



CSI: COASTAL SHORE INVESTIGATION-Maine

Subject: Rocky Shore Ecology

Grade Level: 9-12 (could be adapted for 5-8)

Time Required: 2 classroom periods, 1 field trip day

Maine Learning Results Standards:

Science and Technology: B3, B4, J1-3, K1-6

Mathematics: C1-4, F1

Student Learning Objectives

1. Recognize the effect common physical and chemical factors have on rocky intertidal systems.
2. Become familiar with commonly found organisms of rocky shore.
3. Recognize adaptations of intertidal organisms.
4. Recognize vertical zonation in rocky shore communities.
5. Quantify species diversity and abundance.

Background

Ecologists have long observed the vertical zonation that creates intertidal habitats along the rocky shore. The distribution of organisms in particular zones is consistent with the influence of abiotic and biotic factors. This activity will require students to document the phenomenon of vertical zonation by setting up a transect line from high to low levels and comparing abundances of species along the transect. Because it is impossible to account for every organism in the intertidal, the transect will narrow the field of observation, creating a reference boundary. If a transect is semi-permanent, it can be used to conduct seasonal observations over time. The transect should be long enough and in an area that will properly characterize the ecosystem. Data should be collected on population density for approximately 10-12 intertidal species. Properly identifying the organism is critical and students should be familiar with and equipped with field guides and organism identifiers. The information will be used to discuss the abiotic and biotic factors that affect the distribution and species diversity of the intertidal zone.

Materials

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| <ul style="list-style-type: none"> • Five gallon buckets-to carry equipment • Clipboard, field notebook/paper-see data worksheet • 1 meter quadrats, or hula hoops- quadrats can be made from PVC pipe or wood, recommend drilling holes in pipe/hula hoops to prevent flotation • Field guides for each group • Hydrometer or refractometer for testing salinity • 100mL grad. cylinder | <ul style="list-style-type: none"> • Celsius/Fahrenheit thermometer • Chemical test kits or electronic probes to test water quality • 100m tape measure, or marked nylon rope • Tide chart-*plan well in advance for best tide-very important! • Hand lenses • Shallow plastic containers (Gladware) for short term observations of organisms • Students should dress for the weather, layers work best and wear appropriate footwear, rubber boots preferred or old sneakers that can get wet |
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Field Trip – Transect Activity

Preparation for field trip

One class period: Students should be given an introduction to the activity which includes a demonstration/practice using the equipment, introduction to habitat, review of common organisms, ecosystem etiquette (see below); time to form groups and choose roles for each member; practice setting up transect in hallway or school yard; review map of the field trip area, save precious field time by pre-assigning groups to specific locations of study area. As a class decide on about 10-12 species that everyone is fairly confident identifying, these are the ones that you will census. Not all organisms will be found in every zone. Don't forget the seaweeds!

Field Trip Day

Transect Set-Up

1. Survey the study site and choose an area that has distinct zonation. Lay out the 100m tape measure or marked rope beginning at the Spray zone and extending down to the Subtidal zone, secure each end using a rock or stake. Based on the length of the transect line you can lay your quadrats (1m or 0.5m squares) in a couple of ways:
 - a. *standardized*: generally used for seasonal or yearly comparisons-divide transect length by 10, place quadrats at regular intervals
 - b. *random*: accomplished in two methods-use a random number table to measure off in inches between quadrats, or throw a stone over your shoulder to determine where to begin the next quadrat.
2. Once quadrats are placed count the number of individuals per organism within the quadrat space. If the number is too large to count individually, for example over 100, note 100+ on data sheet. Encourage students to look closely and carefully. They can look under rocks, algae, and ledges as long as they are returned to their original position. Use data worksheet provided.
3. Continue down the transect line completing 10 quadrats. Be sure to work from both sides of the transect line.
4. Observations should be recorded relating to substrate (sand, rock, ledge, boulders), feeding behavior, associations with other organisms.

Collecting Abiotic Data –using data sheet provided

Group members should describe and sketch the general landscape of the study site. A report of the weather conditions is also important. Prominent features such as steepness of slope, wave exposure, man-made elements and influences in the immediate vicinity of study area, etc. Once the general landscape is accounted for, the immediate area of the transect should be sketched and described.

At selected points, within the various zones, along the transect, sample the environmental conditions such as water temperature salinity, pH, dissolved oxygen, duration of exposure to air. These can be obtained using water from a tidepool in the immediate area of the transect. Estimate the amount of time (can be expressed as % of time) the area of a quadrat is submerged through a tidal cycle (low to high to low).

