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## **Microcosms in the Biosphere and How They Affect Humans**

Curriculum Unit 92.05.11  
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### **INTRODUCTION**

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The earth is made up of many environments which range from the coldest climate to the warmest, from the forest to the desert, from the water to the land, under the ground and in the air. Nestled in all of these environments are some forms of life. These organisms whether large or microscopic interact with other organisms in their environment and community. To learn about these environments, scientist divide the world into separate units called ecosystems. Ecosystems consists of living and non-living things that interacts with one another in a given area.

An ecosystem is defined by the ecologist who is studying it. A fresh water ecosystem may include all wild life in the system, microorganisms, plants in and around the system, pollutants in and around the system, and many things associated with system while keeping in mind that ecosystems overlap and affect one another.

My unit will deal primarily with habitat of marine organisms, three types of symbiosis; commensalism, mutualism, and parasitism, to the atmosphere and back to the earth, water pollution which is cause by water runoff and debris, hypoxia in the Long Island Sound which is in most oxygen depleted areas. The organisms will suffer stress and will eventually suffocate. This can result in fish and other mobile animals leaving the area. Which results in oxygen depletion, toxic contamination, pathogen contamination, floatable debris, and education vocabulary. The students will also develop mini ecosystems using a square meter garden. The students will study microscopic organisms from various systems study how they react to toxins (i.e. gasoline, oil, soap, etc.) and will affect organisms. My unit will also include resources, lessons plans, bibliographies for teachers and students, a vocabulary list. A suggested field trip with Quinnipiac Schooner Inc., around the Long Island Sound, lots of hands on activities are recommended, and the garden ecosystem may be used year round. This unit will be used in the 7th and 8th grades science class for two weeks and the ecosystems study will be ongoing.

An ecosystem is not difficult to find, they are all around you.

## HABITAT

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Everyone needs a home, people and other animals share some basic needs. All animals need a place in which to live, and the environment in which an animal lives is called a habitat. In an animal's habitat is food, water, shelter, adequate space in an arrangement appropriate to the animal's needs. If these components are altered or no longer suitable it can cause an impact. Some of the limiting factors that may cause an impact are disease, predation, pollution, accidents, and climactic conditions. The interrelationship comes about due to the interdependencies between plants and plants, plant and animals, as well as animals and animals. The interrelationships and relationship between the two variables is very important.

When we think of interdependency the term symbiotic comes to mind. A symbiotic relationship occurs when two species of organisms live in close physical contact with each other. There are major types of symbiosis: commensalism, mutualism, and parasitism.

In a commensalism relationship one species obtains food or shelter from another species without seriously harming that organism or providing any benefits in return.

A mutualistic relationship in which two different species live in a symbiotic way where both species benefit in a symbiotic way where both species benefit and are dependent upon the relationship.

Parasitism relationship is a relationship between two species in which the parasite species is nourished at the expense of the host species.

Habitat provides shelter and a place to reproduce. A habitat can be small or very large. The entire ocean is the habitat of the whale. In the habitat of animals they have a role to perform in that community. The job or role is called the organism's niche. Even though organisms may share the same habitat, their niches may and do differ.

Succession describes the ever-changing environment and the gradual process by which one habitat replaces another. Changes in an environment trigger changes in plant and animal population. A pond may be transformed into a marsh, then a forest over a thousand years. Environments are not static but ever-changing.

Extinction is a natural process. Excessive and intensive human activity can cause an acceleration in an environment's extinction of various forms of life.

## WATER CYCLE

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Around the world water symbolizes life. Countries where there is an abundance of water prosper while areas where water is frugal suffer disaster. Many years ago people became knowledgeable of a natural cycle to the flow of water on this planet. Today they still rely on that cycle. Three-fourths of the earth is covered by lakes, streams, rivers, and oceans. There is a continuous circulation of water between the earth's surface and the atmosphere. Earth's surface water is heated by the sun and evaporates. This evaporation process changes liquid water into a gas or vapor. The vapor rises into the atmosphere. In the upper atmosphere the water vapor cools and condenses into liquid droplets, (a more common analogy is water boiling in a covered pan, when the lid is removed you will notice beaded water present on the lid) these droplets form a cloud and

eventually fall back to the earth as precipitation; rain, sleet, snow, hail, and fog.

