



How can teachers connect classroom science-education with the world of scientific research?

Science on Scene

Connecting University Research
and California State Ecology
Standards to Classroom Learning

Importance of Temperature to the Non-Consumptive Effects of Predators in Intertidal Communities



Motivation for Change

"Equipped with his five senses, man explores the universe around him and calls the adventure Science."

~ Edwin Powell Hubble

- Science is enjoyable
- Environmental literacy is paramount
- Students rarely see or hear from real scientists resulting in misconceptions about what science

Themes

- Options for teachers (EL strategies, extensions)
- Learning Ecology through one system: tide pools
- Connecting classroom science to university research
- Engaging students through group work, hands-on activities, and scaffolded tasks

THE ECOLOGY AND EVOLUTION REPORTING CLUSTER

The following 15 California content standards are included in the Ecology and Evolution reporting cluster and are represented in this booklet by 25 test questions. These questions represent only some ways in which these standards may be assessed on the California Biology Standards Test.

CALIFORNIA CONTENT STANDARDS IN THIS REPORTING CLUSTER

Ecology

BI6. **Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:**

BI6. a. *Students know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.

BI6. b. *Students know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

BI6. c. *Students know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.

BI6. d. *Students know* how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.

BI6. e. *Students know* a vital part of an ecosystem is the stability of its producers and decomposers.

BI6. f. *Students know* at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.

Evolution

BI7 **The frequency of an allele in a gene pool of a population depends on many factors**

Curriculum Plan

- Teach CA 9-12 grade Biology Standards of Ecology through the context of tide pools

*Video intro's to 4 lessons/activities

*Photo Transect Lab

Activities

1. Constructing a Food Web
2. Understanding Ecosystem Structure and Energy Flow
3. “The Non-Consumptive Effect” game and data analysis of results from an experiment by Stephen Gosnell
4. Biodiversity Action Plan

Activity 1 – Constructing a Food Web

Ecology – Interactions, Energy, Nutrients, and Change in the Intertidal Community

Ecologist: _____

Date: _____ Period: _____

Activity 1 - Constructing a Food Web



Objectives:

1. Students will be able to define the terms: ecology, biodiversity, producer, consumers, decomposer, detritivore.
2. Students will be able to define and give examples of biotic and abiotic features of an ecosystem, and distinguish between the two.
3. Students will be able to identify producers, consumers, decomposers, and detritivores in the tide pool ecosystem and explain their importance.
4. Students will be able to organize the organisms found in the tide pools into a food web.

1. Define the following terms:

Ecology – _____

Biodiversity – _____

“Biotic” means _____. An example of a biotic feature on an ecosystem is _____.

“Abiotic” means _____. An example of an abiotic feature on an ecosystem is _____.

Activity 1 – Constructing a Food Web

WORD BANK

mussels

sand

sea stars

whelks

rocks

water

anemones

octopuses

sunlight

sea urchins

phytoplankton

kelp

dissolved oxygen

temperature

barnacles

zooplankton

pH

crabs

turbidity(water clarity)

bacteria

2. Correctly categorize each of the terms above by writing them in one of the columns below.

Abiotic	Biotic

Use the following sentences to share with a partner how you decided to categorize terms in the word bank. Read the sentence and fill in the blanks with an appropriate term as you read.

Example:

“ Mussels are a biotic feature of the tide pool ecosystem.”

“ pH is an abiotic feature of the tide pool ecosystem.”

_____ is/are an *abiotic* feature of the tide pool ecosystem.

Activity 1 – Constructing a Food Web

After creating your food web, remove the phytoplankton. Examine the food web and determine what organisms will be affected and how as a result of this alteration of the ecosystem.

Now, each partner should remove an organism and explain how that alteration of the food web impacts the ecosystem using the space provided below.

6. Explain the importance of producers in an ecosystem.

7. Predict what would happen in your food web if an environmental toxin or contaminate caused a large number of the algae to die off in an ecosystem.

8. Suppose that Sea Stars have become a delicacy at many sea food restaurants and the emerging demand for

Activity 2 – Energy and Ecosystems



Activity 3 – Non-Consumptive Effects Game and Data Analysis



Activity 4 – Biodiversity Action Plan



Photo Transect Lab



Concepts

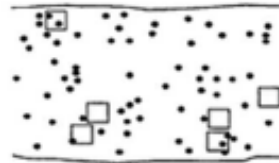
Random

If the question being asked is whether populations (numbers or density of animals) differ at different locations, the focus of the sampling design is to obtain representative samples of the populations being compared. The best statistical design for this question is random sampling within each population (or plot). This reduces the bias that the scientist might make in assigning sampling locations within a plot to denser or sparser areas, unintentionally avoiding edges of the study area, unintentionally aggregating samples etc. A disadvantage of random sampling is that a large number of samples may be required for good statistical power in populations that are patchy or unevenly distributed.

