Hydrology: Background Information & Pre and Post Activities

BACKGROUND INFORMATION

BASIC ECOLOGICAL CONCEPTS

Ecology is the study of the relationships between organisms and their environments. An ecologist asks questions like: Where does this organism live and what characteristics make it particularly suited for that location? How does this organism get its food? What other organisms eat it? By asking questions such as these some basic principles have emerged. Understanding the following basic ecological concepts help us appreciate the complexity of life residing in and around the Bay.

Everything is related to everything else

Perhaps the easiest place to see interdependence in the environment is to look at food. All food on this planet is essentially made by plants through the process of *photosynthesis. Herbivores* are animals, which depend directly on plants for food. *Carnivores* eat herbivores. Take away all of the plants and there would be no animals. Can a plant, then, exist independently of all other organisms? No. Although it doesn't eat, a plant needs *nutrients* and is dependent on *decomposers* (bacteria and fungi) to break down dead organisms, thereby releasing these nutrients for use by the living plant.

Everything depends on something else

All organisms are also dependent on factors in the physical environment. They must have a source of water. Animals must have oxygen to breathe. Plants must have sunlight to perform photosynthesis. You can probably think of many more examples of how organisms are dependent on their environments.

Everything must go somewhere

No object ever disappears completely from the face of the earth. It may be broken down into atoms and be used to build something else, but those atoms are still there. In this way, nature deals with waste by recycling. Any plant or animal that does not become food for some animal becomes food for decomposers, which free the nutrients to be used again. Anything that cannot be decomposed must remain in the environment as it is. What are some examples of this kind of waste? The next time you throw something away, you might remember that there really is no "away" to throw it to.

Earth's resources are limited

How often do you run out of time to do what you want or need to do? Everyone knows that each day only has so much time in it, and that we have to be careful how we use it if we are going to

accomplish everything we need to. The earth's available resources are like time in that we have to be careful how we use them, or they might run out. There is only so much gold, so much petroleum, so much fresh water, so much food, and so much space. All organisms are limited by the availability of resources, but humans have a special opportunity and a special responsibility. Although plants cannot make a decision to conserve clean water, humans can. To do this intelligently we must find out how much of each resource is available and then we must budget our use. We must also think about recycling. The earth can recycle its components naturally but humans must make special efforts to preserve the natural resources.

HYDROLOGY

"Hydro" is the Greek word for water, and "ology" means "the study of." So, hydrology is the study of water. The San Francisco Bay Estuary is a very complex body of water. In the northern part of the Bay, from Suisun Bay to the Golden Gate, fresh water from the Sacramento and San Joaquin rivers flows down toward the dense ocean water, making this mixture estuarine. Since the South Bay is geographically removed from fresh water inflow, and does not have as much circulation as the northern areas, the water is sometimes very close in salinity to ocean water.

SALINITY, TEMPERATURE & OXYGEN

Salinity is a measurement which tells us how much salt is in the water. We measure it in parts per thousand (ppt). The ocean averages about 35ppt. This means for every one thousand buckets of sea water, 35 of those buckets would be salt, and 965 would be water. The salinity of the water is a physical factor that determines which organisms can survive in this habitat. Some can only survive in ocean water and some only in fresh water, but estuarine species have become much more salinity tolerant than ocean or fresh water species. This means that they can survive in high salinity during summer when there is no rainfall, and little fresh water entering the Bay, and also in lower salinity during winter and spring when rainfall brings fresh water from the mountains into the Bay.

Temperature is another physical factor that determines the species of organisms found in the Bay. In the summer, organisms in the South Bay must adapt to warmer temperatures. In the winter and spring, the temperature drops dramatically, and only the adaptable species will survive here. Others will have to migrate to warmer climates. The temperature in the Estuary varies a lot more than in the ocean. Primarily, this is because the ocean is much deeper with a larger volume of water which can absorb heat more easily than the shallow Estuary.

Dissolved oxygen is a third and very important factor since it supports fish and other marine life. Oxygen produced in the oceans and released from solution accounts for most of the oxygen in our atmosphere. There are two ways that oxygen can get into the water, photosynthesis by phytoplankton and by atmospheric exchange. Atmospheric exchange simply means that wind makes contact with waves, thereby mixing the water and air together to form oxygenated water.