Most precipitation falls back into the ocean, lakes, rivers, and streams. Some water falls on land and runs off into the aquatic systems, and the cycle repeats itself.

Not all water goes back into the various systems of water but taken in by living things and later returned to the nonliving part of the environment. For example, plants take in water through their roots and release some water vapor through their leaves, this process is called transpiration.

## **MARINE BIOME**

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Some factors that affect ocean organisms are sunlight, temperature, water pressure, and water movement, and because of these factors the ocean can be divided into four zones. Each zone will contain organisms adapted to the conditions. Most marine organisms live near the surface or shore. Many attach themselves to rock while others may burrow into the sand. Along the shore you may find clams, barnacles and sea stars.

Past the low tide line you can find microscopic plants (phytoplankton), living near the surface in order to receive sunlight which aids in food production. Almost all the animals in the ocean depend either directly or indirectly on phytoplankton for food.

## **FRESHWATER BIOME**

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Freshwater biome includes both still and running water. Lakes and ponds are still water while streams and rivers are running water. Temperature, sunlight, the amount of oxygen, food availability and speed of stream, affect fresh water life. Organisms living in fast moving streams have developed special structures to prevent them from being swept away such as strong roots or stems that bend easily, suckers on the body, or streamline bodies.

Fresh water serves as a habitat for organisms such as the water lilies, cattails, algae, fish, water snakes, frogs, and microscopic plants to mention a few. Freshwater biomes may receive visits from ducks, raccoons, and other animals to feed or nest.

The Chesapeake Bay, situated on the eastern coast of the United States, is the largest estuary in the United States. An estuary is the boundary between a freshwater biome and a marine biome. Estuaries include salt marshes, lagoons, mangrove swamps, and that mouth of rivers that empty into an ocean. This area contains both freshwater and saltwater.

Because of the shallowness of estuaries, sunlight can reach all levels of the water. Organisms found growing in estuaries are marsh grass, algae, and all kinds of plant life that provide food for a variety of fish, crabs, oysters, and shrimp (scavengers). It also serves as nurseries for many different types of fish before heading to the open ocean. Many birds can be found nesting there.

The Chesapeake Bay estuary has benefitted man tremendously by producing many crabs, oysters, and fish. It

has enhanced the economy of Virginia and Maryland.

Sometimes the impacts of environmental pollution can be difficult to see, where as at other times they are obvious. A major oil spill causes a potential impact to wild life. Feathers of birds are damaged, embryos are killed because oil seeps into eggs, fish suffocate when gills are clogged, and death comes to marine and terrestrial animals by ingesting food and water contaminated by the oil.

Cleanups are not always successful. The detergents used to clean up the spill and remove the oil from the birds wings can cause damage to the structure and arrangement and water proofing of the feathers. Birds may also be more susceptible to disease during this time of stress, and weakened to the point that it is difficult to secure necessary food and water. Because of the pollution, food and water sources may be affected quality wise.

Animals are threatened when crowded by humans and their discomfort may be displayed by fleeing, grinding of teeth, coiling, hissing, stomping feet, snarling, coughing or woofing. However, flight is the usual way of showing stress. Many animals have certain distances they keep from their own kind. An example is the wolf. The wolf may demand a large range which no other wolf outside their pack may enter.

## **WATER POLLUTION**

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If you took a trip around the Long Island Sound you would encounter several polluting factors. Pollution is described in terms of its source. The term “point source” refers to the discharge of pollution from a fixed located or stationary facility or a single identifiable source such as a pipe, ditch, ship or smokestack. Non-point source pollution refers to sources that do not have a single point of origin or are not introduced into receiving water from a specific outlet. Common non-point sources are water run-off from paved areas that contain oil, brake fluid, antifreeze, or other contaminates; agriculture runoff containing pesticides, sediment, and other pollutants; erosion caused by land grading, and deposition of air pollutants by precipitation.

