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Flora and Fauna of the Hill Neighborhood

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Introduction

Biodiversity is a concept that touches upon many areas of study. It ranges from how to preserve the globe's vast assortment of genes to counting and cataloguing the species in an ecosystem. It also includes the interactions between species. For instance it looks into trying to determine if there are too few species in an ecosystem, too many, or if the species is too new, as in the case of evasive species. Humans also attempt to put value on biodiversity. Some values are economic some are ecological. Finally, we have cultural priorities on biodiversity, but none of them universal, even within a single society.

The interactions between the various plants animals and micro-organisms in the biosphere serve a great many purposes from scrubbing industrial gasses to regulation of global temperatures and precipitation. In each situation a species not only has an effect on its own local habitat but may also have an effect on the Earth's environment on a whole. In this light, perhaps we can view the Earth's biosphere not just as a collection of species and their isolated interactions but as pieces of a whole organism. This concept is also known as the Gaia hypothesis where the Earth functions like any other organism that seeks to maintain its homeostasis by regulating its many processes.

Human health and well being is tied in very closely with the Gaia concept. There seems to be a direct correlation between the strength and health of a regions biodiversity and the relative health of the people living there. For instance, in our high density urban areas with low biodiversity levels we have very high rates of asthma and other pollutant borne illnesses (Suzuki).

On the other hand as we continue to find new species we will find new relationships with other known species. This could lead to the development of new medicines or techniques. Recently strains of the fungi *Beauveria bassian* and *Thizam anisopliae* have been found to kill malaria mosquitoes. While commercial application is years away this highlights the important role each species has in the world order (Ensirink). The finding of an unnoticed fungus may lead to the creation of a treatment which can lead to the decrease of human suffering.

There are numerous examples of the detriments of humans living in an environment where there is a documented loss of biodiversity. For instance fragmentation of New England forests have led to the removal of the competitors and predators of the white-footed mouse. As a result, the populations of these rodents have

increased giving the deer tick that transmits Lyme a deep reservoir for hosting the disease. In fact, Lyme disease is now the leading vector-borne infectious illness in the United States (Osfeield, SEAM)

Biodiversity issues are extremely important in our cities. In our modern world more and more people will be living in urban areas. It's predicted that by 2015 the growth of urban areas with populations over 1 million people (like Greater New Haven) will have increased by 40% (Crane). Soon there will be far more people living in areas of low biodiversity levels than in high levels. This creates urgency that as science educators we need to address. The urban dwellers will not only be consumers of natural resources from beyond their own environs but also most likely be involved in making laws regarding its use. The more our future citizens understand about the concept of biodiversity the better their decisions will be in the future.

Intended Audience

This unit is written primarily for teachers of AP Biology but can be modified for other levels of High School Biology. Here it is assumed the students have not had formal training in Taxonomy or Ecology. Some students will have heard some of the ecological terms by exposure to mass media such as the Discovery Channel, National Geographic and the movie the "Lion King". The students should finish up this unit with a understanding of how the various organisms are identified by the properties that allow them to be classified. In addition they should develop a vocabulary that allows them to describe how organisms interact with one another to create ecosystems. The teacher will know they really understood the unit when they are able to look at a particular patch of land and begin to describe the ecosystem that thrives there.

Urban Education

It became apparent to me while designing a curriculum unit for the "Ecology and Biodiversity Conservation" Seminar for Oswald Schmitz, that my students need to understand that the environment is everywhere. Many of my students have spent most of their lives in urban or suburban areas. They view their immediate environment as one that consists primarily of a random scattering of trees, shrubs, grass, dogs, squirrels and pigeons. Furthermore they do not differentiate between the various types of trees, shrubs and plants. To the uninitiated urban student a maple tree is the same as an oak tree is the same as a birch tree. I've heard the comment "Mr. Coleman, trees are trees" all too often from my students. They remind me of former President Ronald Reagan's remark regarding redwoods; "If you've seen one then you've seen them all".

Furthermore the students do not understand the relationships and dependencies that exist among these magnificent organisms, with the exception that they will admit that birds build nests in trees. Most of my students think that nature with its vast array of flora and fauna starts somewhere beyond the suburban environs of Hamden. Certainly not here in New Haven. To make matters worse, their Environmental/Ecology textbooks illustrate ecosystems only in rural, woodland or other exotic settings. It is a real challenge to find references to urban biodiversity. It is no wonder that most students think ecosystems only exist in places, far beyond their world.