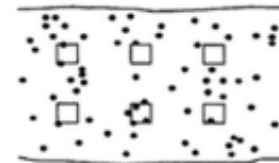
Random number tables can be used to select numbers which can be used, for example, as coordinates for transect lines.

Random sampling is not always feasible, either due to time or physical constraints. Completely random sampling may not be appropriate if populations are obviously distributed in a systematic fashion or if the question being asked is about particular habitats and not the general community. In these latter cases, Systematic (also known as Stratified Random) sampling is a better choice. Other approaches commonly used include systematic sampling and targeted sampling.

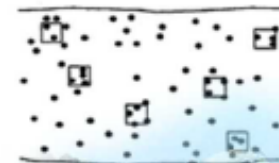
A. Random



B. Systematic



C. Targeted



Why This Curriculum Is Valuable

Students...

- See science
- See scientists
- See students in science
- are engaged in current scientific research

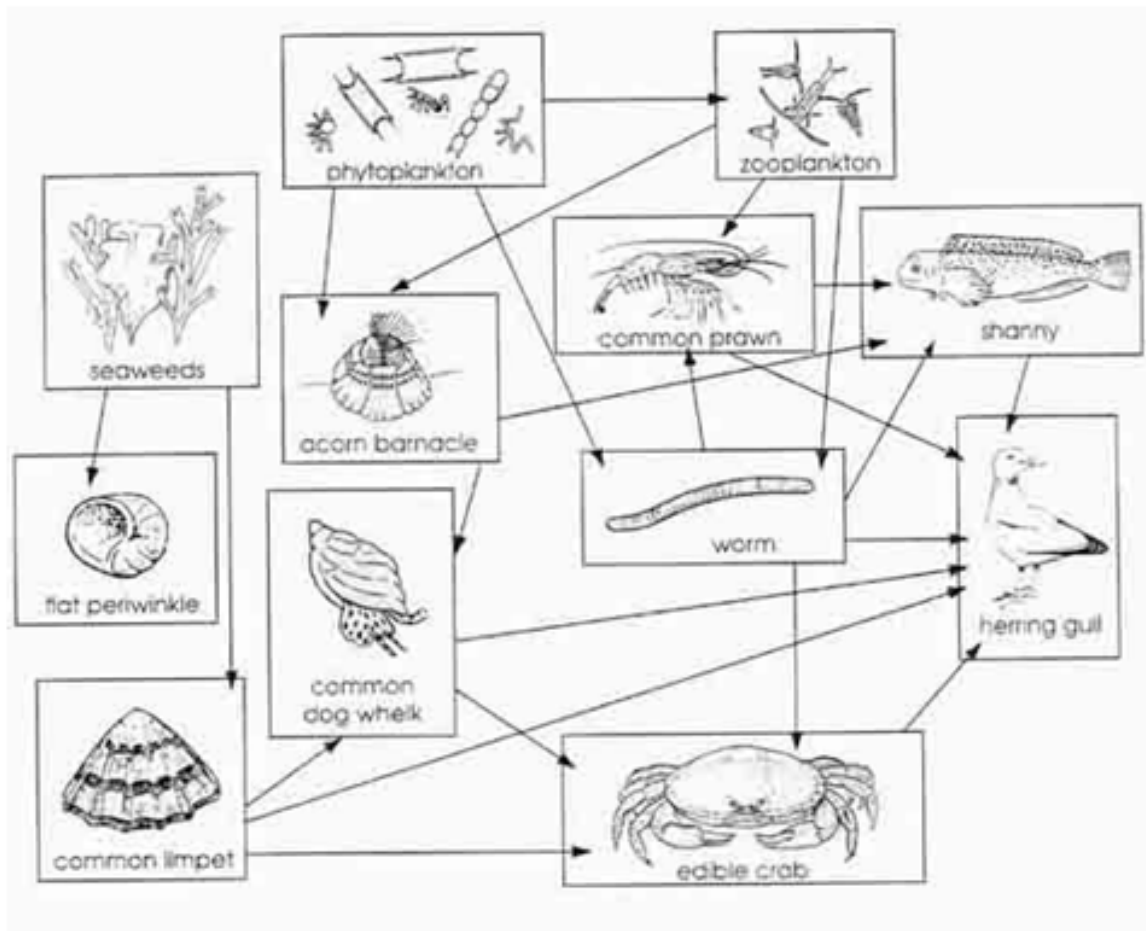


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Activity 2 – Energy and Ecosystems