Tributaries of freshwater entering the Long Island Sound include 70 percent from the Connecticut River, 12 percent from the Housatonic River and 9 percent from the Thames River. Both points and non-point sources of pollution of these rivers occur upstream from Massachusetts and Northern New England. A major source of non-point pollution is runoff from roads.

Studies have revealed that the biological foundation is threatened by the by products of human activity. All flora and fauna, such as fin fish and shell fish are subject to the effects of eutrophication, industrial or municipal discharges toxic pollutants in water and sediments, steam flow diversion, thermal pollution, siltation, and habitat destruction. Also filter feeding shellfish grown in water with high concentration of human sewage may bioaccumulate infectious microorganisms that can be passed on to the human consumers. Sometimes the ingestion of these infectious microorganisms can result in a tragedy (death).

Protecting the Long Island Sound fisheries from pollution will enhance the quality of life in Connecticut’s residents and bring about more tourism which will provide strength to the boating and fishing industries. All of the above will add to Connecticut’s economy because shell fishing and fin fishing are contributors. The winter flounder, lobster, and oyster are the most economically important species in Connecticut. Others are tacetoy, striped bass, blue fish, cod, fluke, shad, salmon, lobster, blue crab, clams, oysters, and scallops.

Connecticut's State Department of Health Services has issued human health advisories regarding consumption of both striped bass and large blue fish, because of the concentrations of PCB's in their tissues. PCB is a cancer causing agent. In the past four years there has not been any new data indicating whether the PCB problem is improving or worsening.

Shell fish obtain food by filtering seawater through their tissues, they can obtain infectious bacteria, viruses, parasites, and toxic chemicals that are present in the seawater. These harmful pathogens may be passed on to the consumer. Biological toxins from marine algae (saxitoxin, shell fish poison) when consumed may cause illness to humans or death.

## **HYPOXIA**

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Human beings depend upon oxygen to sustain life and marine animals depend on oxygen also. These animals use the oxygen dissolved in the water they live in. When the amount of dissolved oxygen in the water falls below a certain level the animals will acquire a condition call hypoxia. Most animals in an oxygen depleted area will suffer stress and eventually suffocate. Some mobile animals may leave the area while the less mobile remaining will be trapped and die if the circumstances are prolonged.

It is believed that in the Long Island Sound the problem is intensified by excess nutrients entering the Sound via sewage treatment plants, runoff, and the atmosphere. In 1987 the Long Island Sound's studies determined that hypoxia is more of a problem in the western half of the Sound. In 1988 the hypoxia conditions were slightly less severe while west of Bridgeport and Port Jefferson showed evidence of oxygen being below acceptable levels.

Microscopic plants (phytoplankton) growth is stimulated by the nutrients nitrogen and phosphorus in order to live. If there is an excess supply of nutrients phytoplankton grows in large quantities.

They produce oxygen during the day and at night they require oxygen for respiration especially when the phytoplankton dies it sinks and uses up still more oxygen from the water.

Hypoxia can occur naturally, especially in summer. This occurs when the sun warms the surface of the water forming a lighter layer that the water below. "This stratification reduces mixing between surface and bottom waters, so oxygen added to the upper part of the water column, through interface with the atmosphere and the photo synthesis of marine plants, is largely prevented from replenishing the oxygen in deeper waters."

Computer models are being developed to better understand the cause of hypoxia.

Hypoxia plays a role in animal reproduction. Studies indicate that the population of some animals (lobsters, window pane flounder) was affected by the presence of hypoxia.

