____

_____

_____

In the following sections list all of the traits that seem to be unique to your individual pet. Think carefully about the trait and decide whether it is controlled by genes:

Size traits: (Carry out measurements such as the following: height, girth at belly, head width, distance between tips of ears, length of beak, others)

Description of Measured Trait:	Genetic Trait?(Y or N)	Comment

Colour and pattern:

Description of Trait:	Genetic Trait?(Y or N)	Comment

Other characteristic physical features:

Description of Trait:	Genetic Trait?(Y or N)	Comment

Behavioural traits:

Description of Trait:	Genetic Trait?(Y or N)	Comment

Habitat Inhabitants

Ocean News Reference: Looking at species diversity, page 4; Habitat diversity, page 5; poster, page 6/7

Main Ideas:

Habitats are really 'nested ecosystem components' with different dimensions of organization and complexity. A habitat such as a forest area has within it a number of 'sub' habitats. To understand diversity in the larger habitat, one must also understand the subhabitats within it.

Objectives:

Students will:
- carry out a semi-quantitative and qualitative study of species in a micro habitat, a habitat of intermediate dimensions, and a larger habitat such as a patch of forest.

Background:

A habitat is not easily defined. It is a region of the earth's biosphere occupied by living things and the physical things with which they interact. There are big habitats that occupy a huge volume such as the midwater region of the open ocean, and there are smaller habitats, such as a bed pillow with its community of dust mites, or a rotting log with its community of organisms. The edge of a pond, a forest plot, a tiny patch of soil - all are habitats of different dimensions and different kinds of species diversity.

This activity gets students to look at species diversity in progressively larger plots, each plot is a habitat contained within the next larger habitat. The goal is to begin to understand the diversity of habitats most familiar to our experience (a garden, a field, a forest), in terms of the remarkable diversity of the 'subhabitats' which they contain.

This activity is oriented around a series of three field sessions in an ecosystem accessible to your class. (If transportation is an issue, you may wish to carry out all three activities in one day at the site.) A seashore intertidal area or a lush forested area is ideal, but a meadow, vacant lot, pond or other environment can also be used. For aquatic environments, you will have to modify the sampling techniques. For an intertidal environment, you will have to utilize a good low tide or series of low tides.

Students should be aware that they will be doing a study of species diversity in a local habitat which will involve three field studies. Notebooks, rulers and pencils and proper clothing are required.

Part 1

Materials:

- magnifying instrument (hand lens, jeweler's loop, Discovery Scope, etc.)
- a small 'microplot' quadrat of about 100 cm2 area (a 10 cm by 10 cm square transect made of clothes hanger wire, or a 11.2 cm diameter circle made of clothes hanger wire)
- a small foam pad is nice to kneel on while doing the survey

Procedure:

1. Upon arrival at the site, have students explore the area for a few minutes to get a sense of what lives there. Bring the group together for a short discussion.

2. Distribute the small quadrats and magnifying instruments. Working individually, students should carry out a 'diversity survey' of a small quadrat plot (microplot). Keep the microplots separate enough so that a variety of microplot habitats are sampled, but together enough to monitor and assist students as needed. Place microplot transects on a patch of terrain that seems to have a variety of small organisms.

Have students carefully observe and record every species and every individual within each species in their microplots (a diversity survey). Their data should be in the form of a table listing: species, description of species, and the numbers of individuals. (Use descriptive names to list species, and don't worry about keying species out. Examples would be 'grass species #1- short grass with a purple flower head' or 'spider species #3 - black spider with medium legs that are hairy')

Back in the classroom, spend some time discussing the findings from this study in small groups or as a class.

Part 2:

Materials:

- quadrat-defining tools such as string, stakes and tape measure. (Depending on the type of habitat you are studying, choose a quadrat size for this portion of the study that is appropriate as an intermediate quadrat. In a forest area, for example, you might choose a square plot of 2m on a side. In an intertidal area, you might use a hula hoop)

Procedure:

1. Students will work in teams of 2 or 3. Assign students to appropriate plot areas. If possible, have this intermediate plot contain a microplot previously surveyed by one member of the student team. Divide up the work of the team. Have students carefully carry out a species and population survey of this intermediate plot. They should be thorough and work to the smallest level that is reasonable, but it is not likely they would work to such fine detail as they did with the microplot survey. Again, discuss and compare results of the teams back in the class or at the site.