About 10% of the energy phytoplankton captured from the sun will be available to the acorn barnacle. For example, if there is 240,000 Joules of stored in the biomass of the phytoplankton, only 24,000 Joules of energy will be present in the biomass of the acorn barnacle. This calculation is shown in the example below.

$$240,000\text{J} \times 10\% =$$

$$240,000\text{J} \times .10 = 24,000\text{J}$$

OR just move the decimal to the left:

$$240,000. = 24,000\text{J}$$



5. What percentage of the energy stored in seaweeds is transferred to the flat periwinkle? **(Show your work)**

Assessing Student Learning

- Informal Formative Assessments
 - Weather reports, equity card questions
- Formal Formative Assessments
 - 4 video companion assignments
- Formal Summative assessments
 - Group Biodiversity Project

Formal Formative Assessments of Student Learning

There are 4 assignments to assess student learning for each part of the ecology unit. Objectives are stated on each assignment and are clear and measurable.

Example: Students will be able...

to define

compare

graph

record

give an example of

explain

predict

match

Measuring Proficiency

Each assignment will have a key of correct answers.

Students must be able to complete each assignment with 85% accuracy to demonstrate proficiency.

Summative Assessment

Objective: Given background information on a specific tide pool ecosystem, students will be able to create an action plan designed to maximize biodiversity. This action plan may be in the form of a powerpoint, poster, advertisement pamphlet, song, skit, poem, rap, etc.

Choose one of the following assessment options:

Assessment	Requirements	Max # of group members
Poem	Minimum of 3 stanzas with 4 lines each	2
Rap	Minimum of 3 verses with four lines each. Must also have a beat-boxer	3
Skit	Must in be at least 1 minute in length, and include people	6
Interpretive Dance	Must include a narrator, awesome/perfectly choreographed dance moves	6
Poster	Must include two pictures, labels	2
Powerpoint	Minimum of 3 slides/max. of 10. Must include at least 2 pictures	2

Each assessment must: include a title, define and use important vocabulary.

CATEGORY	4	3	2	1
Content	Project meets all of the following criteria: includes a title that describes the project; correctly uses all of the required vocabulary term, and meet all of the specific requirements for the selected project type.	Project meets all but one of the following criteria: includes a title that describes the project; correctly uses all of the required vocabulary term, and meet all of the specific requirements for the selected project type.	Project does not meet two of the following criteria: includes a title that describes the project; correctly uses all of the required vocabulary term, and meet all of the specific requirements for the selected project type.	Project does not meet three or more of the following criteria: includes a title that describes the project; correctly uses all of the required vocabulary term, and meet all of the specific requirements for the selected project type.
Content Accuracy	All content throughout the presentation is accurate.	Most of the content is accurate but one piece of information that might be inaccurate.	The content is generally accurate, but one or more pieces of information is clearly flawed or inaccurate.	Content is confusing or contains several factual errors.
Use of Graphics	All graphics, fonts, and backgrounds support the theme/content of the presentation by their content, size, and placement.	Most graphics, fonts, and backgrounds support the theme/content of the presentation by their content, size, and placement.	Some graphics, fonts, and backgrounds support the theme/content of the presentation by their content, size, and placement.	Graphics, fonts, and backgrounds distract from or make difficult to read the theme/content of the presentation by their content, size, and placement.
Cooperation	Group delegates tasks and shares responsibility effectively all of the time.	Group delegates tasks and shares responsibility effectively most of the time.	Group delegates tasks and shares responsibility effectively some of the time.	Group often is not effective in delegating tasks and/or sharing responsibility.
Presentation of topic	The topic of the presentation is stated clearly, presenters face the audience, maintain eye contact with the audience, and speak at an appropriate volume at all times .	The topic of the presentation is stated clearly, presenters face the audience, maintain eye contact with the audience, and speak at an appropriate volume most of the time.	The topic of the presentation is not stated clearly, or presenters do not face the audience, maintain eye contact with the audience, or speak at an appropriate volume most of the time.	The topic of the presentation is not stated clearly, and presenters do not face the audience, maintain eye contact with the audience, or speak at an appropriate volume during the presentation.

Required Vocabulary Terms:

biodiversity, ecosystem, abiotic, biotic, trophic level, 10% rule, producer, consumer, decomposer, biogeochemical cycle, population