Unfortunately, my AP Biology curriculum (along with my other biology courses) only briefly touches upon ecology. Time is the major constraint. We are required by the College Board to cover a very broad curriculum in a short time span. When it comes to ecology we are limited to high level discussions in which the emphasis is on vocabulary (herbivore, omnivore carnivore. etc) since only 10 percent of the standardized test questions come from this category. In our ecology lessons we will use the standard illustrations of food webs and food chains. Later, the students will be asked to predict what happens if an organism is removed from a food web. However, these activities do not give the students a full appreciation for a living, breathing ecosystem that starts just outside their front door. Instead, Ecology is viewed as a subject on the same level as Shakespeare or Geometry. They perceive it as just another academic exercise that has little to do with their lives.

Natural and Human History of New Haven

The last glacial period for Connecticut was about 10,000 years ago. When the glaciers retreated they left us with a till of rock, clay and sand. The landscape during the glacial periods was similar to the present tundra regions of Alaska, Canada and Siberia. The later forests were a succession of spruce to pine to a hardwood forest dominated by oaks, chestnuts and birches. This is similar to the forests we see today, with the exception of chestnuts, which were destroyed by blight in the last century

Human interaction in the area began about 10,000 years ago with the arrival of the forefathers of our Native Americans. These peoples settled in to take advantage of the abundance of fishing and hunting (mostly caribou at first then onto other mammals). For their agriculture they altered the land using slash and burn techniques that later resulted in the ideal conditions for blueberry and huckleberry (Hammerson) The last tribe to reside in the New Haven area were the Quinnipiack which feasted on the bountiful oyster beds at City Point

European interaction began in 1614 by Dutch explorer Adrian Block. He named the town and its harbor Roodeburg after the red cliffs of East and West Rocks. Settlement began in earnest on April 24, 1638, when a company of five-hundred English Puritans led by the Reverend John Davenport and Theophilus Eaton, a wealthy London merchant, sailed into the harbor. The area grew slowly at first with the economy relying upon agriculture and trade. After the Civil War the population of New Haven began to grow quickly with its ever expanding industrial base and arrival of waves of immigrates from Ireland, Italy and Eastern Europe. By 1900 the population had swelled to 108,000 people. Today New Havens population is about 124,000 with its economic health coming from manufacturing, communications and the health care fields.

The Neighborhood

Our neighborhood, The Hill, was at one time home to all the various waves of immigrants. It is ideally located within walking distance of he waterfront and rail yards where jobs were readily available Up until the 1950's the neighborhood had distinctive Jewish and Italian populations. (Wollensock) Most of the current residents are African-American and Caribbean-American

Today, the Hill neighborhood embraces the areas encircled by Route 10 Ella Grasso Boulevard to the West,

Legion Avenue to the North. The Metro North Lines run along the southern border. It contains a large variety of multifamily houses that are well aged. The land surrounding the buildings consist of small lots about one tenth of an acre. Neighborhood vegetation is a combination of domesticated grasses and ornamental shrubs. In the few vacant and unkempt lots there is a larger variety of plants. The streets are lined with mature hardwood trees that have been planted over the decades. The largest piece of land is the cemetery, which is frequently mowed and landscaped. It is very likely the Hill receives avian and small mammal visitors from the nearby West River Park that cross the busy Ella Grasso Boulevard

Present Climate

The present climate of the area can be termed as temperate. The mean summer temperature is 70oF with an average monthly precipitation of 20 cm The average winter temperature is 30oF with a average monthly snowfall of 18 cm. Long Island Sound adds a moderating effect, making New Haven a few degrees warmer in the winter than our inland sister cities of Harford and Waterbury. During the summer we will be a few degrees cooler.