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The units of oxygen are measured in %, or milligrams/liter. Temperature and oxygen are directly related. In the summer when temperatures are highest, oxygen levels are very low, because water is less able to hold oxygen in solution as it becomes warmer. For this reason many animals leave the South Bay at this time and travel north to colder and more oxygenated waters.

GLOSSARY

ADAPTATION	Modification of an organism in order to survive within its habitat.
ALGAE	Primitive aquatic plants that lack true stems, roots and leaves. They are in their own kingdom.
BENTHOS	The substrate at the bottom of a body of water; the adjectival form of benthos is benthic.
BIODEGRADABLE	Something capable of being broken down to simple compounds, especially into harmless products, by the action of microorganisms.
BIODIVERSITY	The richness, abundance and variety of life across all trophic levels of which all ecological systems, including the planet earth, are comprised.
BRACKISH	Water that has more salt than fresh water but not as much as seawater.
COMMUNITY	A group of plants or animals living in the same area and depending on one another for survival.
CONSUMER	An organism that gets its nutrients by eating other organisms.
DECOMPOSER	An organism that breaks down organic material and releases simple substances usable by other living things. Examples of decomposers are bacteria and fungi.
DECOMPOSITION	The breakdown of substances into inorganic forms.
DEPOSIT FEEDER	An animal that feeds by ingesting substrate and filtering out the small organic particles on the substrate.
DETRITIVORE	An animal that eats detritus.
DETRITUS	Dead plant and animal material.
DIATOM	A type of microscopic, one-celled photosynthetic organism. All diatoms are surrounded by a silica shell and most are a golden brown in color.
DISSOLVED OXYGEN	Oxygen that has dissolved in water and can be used for respiration.
ECOLOGY	The study of relationships between organisms and their environment.
ENVIRONMENT	The sum of all physical and biological factors that affect an organism.
ESTUARY	A semi-enclosed body of water where salt water and fresh water meet and mix.

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FILTER FEEDER	An animal which extracts food particles by straining the water. Examples of filter feeders are clams, oysters, sponges and some fish.
FOOD CHAIN	A sequence of living organisms in an ecosystem in which members of one level feed on those in the level below and in turn are eaten by those in the level above them.
FOOD WEB	An assemblage of organisms in an ecosystem, including plants, herbivores and carnivores, which shows the relationship of "who eats whom."
HABITAT	The particular area in which an organism normally lives.
HERBIVORE	An animal that eats plants.
INVERTEBRATE	An animal without a backbone.
NUTRIENTS	The raw materials necessary for continuing life processes.
OMNIVORE	An organism that eats both plant and animal material.
PELAGIC	Living or occurring in the open ocean.
PHOTIC ZONE	Upper sunlight portion of the water column. The depth of the photic zone in the ocean ranges from 30 to 200 meters.
PHOTOSYNTHESIS	The process used by plants to make food; in this process light energy is used to combine carbon dioxide and water to make carbohydrates (sugar and starch); oxygen gas is given off as a by-product.
PHYTOPLANKTON	Algae, usually microscopic, which freely drift in the sunlit portions of the water column.
PLANKTON	Drifting aquatic plants and animals; the adjectival form of plankton is planktonic, and a planktonic organism is called a plankter.
POLLUTION	Harmful impact on the environment resulting from human activities.
PREDATOR	An animal that captures other animals for food.
PREY	An animal caught for food.
PRODUCER	An organism that makes its own food; an example of a producer is a green plant.
RESPIRATION	Process used by animals and plants to release energy from food; this process requires oxygen and releases carbon dioxide and water.
SALINITY	The amount of salt in the water. Measured in parts per thousand.
SCAVENGER	An organism that is an opportunistic feeder; scavengers usually include dead and decaying animal flesh in their diets.
SPECIES	A population of plants or animals that are able to produce viable of with each other and not with other species.
TIDES	The daily rise and fall of the sea level along a shore, occurs twice a day on our local shores.
VERTEBRATE	An animal with a backbone. The back bone can be made of bone or of cartilage like in some fish (sharks and rays).
ZOOPLANKTON	Animal plankton.

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PRE-VISIT ACTIVITIES

You may want to ask your librarian to set aside ecology or marine science books for your class, or ask students to bring books and magazines from home to share.