## **TOXIC CONTAMINATION**

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Long Island Sound has had problems with contamination of water fish and sediments. The chemicals responsible for the contamination comes from metal, pesticides, products used in various industries and compounds derived from petroleum or from processes such as burning. There is a big concern about the sufficiently high concentrations of toxins in the Sound because they can be harmful to marine animals and humans who eat seafood from the Sound. In 1986 the Connecticut Department of Environmental Protection and the New York State Department of Environmental Conservation in their monitoring of certain fish and shell fish in the Sound found that some levels of contamination were higher than expected. Concentration of cadmium and PCB's were particularly high in lobsters and hepatpancreus. During the winter of 1987 metals were very low in the edible portion of the fish also the lobster tail and claw meat.

The atmosphere deposited large amounts of copper and lead to the sediments in Central Long Island Sound.

The NS and T Program showed four elements and four classes of organic compounds having average concentration over three years. These concentrations differed among the nine Long Island Sound sites. The elements are silver (Ag), chromin (Cr), mercury (Hg), and lead (Pb). The organic classes are polychlorinated biphenyl (PCB's), polynuclear aromatic hydrocarbons (PAH's), and pesticides (DDT) and chlordane. Mussels and sediments in the Throgs Neck area show a general wester enhancement of contamination.

Contamination in Long Island Sound changes overtime. This change is brought about due to the condition in surrounding water. It is believed that mussel analysis is the best source to determine contamination trends over time.

Damage to DNA, the basic genetic material of an organism, may not affect the health of an animal but it is considered a necessary preclude of the kind of abnormal cell growth that cause tumors. Only one fish in the Sound was found to have liver tumors which was believed to have been contributed to contamination.

## **PATHOGEN CONTAMINATION**

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On a hot and muggy day we all would enjoy the beach. A down side to a frolicking day at the beach is contaminated water. Contamination can be caused by diseased causing microorganisms referred to as pathogens (bacteria and viruses). The disease producing organisms that can cause typhoid, dysentery, diarrhea, cholera and hepatitis. Contaminated water by pathogens can cause both economical and social problems. Pathogens in the Long Island Sound can enter from sewage, wildlife, and storm water runoff. The sewage comes from inadequate municipal treatment plants, failing septic systems, and untreated boat discharge.

There is no test for determining the number of pathogenic organisms, but there is a test that counts indicator organisms. The indicator organisms are coliform bacteria which is commonly found in the intestinal track of humans and other warm blooded animals. These organisms can be found in water runoff. These bacterias are not harmful to humans but their presence indicates other pathogenic organisms may also be present.

## FLOATABLE DEBRIS

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Floatable debris is an eye-sore. It takes away from the beauty of beaches and shorelines, and create health hazards. The debris is made up of an assortment of waste materials. Plastic, metal, paper, wood are some debris that can be suspended in water or washed up on shore. Plastics are the largest category by number of floatable debris. Included in this category are bottles, bags, cups, plates, ropes, diapers, condoms, and polystyrene particles of all sizes. The major sources of floating debris in the Long Island Sound are sewer over flows, storm water out falls, storm runoff and recreational beach and vessel litter.

Floatable debris presents a problem to marine environment, fish, birds, marine mammals, and turtles. These animals can be fatally entangled, especially in six pack rings, and they can ingest floatable debris which can cause suffocation or starvation.

In the past, medical waste was found on beaches all over the country. Although Long Island Sound has been exempted from that type of waste litter there is still a problem of litter washing upon beaches and shorelines.

Marine debris can cause beaches to close because of health hazards.

## EDUCATION

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In an effort to make the public aware of the hazards of pollution and to preserve Long Island Sound, a Public Outreach Program was initiated. Participants to head up the program came from both New York and Connecticut. Management actions were as simple as persuading beach goers to use receptacles for floatable debris or as complicated as upgrading sewage treatment plants to reduce hypoxia. The program presented a myriad of informative activities to the public. Public education includes intensive briefing of public officials to the use of the mass media to inform the public about Long Island Sound Study. Posters on pollution and how citizens can help were distributed to libraries, schools, town halls, and Sound user organizations. Written materials is a major component of the education program. Making the public aware is making an impact on water pollution.