The Plants

Plants are currently classified as multicellular organisms composed of eukaryotic cell that are enclosed in walls of cellulose and contain chloroplasts. Plants capture energy from sunlight and convert it to nutrients that will be used by the plant and other the organisms that feed off them. Plants are the foundation of most food webs where they were they are labeled *producers* . Plants are important in our ecosystems since they absorb great quantities of carbon dioxide and release the oxygen we breathe. Plants also take up water from the soil and give up large amounts of water vapor. They provide shelter, building material, a place to lay eggs, and to bear young. They also provide humans with fuel, fertilizer, drugs, pesticides, ornamentation and research material. Plants lay the foundation of most ecosystems where they are the base layer of the biomass pyramid. The biomass pyramid is a measure of all the mass in an ecosystem sorted and accumulated by its role. Roles are defined as producers (the organisms that produce their own food energy). Primary consumers, those organisms that eat the producers also called herbivores. Secondary consumers are those organisms which eat the primary consumers. Secondary consumers are also called carnivores. The tertiary consumers are at the high point of the food chain and will consume the secondary consumer. Plants will make close to 90% of the biomass of most ecosystems.

In biology, the equivalent of a phylum in the plant or fungi kingdom is called a division.The main plant divisions, in the order in which they probably evolved, are the mosses (Division Bryophyta), the ferns (Division Filicophyta), the horsetails (Division Sphenophyta), the Cycads (Division Cycadophyta), the Ginkgo (Division Ginkgophyta), the conifers (Division Pinophyta), the gnetophytes (Division Gnetophyta), and the angiosperms (Division Anthophyta).

Since the purpose of this exercise is to give a high level overview of the identification of the organisms in the neighborhood, the student be able to identify the more common species in our local area with field guides..

Once a plant is identified they can see where a plant falls in the general scheme of classification. They should begin to see the taxonomic trends that exist between the species. AP students need to pay particular attention to the life cycles of each of the major phyla and evolutionary trends.

The mosses are nonvasculated plants that can live in either shady or sunny spots. Often they are found in swamps or bogs. Mosses lack true roots and without a vascular system they are limited in size. They can also be found on bare ground or rocky crevices as pioneer plants where they break down the rock into soil providing a jump point for other plants to begin their colonization in a location that was once barren to them.

Horsetails have only a few dozen species of which 8 grow in Connecticut. These plants are the earliest type of plant with a defined vascular system. Earlier they flourished in swamps of the Carboniferous Period with some species growing the size of a full tree. In Connecticut the few examples of the horsetails are club mosses and spike mosses. They tend to grow in the matted forest floors.

Ferns are another example of an early vascular plant. Vascular tissues allow the movement of water and nutrients far greater distances than by osmotic differences alone. This allows a plant to grow to greater heights than their nonvasculated competitors. They are easily recognized because of the Christmas tree pattern of their fronds. Like the horsetails they were dominant in the Carboniferous Period when fern trees grew to heights exceeding 40 feet.

Conifers are our "evergreens". They are recognized by their needle like leaves that are not shed during the winter. They get their name from the woody cones in which the seeds are borne. Common examples in Connecticut are the white pine, spruce ,hemlock and many ornamental shrubs

Angiosperms are flowering plants that dominate the plant world (80% of all vascular plants are angiosperms). They are indeed the most successful division in terms of sheer number of species. There are a number of reasons for their success most notably the proactive nature of seed production, which allows seeds to be carried to geographic locations beyond the base of the plant. Angiosperms can further be divided into a long list of classes depending upon the number of cotyledons or seed leaves that are found in the embryo. Monocots have one while dicots have two.

Some common families of the monocots include

- Typhascae: the cattails
- Gramineae: the grasses bamboo, and cereal grains
- Liliacaeae; the lilies, onion and tulips

Some of the more common dicot families include

- Salincaceae: willows, populars, and cottonwoods
- Juglandaceae: walnuts and hickory
- Aceraceae: maples

- Ericaaceae: laurels rhododendrons, azalea, and heather

The Animals

Organisms that comprise the Kingdom of Animalia are distinguished by being multicellular eukaryotic and heterotophic (do not produce their own food). Animals lack cell walls. Muscle and nervous tissues can only be found in animals. Sexual reproduction is done by most species and the major part of the life cycle is diploid. Many species undergo metamorphosis that transforms them from the larval to adult stages. In addition most species we study will have 3 tissue layers the endoderm, mesoderm and ectoderm that is formed from the gastulation of the blastulla. Animals are also heterotophs in in in that they get their food energy by eating other organisms. In this manner they comprise the consumer layers of the most food webs.