ORGANISM REACTIONS

A. Varying salinity

Have students make wet mounts of a thin section of red onion bulb. Mount in 1% NaCl (salt) solution and observe effects. Flush with fresh water and observe effects. Have students explain the reactions.

B. Varying temperature

Put equal numbers of fruit flies in jars and keep them at different temperatures for a few minutes. Observe relative activity rates. If a pond or other body of water is nearby, measure air and water temperatures at different times of the day to see which environment has more stable temperatures.

PLOP PLOP FIZZ FIZZ (Adapted from biologycorner.com)

Description: In this activity, students will learn the steps of the scientific method by conducting a basic experiment using Alka-Seltzer tablets. Students will determine what factors make a tablet dissolve faster.

Objective: Students will develop and test a hypothesis, analyze data, and draw conclusions. This activity will help students become familiar with the steps of the scientific method.

Grade Level: 4th-8th grade

Set up time: 10 minutes

Activity length: 45 minutes

Materials: Beakers, Alka-Seltzer tablets, tap water, warm water, cold water, salt water, vinegar, beakers, stop watch.

Vocabulary Words: control group, independent variable, responding variable, observation, research, hypothesis, experimental design, analyze, conclusion

Procedure: Print out the work sheet below and have the students record their answers as they conduct the experiment.

Discussion Points: Why were your results the same or different from another student's result? Was your hypothesis correct? Why or why not? If you did this experiment again, would you do anything differently?

Name: _____

Step 1: Question or Observation

Question: What factors will make an alka-seltzer tablet dissolve faster?

Variables to test:
Tap water, Warm water, Cold water, Salt Water, Acidic water (using vinegar)

Of the variables above, which should serve as your CONTROL group? _____

In this experiment, the independent variable is the type of water (warm, salt..etc).

What is the responding variable, or the thing you will be measuring? _____

Step 2: Conduct research by talking to your class mates and finding out what type of water they think Alka seltzer will dissolve faster in.

Step 3: Develop a hypothesis. Finish this statement…

Alka seltzer will dissolve fastest in _____ water, and the slowest in _____ water.

Step 4a.: Experimental design: create your procedure.

Answer these questions regarding your experimental procedure:

A) Will you use a whole tablet or a half a tablet of alka seltzer? _____
B) How will you measure how quickly it dissolves? _____

C) How much water will you place in your beakers? _____
Will this amount be the same in all of your tests? _____
D) What safety precautions should you take? _____

Step 4b: Experimental Design: Data Collection

Type of Water	Dissolve Time

Step 5: Analyze Data: Look at your table, determine which type of water the tablet dissolved in the fastest time.

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Step 6: Draw Conclusion: In a complete sentence, answer your experimental question by summarizing the data.

Step 7: Communicate your results to your class mates. Remember to make eye contact and speak clearly and loudly when presenting your results.

GRAPHING

Make a tide table. Have the students check the newspaper each day for the tides. Then record each day on a graph. Watch how the tides go up and down each day and get higher and lower as the month progresses.

Activities/Curriculum links:

http://aswc.seagrant.uaf.edu/kindergarten/investigation-1.html
https://coast.noaa.gov/estuaries/curriculum/
http://www.waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/teachers/
https://dataintheclassroom.noaa.gov/
http://www.noaa.gov/resource-collections/hands-on-science-activities
https://coast.noaa.gov/estuaries/curriculum/human-impacts-on-estuaries-terrible-spill-in-grand-bay.html
https://sc.club.northwestern.edu/program/curriculum/

POST-VISIT ACTIVITIES

WRITING THANK YOU LETTERS

Write letters to the instructors and/or your class sponsor to tell them about the trip. When we receive letters and pictures back from the kids our instructors remember what a thrill it is to be teachers. The sponsors also enjoy getting direct feedback from the class and teacher to reinforce that they are making a difference for kids learning science. Please include the day, date and time of your trip so we can try to remember your group a little better.

Activities/Curriculum links:

http://aswc.seagrant.uaf.edu/kindergarten/investigation-1.html
https://coast.noaa.gov/estuaries/curriculum/
http://www.waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/teachers/
https://dataintheclassroom.noaa.gov/
http://www.noaa.gov/resource-collections/hands-on-science-activities
https://coast.noaa.gov/estuaries/curriculum/human-impacts-on-estuaries-terrible-spill-in-grand-bay.html
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