Transect Tips and Hints

- Check your tide charts well in advance to pick the best tide for working the transect. Move from Spray to Subtidal if the tide is going out, work from Subtidal to Spray if tide is coming in.

- Once a procedure has been worked out, students should know to move as quickly as possible through the quadrats. You may be competing with an incoming tide.
- Consistency, consistency, consistency!! Reinforce with students that it is critical that they maintain a consistent procedure with each quadrat. This is important to all scientific observations that are repetitive, to prevent bias.
- Agree as a class before heading out how you will handle organisms that might be located half in and half out of the quadrat.
- Student groups should work together to complete the transect-half of the group sampling the abiotic factors; the other half working the quadrats. Consider having them switch roles if you are planning more than one transect for each group.

Ecosystem Etiquette

Students should be dressed appropriately for the conditions. They should NEVER work with their backs to the water in the lower intertidal, keeping waves in view. All organisms should be returned to the location where they were found. All disturbed rock, seaweed or other substrate should be returned to its original position. Animals should be treated with respect and care.

Carry in, carry out and make every effort to leave no trace!

Data Analysis

Each group will need to note on their data sheet which quadrats were in each of the four intertidal zones of their transect, for example Quadrat 1 and 2 were in Spray zone. All of the data from the quadrats in that zone will be added together and averaged by the number of quadrats. If more than one transect was completed, all the better, pool all of the data or have the entire class pool data to make more accurate statements about the diversity of the area.

There are many methods for visualizing the data. Have the students create graphs and charts to illustrate their observations and records.

Quantifying Biological Diversity

The two main factors taken into account when measuring diversity are richness and evenness. Richness is a measure of the number of different kinds of organisms present in a particular area. For example, species richness is the number of different species present. However, diversity depends not only on richness, but also on evenness. Evenness compares the similarity of the population size of each of the species present.

1. Richness -The number of species per sample is a measure of richness. The more species present in a sample, the 'richer' the sample.

Species richness as a measure on its own takes no account of the number of individuals of each species present. It gives as much weight to those species which have very few individuals as to those which have many individuals. Thus, one periwinkle has as much influence on the richness of an area as 1000 periwinkles.

2. Evenness -Evenness is a measure of the relative abundance of the different species making up the richness of an area.

To give an example, we might have sampled two different fields for wildflowers. The sample from the first field consists of 300 daisies, 335 dandelions and 365 buttercups. The sample from the second field comprises 20 daisies, 49 dandelions and 931 buttercups. Both samples have the

same richness (3 species) and the same total number of individuals (1000). However, the first sample has more evenness than the second. This is because the total number of individuals in the sample is quite evenly distributed between the three species. In the second sample, most of the individuals are buttercups, with only a few daisies and dandelions present. Sample 2 is therefore considered to be less diverse than sample 1.

(Definitions and example from <http://www.countrysideinfo.co.uk/simpsons.htm>)

Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species. The equation looks like this:

$$D = 1 - \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

D = diversity index; Σ = the sum of; N = total number of organisms in the survey; n_i = the number of individuals for each species

Assessment Questions

1. What kind of patterns in distribution of organisms did you observe as you worked along your transect?
2. The adaptations of intertidal organisms are important to their survival. Describe some of the adaptations you observed and relate them to specific environmental factors.
3. You were asked to record the weather conditions during your transect study. Why is weather important to observe? Describe what differences you might observe if the weather conditions were different.
4. Tidepools were encountered during your transect study. How do you explain the differences in salinity, temperature and organisms present in the tidepools along your transect?
5. Compare the data your group collected to another group. How do you explain differences in patterns of organism distribution and abiotic factors? Note any similarities as well.
6. Describe "microhabitats" along your transect. What differences did you observe in organism distribution when compared to the surrounding substrate.
7. Is there any correlation between physical/chemical factors and diversity?
8. Discuss the relationship between species abundance and species diversity.

Vocabulary

Abiotic - the physical factors influencing an organism.

Diversity - the richness and evenness of a group of species.

Evenness - a measure of the similarity of the abundances of different species in a group or community.

Richness - the number of different species in a group or community.

Species - a group of organisms that have the ability to interbreed.

Activity adapted from *Rocky Intertidal Transect Study*, Anne Maben, Los Angeles County Office of Education