The animal Kingdom has been divided into 35 phylum. In our unit we will focus on the collection and identification of terrestrial Arthropods (insects), Chordates(amphibians, reptiles mammals and birds) and the Annelida (segmented worms like earthworms).

Annelids

Annelids are segmented worms that are characterized by their bilateral symmetry (as opposed to the radial symmetry found in lower animals) and are segmented. They are interesting to study since phylogenticaly they are somewhere between earliest multi cellular animals and the very complicated insects. Annelids have closed circulatory systems. The exchange of oxygen and carbon dioxide occurs on its moist skin.

Since there are only 26 species of annelids and most of them are aquatic, Annelid collection and identification will be limited to earthworms. We will use them primarily as a soil health indicator. When you find them in sufficient numbers in a particular area you can be assured the soil has a recent history of sufficient moisture content. They are beneficial to an ecosystem because they loosen the soil thereby increasing air and water penetration. Darwin estimated that an acre of British farmland contained 50,000 earthworms that produced 18 tons of castings per year. They also provide a robust meal for some of the bird populations that will visit the neighborhood. It is important for the students to recognize that the various insect larvae they will find latter on are not worms

Arthropods

The arthropod collections allow the students to get a taste of the diversity of these creatures even in urban environments. We will attempt to identify each specimen collected to its genus and species; however, if they recognize the major classes of the insects then they will have achieved a good amount.

One of the arthropods classes we will study are the insects. The other classes such as the arachnids (spiders, ticks etc) and crustaceans (generally aquatics species such as the crabs) we will ignore for now.

The shear numbers of insect species is an indicator of how successful they have become. There are over 900,000 known species of insects versus 38,000 known vertebrate species. Representatives of these animals in almost any land climate zone except the Antarctic zones. They are small animals with three body parts head, thorax and abdomen six legs a pair of antennae. Most of them contain a double pair of wings (With the exception of the fly family which have one pair). Their body is supported by a tough exoskeleton. This tough outer skeleton is called the cuticle. The cuticle is composed of a layer of wax and chitin. These materials make the cuticle impermeable to water. It acts as a medieval suite of armor, protecting the insect from dilute acids, alkalis and organic solvents. Thus designing an insecticide is no simple matter.

The most complicated feature of insects is the mouth. There are a two basic variations in the structure and purpose of insect mouths. First is the very primitive mandibulate version used for crushing and chewing. The other is the haustellete version used for sucking.

Insects play an extremely valuable role in any ecosystem. The relationship between plants and insects is so close it is doubtful whether the evolution of the angiosperms could have proceeded without them. Plants and insects have evolved to the point where often one species of plant will be totally dependent upon a single species of insect to survive. Humans have become dependent upon these animals as well. We depend upon them to pollinate our fruits, vegetables and field crops. Mention could be made as well of the predatory and parasitic varieties that help to keep down the insects that could cause unfathomable damage to our agriculture.

The major classes of insects we expect to find

· **Coleoptera-** Has two pairs of wings. The fore wings are hardened to form a protective cover. The hind wings are membranous. Mouth parts are mandibulate. Larvae (also called grubs) usually eat the same food as their parents.

· **Diptera** – Only has one pair of wings which are membranous. Mouth parts are designed for the food source they seek. Larvae (called maggots) prefer moist areas. Examples include the horse fly, house fly, crane flies mosquitoes, midges and the fruit fly (which we will use later in genetics)

· **Hemitptera** or true bugs. These insects have two pairs of wings. The forewings are partly thickened the hind wings are membranous and fold over the body. Their young are nymphs in that they resemble adults. Examples include the water bug, bed bug and stink bug

· **Hymenoptera** - These are the bees, ants and wasps. Have two pairs of membranous wings. The forewings are much bigger than the hind wings. Wings are absent in ants unless for reproduction phase. Most varied of orders in terms of feeding. Bees gather pollen, some feed on nectar, others are predatory or parasitic. Larvae

usually do not eat same type of food as adults

· **Isoptera** - Have no wings unless in the reproductive phases. Tend to be found in the wood and the ground and are social. Examples include Termites

· **Lepidoptera -** Two pairs of wings of differing size and shape. Mouth parts are haustellete and specifically designed for siphoning. Generally feed off the nectar of flowers Larvae are called caterpillars and do not resemble adults. Examples are the moths and butterflies.