Part 3:

Procedure:

1. Repeat the procedure of Part 2 working at a level that will characterize the larger habitat. For example, this might be a square forest plot 30 metres on a side. Have teams of 4-6 students carry out a species and population survey of this large plot. Again, have the large plot contain at least 1 intermediate plot. Try to identify the larger common organisms to species. For example, in a forest plot, the larger trees and shrubs should be identified (using plant identification books) and their numbers noted.

Discussion:

1. How did the students' view of species biodiversity change as they carried out the three different surveys?

2. What is the best approach to determining species diversity for the habitat you studied?

3. How would this approach change when different types of habitat are studied?

Habitat Hunt

Ocean News Reference: Habitat diversity, page 5; poster, pages 6/7

Main ideas:
- there are a variety of habitats, large and small, in all communities

Objectives:
Students will:
- explore habitat diversity in their neighborhood

Background:

There are a variety of habitats in all neighbourhoods. Entire communities of invertebrates live in garden soil. Streams may be home to unique groups of fish, insects and plants. Different habitats are home to particular assemblages of plants and animals. A habitat consists of all living and non-living things in a given area that interact with one another.

Materials:

- presentation materials (writing, art, video and/or photographic equipment)

Procedure:

As a class, brainstorm to create a list of the variety of habitats near your school, or in your community. **Include small and more obscure habitats as well (inside your house; in a litre of soil, etc.).** If you live near the ocean, focus on the marine environment.

Divide the class into small groups and have each group investigate a different habitat.

Have students present a 'snapshot' of their habitat to the class. Students could use a variety of presentation methods such as: posters, murals, video, public speaking, etc.

Extensions:

Create a list of any local problems associated with biodiversity (e.g. is the habitat of a particular species rare? are wetlands being drained and developed? do people favour rolling, green lawns of grass over natural vegetation?).

Create a display or other educational product for your school or community that highlights some of the biodiversity of your area. Some ideas: collage, mural, an interpretive booklet ('walking tour') that highlights of biodiversity in your community, write a play, song, music video or poem.

Seaweed Search

Ocean news reference: The ocean in your home, page 3.

Main ideas:

- substances derived from red, green and brown algae provide ingredients that are used in the manufacture of many common food products

Objectives:

Students will:
- investigate the use of seaweed derivatives in common household products
- make connections between biodiversity in the ocean and some of the benefits people derive from marine life
- investigate the use of seaweeds in the human diet

Background:

Red, green and brown algae all provide ingredients used in the manufacture of many food products. Carrageenans are extracted from red algae and form a medium-soft gel used to stabilize and gel food, cosmetics, pharmaceuticals and some industrial products. Agar is also extracted from red algae and makes a harder gel used in food such as jellied candies. Alginates are derived from brown algae. They are used to make products thicker, creamier and more stable. Beta-carotene is a reddish-orange pigment found in green algae and is used as a food colourant.

Materials:

- Ocean News #5 - list on page 3

Procedure:

1. As a homework assignment or field trip, have the students find ten items in their home or local grocery store that contain algin, carrageenan and/or agar. They can use the list on page 3 of Ocean News #5 or locate the ingredients on the food labels.

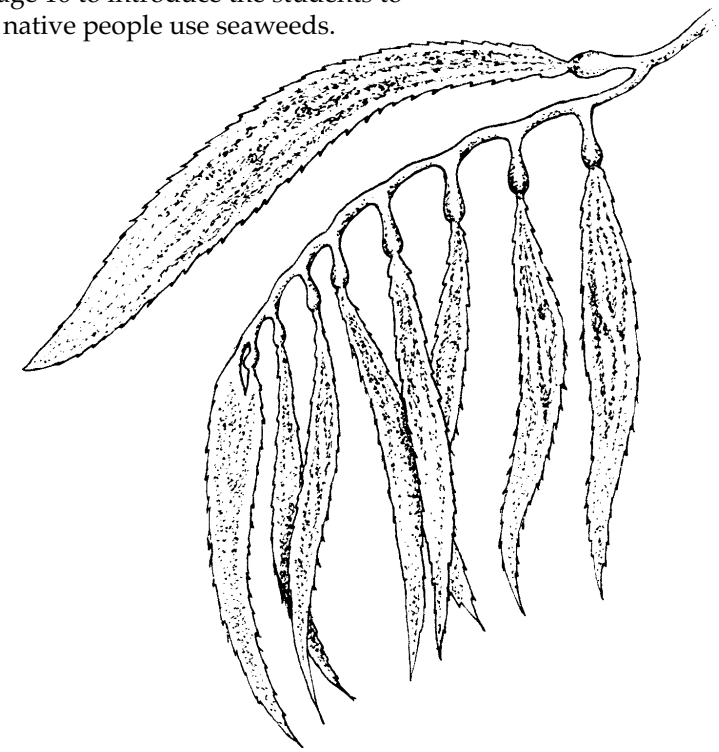
2. Exhibit the diversity of products that contain seaweed derivatives (labels, cans, food packaging, etc.) for your class or school.