## CONCLUSION

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Organisms live in every ecosystem in the biosphere. There is a constant interaction going on in the various habitats. As changes occur in environments the effect is felt on both plants and animals. the environment is forever changing; nothing remains the same. Water sources are used for recreation and food. However, man has caused many problems in the environment due to his pollution. Because of this plants and animals suffer. Our waterways are polluted, beaches are littered and unattractive, marine life that we depend upon for food contain toxins that are passed on the consumer when consumed some are deadly or cause illness.

There is an effort to educate the public in keeping our beaches, waterways and shoreline clean of all pollution and litter.

*(figure available in print form)*

Sources of Nitrogen to Long Island Sound

(figure available in print form)

Mussel Contamination Over Years 1986, 1987, and 1988

(figure available in print form)

Water Cycle

## VOCABULARY

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Habitat	Symbiosis	Commensalism	Mutualism
Parasitism	Niche	Succession	Extinction
Pollution	Precipitation	Phytoplankton	Biome
Estuary	Ecosystem	Sediment	Tributary
Flora	Fauna	Silt	PCB
Hypoxia	Photosynthesis	Interface	Pathogen

DNA

## LESSON PLAN I

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**Performance Objective** *The students will be able to discuss what takes place in a symbiotic relationship and describe the three major forms in a symbiotic relationship with 100% accuracy.*

### I. ICE BREAKER:

**Materials** medicine dropper, water, and wax paper

- With the medicine dropper drop a drop of water on to the wax paper.
- Have the students write their description of the drop of water and everything that they know about water.
- Have the class share their information verbally and record on the board.

### II. VOCABULARY

Symbiotic Mutation Environment

Habitat Parasitism Succession

Commensalism Niche Extinction

### III. THREE MAJOR FORMS IN A SYMBIOTIC RELATIONSHIP

A. Commensalism

B. Mutualism

C. Parasitism

### IV. REVIEW QUESTIONS

(symbiotic) 1. A \_\_\_\_\_ relationship occurs when two species live in close physical contact with each other.

(one) 2. In a Commensalism relationship *none* of the species obtain food or shelter from the other species.



- (does) 3. A mutualistic relationship *does not* involve a reciprocal relationship where both species benefit.
- (true) 4. Habitat provides shelter and a place to reproduce.
- (ever changing) 5. Succession describes the *stationary* environment and the gradual process by which one habitat replaces the other.
- (false (is)) 6. Extinction is *not* a natural process.
- V. PLAN A FIELD TRIP TO THE WHITNEY WATER CENTER

## LESSON PLAN IV

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### **Performance objective**

1. The students will be able to describe the cause of hypoxia and relate it to problems in the Long Island Sound.
2. The students will be able to list two chemical contaminants in the Long Island Sound.
3. The Students will be able to list physical conditions related to water contamination.

### **Questions**

1. How do you define water pollution?
2. Where do the pollutants come from?
3. What can be done to stop pollution?
4. What happens when you eat from polluted water?

#### I. WATER POLLUTION

- A. How pollutants get into water
- B. Eutrophication
- C. Tributaries
- D. Health Advisories

#### II. HYPOXIA

- A. Stress
- B. Nutrients and Sewage
- C. Microscopic Plants (Phytoplankton)

#### III. TOXIC CONTAMINATION

- A. PCB's
- B. Atmospheric deposits

#### IV. PATHOGEN CONTAMINATION

- A. Disease
- B. Source of Contamination

#### V. FLOATABLE DEBRIS

- A. Health Hazards

Affect  
on  
B. marine  
life

## VI. EDUCATION

### **Activity Building a Garden Ecosystem**

Select an area around the school. Section the area off with some type of marking. Observe any organic and inorganic matter. Be sure to include organisms above, on, and inside the ecosystem. Using a diary make interval recordings of your findings. Use the ecosystem year round. Do not remove any objects from your ecosystem.

**Things to do... measure growth of vegetation, check for small animals (butterflies, flies, gnats, bees, etc.); check for trees, leaves, seeds, bugs, ants, worms, birds (feathers), rocks, new plants, grass, streams (life in the stream microscopic or otherwise), etc.**

## STUDENT'S READING LIST

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