Extension:

1. Investigate the use of seaweed as food by people around the world.(Note: The teacher may gather some resources of current use of seaweed in North America by visiting a health food store). Many Asian cultures for instance use seaweeds in cooking.

2. Try some recipes using seaweeds. If seaweed is not available at a local health food store contact Canadian Kelp Resources Ltd., Bamfield, B.C. V0R 1B0 for west coast kelp. This company farms and wild-harvests a variety of kelp species. Their packages of dried kelp are inexpensive and have recipes on the labels.

3. Try the activity 'Kelp technology' on page 16 to introduce the students to how native people use seaweeds.



Kelp Technology

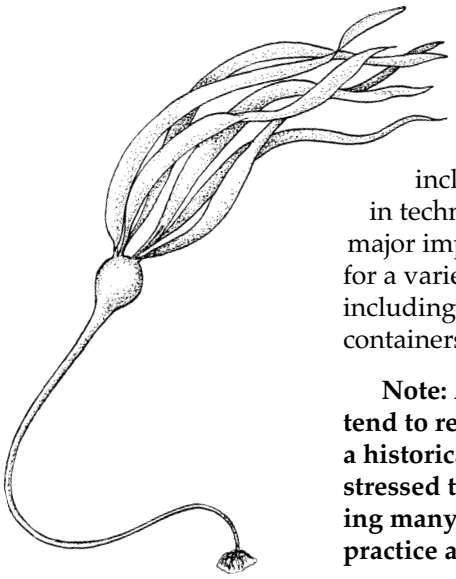
Ocean News Reference: Meet Robert Dennis, page 10; Hesquiaht traditional ecological knowledge, page 11

Main ideas:
Seaweeds are used in many ways by First Nations people.

Objectives:
Students will:
- investigate the food and technology uses that west coast First Nations people had for some species of seaweed
- create some of their own technological uses for bull kelp *(Nereocystis luetkeana)*

Materials:

- copies of: Food Plants of Coastal First Peoples, Nancy J. Turner, UBC Press/ Royal B.C. Museum, 1995 (pgs. 19-22) and Plants in British Columbia Indian Technology, Nancy J. Turner, British Columbia Provincial Museum Handbook 38, 1979 (pgs. 42-47). (available at public libraries)
- kelp questions worksheet (page 00)
- (optional) bull kelp collected from a beach.



Background:

Coastal native peoples used a wide variety of plants, including seaweeds, for food and in technology. The bull kelp was of major importance to the coastal people for a variety of technological uses including: rope, fishing line, storage containers and siphons.

Note: Although reference books tend to refer to native uses of plants in a historical context it should be stressed that the use of plants, including many seaweeds, remains a common practice among First Nations people.

Procedure:

1. Using the reference books have students fill out the kelp question worksheet.
2. Review the worksheets with the students.
3. Have students create their own uses for bull kelp.

'Kelp Questions' Answer key:

1) Giant kelp (*Macrocystis integrifolia*); dried and put in the fire to cause them to explode.

2) The hollow tube of bull kelp was placed in the fire and water poured down the tube.

3)The small sacs of red algae, sea sac (*Halosaccion glandiforme*), retain water and can be used to squirt friends and enemies.

4) The stipe.

5) Eulachon (candlefish) grease, fish oil, water, molasses

6) During the spawning season, Pacific herring lay thick layers of eggs on the blades of these kelp. The blades are harvested and dried. To prepare for eating, the roe and kelp were boiled or fried.

7) The wood for the hook was sharpened and placed in the hollow bull kelp stipe. The stipe was filled with water, the ends plugged, and placed in the fire overnight. The steamed and pliable hook was removed from the ashes in the morning and was bent and placed in a mold in the appropriate shape.

8) One end of a long tube of bull kelp was buried under the dance house floor, or even in the centre of the fire pit. Participants could speak through one end of the tube and the voice would come out of the other.

9) Sea wrack or rockweed (*Fucus*)

10) Fishing line, net, rope, harpoon line and anchor line.

11) Kelp

12) Red laver (*Porphyra abbottae*)

Kelp Questions:

1) Which seaweed makes the best firecrackers? How were they prepared and used?

2) How was seaweed used to safely add water to the food in steaming pits?

3) Which seaweeds can be used like a water pistol?

4) What part of the brown kelp, Laminaria, was used for beach hockey?

5) What was stored in the bulb-like floats of the bull kelp?

6) What fish commonly lays its eggs on giant kelp and bull kelp? How are these eggs used?

7) How was bull kelp used to make halibut hooks?

8) Describe one way that bull kelp was used to enhance the special effects during winter gatherings of native people.

9) What seaweeds were rubbed on fishing lines to remove the human scent?

10) Name five uses of the bull kelp stipe.

11) What is the English translation of the Bella Coola word for garden hose?

12) Which algae is made into seaweed 'popcorn'?

Biodiversity Experts

Ocean News Reference: Meet a marine scientist, page 2.

Main ideas:

Many careers include work that includes biodiversity issues.

Objectives:

Students will:

- using the internet, other research tools, or phone interviews, investigate the variety of careers that are biodiversity-related.

Materials:

- research materials (students might want to search the Internet if they have access to it)
- writing materials, video equipment if available
- 'Careers in biodiversity' interview questions below.

Procedure:

1. Brainstorm with the class to see if they can list careers that may deal with biodiversity. Some ideas include: biologists, aquarists, taxonomists, naturalists, museum, zoo or aquarium researchers and curators, horticulturists, botanists, geneticists, ecologists, and conservationists.

2. Review the list of 'Careers in biodiversity' interview questions below. As a class determine if there are other questions the students would like to ask.

3. Have students complete an interview sheet they make up from the questions, by doing interviews in person, by electronic mail, or over the phone. If possible, invite a guest or two to your classroom.

4. Have the students present their findings to the class.

Careers in Biodiversity - Interview Questions

Name:

Position and Company/Organization:

Could you describe a typical day on your job?

Why did you choose your career?

What type of skills and personality traits does a person in your job have?

How does your job relate to biodiversity?

Why is biodiversity important?

What type of training and education do you need for your job?

Ocean Habitat World Tour

Materials:

- shoe box
- scrapbook
- sand samples, shells, bones, photographs
- video recorder (optional)
- writing/drawing materials

Procedure:

1. Brainstorm with the class to make a list of marine habitats.

(Marine ecosystems include: continental shelf waters, neuston (organisms that live near the surface film of water), mangrove swamps, coral reefs, kelp forests, estuaries, salt marshes, sea grass beds, temperate rocky shores, continental shelves and slopes, deep sea and more. Even though they are not marine habitats, rivers, wetlands and drainages all can influence marine systems.)

2. Have the class inventory the variety of marine habitats in their community (or, if you live away from the ocean, local habitats that impact the ocean).

3. Have the class choose a local marine habitat they would like to profile and share with another community. Compile a small discovery box (shoe box size) to send to your 'sea pen pals'. Suggested items to include:

- photographs, including photos of your class
- video (optional; ensure your system is compatible with a partner school)
- hand drawn maps of your site
- results of flora and fauna surveys
- results of beach clean-ups showing the types of garbage collected and where it originated (if known)
- sand samples
- a few shells or other beach artifacts
- samples of seaweeds, pressed and dried on cards
- essays describing the area (Things to consider: importance of the ocean to your community (e.g. fisheries, nursery area for fish, recreation, industry, transportation, etc.); use of the area by animals (e.g. breeding habitat, seasonal migration route, etc.); unique plants and animals in the area; local conservation efforts; protected status, or lack thereof, of the area,
- prose and poetry inspired by the area

Hints for choosing schools for twinning: Contact the Public Education Program Coordinator at the Bamfield Marine Station (604-728-3301) or the Senior Program Coordinator at the Vancouver Public Aquarium (604-631-3364) for assistance finding a sister school. Sites can also be located through other educational institutes, the internet, local school board offices and local Chambers of Commerce. You might try twinning with a school that shares a particular species of animal with you. For example, if you are on a shorebird or whale migration route, twin with another school along this route. You may also want to try linking up with a school on a different ocean within Canada, North America or the world.

Extension:

1. Investigate rare and unique marine habitats such as hydrothermal vents and Arctic polynas (ice-free areas that remain open throughout the winter; these areas often support large concentrations of marine mammals).

2. Display the package you receive to your school and/or community.

Main ideas:

- marine habitats vary between locations; (e.g. a rocky intertidal area in the eastern Pacific has some difference from a rocky intertidal area in another part of the world).

Objectives:

Students will:
- discover the variety of marine habitats in their community and other parts of the world
- 'twin' with similar groups from other coastal locations nearby or even around the world to discover more about the variety of marine habitats.

Parts of this activity were originally published in 'Our Oceans, Ourselves: Marine Biodiversity for Educators' (see bibliography). Used with permission.

Marine Medicine Chest

Ocean News Reference: Marine medicine chest, page 3.

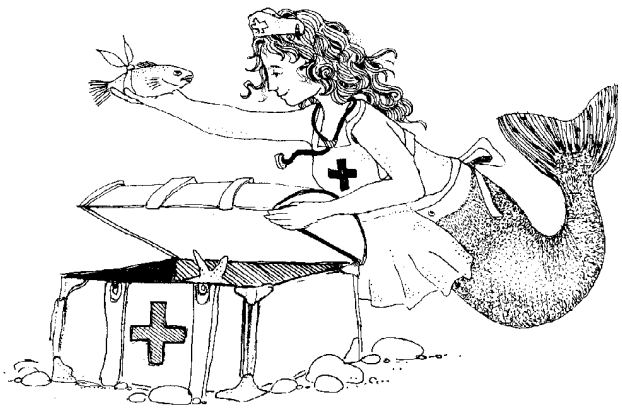
Main Idea:
Many marine organisms are being investigated for their efficacy as pharmaceuticals.

Objectives:
Students will:
- investigate the use of marine organisms in pharmaceutical research

Background:

Have your students ever had stitches? Did they check closely to see what the doctor used to sew them up? Although they'd never be able to tell, many dissolvable stitches contain chitosan, a product made from the ground up shells of shrimps and crabs. More and more pharmaceuticals are being discovered in the world's oceans.

Long before the advent of modern medicine, traditional societies used (and



many still do) derivatives of living things for medicines. Today, over 120 chemicals extracted in pure form from 90 marine species are being uses in medicines throughout the world. This is only the beginning of the potential that exists.

Materials:

- Ocean News #5 - page 3

Procedure:

1. Read the article, Marine Medicine Chest.

2. If students aren't familiar with some of the organisms mentioned use reference books or the Ocean Explorer Disk #5 for pictures and more information.

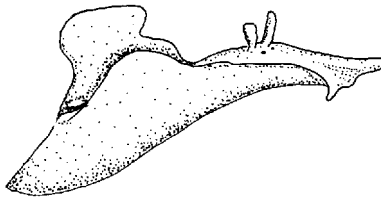
3. Create class collage or mural, showing the variety of marine organisms that are being used, or studied for use as medicines.

Discussion:

1. Most medicines that we presently know of are derived from land plants and fungus. Comparatively few medicines have been discovered in terrestrial animals. However, many pharmaceuticals are being discovered in marine animals. Why do you think marine animals and terrestrial plants are the source of most pharmaceuticals? (Hint: Think about the lifestyle, particularly the defensive strategies, of these organisms.)

(Land plants and fungus, as well as most of the marine animals from which pharmaceuticals are derived, don't move much.

Because of this, they have had to evolve chemical compounds for defense. Jellyfish and anemones have stinging cells for example. Many sea slugs and the leather star, for example, produce warning scents.)



2. Discuss the value of protecting species and habitats because of what they might provide for us in the future.

3. Discuss the merit of preserving species and habitats because of their intrinsic value. Do species and places deserve to be protected even if they do not immediately provide us with anything?

Extensions:

Investigate the use of plants and animals by indigenous peoples around the world (research using the key words ethnobotany and ethnozoology).

The articles on page 10 and 11 in Ocean News #5 are a good place to start your research. How do these people learn about the efficacy of certain species? (*living intimately with their environment for generation after generation, for esample.*)

For B.C. classes you may want to look for these reference books:

Teachings of the Tides: Uses of Marine Invertebrates by the Manhousaht People by David Ellis and Luke Swan;

The Knowledge and Usage of Marine Invertebrates by the Skidegate Haida People of the Queen Charlotte Islands by David Ellis and Solomon Wilson;

Plants in B.C. Indian Technology by Nancy Turner; Food Plants of Coastal First Peoples by Nancy Turner.