· **Orthoptera** – Winged insects with gradual or simple metamorphosis. Examples of this call would be the grasshopper, crickets and cockroaches

· **Odanta** - Have two pairs of membranous wings about equal in size. Mouth is designed for chewing. Examples of this class are the dragonflies and damselflies

The Chordates or Vertebrates

This phylum may be the most interesting for our students to study because they are the most familiar to them. They are distinguished by there endoskeleton composed primarily of cartilage or bone. This phylum is represented by fish, amphibians, reptile mammals and birds. Their forms and life histories are easily familiar to our students. However, in New Haven are restricted by state and municipal regulation about capture of these animals so collecting specimens for laboratory identification is out of the question. We will concentrate on visual identification and counting.

Class Room Activities

Note at Career High School we are blessed with 80 minute block schedules These classroom activities are designed to fit within this class structure. Teachers with other schedules can easily modify the activities to fit their structure

Class 1: What is a plant?

In this class the students will explore the properties of plants. The students will look at various structures like the leaf and root to explore the concepts of structure and function. Students should finish this unit with a understanding of plant cell structures and important plant organs. Photosynthesis may or may not be introduced depending upon time frame. In addition AP Transpiration Lab 9 may be done as a follow up exercise

Objective

· Students will be able to identify the major structures of a flowering plant.

Materials needed

· Microscopes

· Prepared slides of various plant cells

· Pressed dry mount leaf collections of trees found around the neighborhood

Procedures and Activities

1. Start off the unit with the general discussion question, "What makes a plant a plant?". This a brain storm question where answers are written only on a board with minimal effort to keep it structured. Try to get the students imaginations going in every direction from what is a plant's cell structure to their role in the ecosystem. It maybe helpful to have a prop for them to focus on. I often bring in my pet rabbit and a geranium. Students should also take notes on all ideas presented. Other alternatives would be to use mind mapping software where ideas can be captured on computer and expanded for future use or a smart board.

2. Have students examine the prepared slides of various plant tissues. The students should make detailed drawings in their notebooks. Have them label the nucleus, cell wall, chloroplasts etc. Have them correlate their drawings to any that might be found in their text book. For example after sketching an example of a root hair the student will describe the structure purpose of the root and root hair. The student should also note what importance the root is for ecosystems. They should note how it provides a good food source for some herbivores and helps to prevent erosion by holding onto the soil around it.

3. If time permits go back to the general question "What makes a plant a plant?" The students answers should now be much more deliberate and detailed.

Evaluation

The teacher should walk around the classroom during the examination of the plant tissues. Questions should be asked of each student asking them what is it that they see in each slide now, how is it different from the previous slide. At the end of this session their notebooks should be filled with ideas and concepts

Homework

· Have students read the chapters in their text book on plant structure.

· Complete a list of defined words.

Class 2 Plant Biodiversity

In this class the students will be taken outdoors to get a first hand appreciation of the number of plants that exists right outside our doors. First they need to aware of the different phyla or divisions of plants. Students should be aware how they possibly evolved from green algae. As each division is introduced be sure to include evolutionary adaptations that helped the phyla to thrive in its surroundings. It's a good idea to center your discussion with plants they will most likely encounter in the vicinity of the school by introducing them using a field guide. When the students are outside they should look at the various identification properties of plants. Trees are a good starting point since many trees can be identified by the shape of their leaves, texture of their

bark and the shape of the seed. As you examine each specimen make sure they the take notes to the following questions Where is the plant is located? Is it in full sun or shady conditions? Are there any animals that feed on it? Does it provide shelter for any other animal? Does it compete with any other plants? Does it look healthy?

Also look at soil conditions in your area. What kind of soil is it? What is its Ph? What is its moisture content? Explore reasons why the plant density and diversity is the way it is.

Objectives

· Students will be able to describe the major plant phyla (divisions) and describe the life cycle of each of them.

· Student will identify the plants found in the neighborhood.

Materials needed

· Live examples of various plant types (ferns, moss, conifer etc)

· Examples of plant pressings from common plant from around the neighborhood

· PowerPoint presentations of each of the major plant divisions found in New Haven

· Various plant identification booklists

Activities and Procedures

1) With the examples of a moss and an angiosperm, ask the students to compare and contrast the differences between the plants we see here. Look at their leaves, stems, and height? How do they reproduce?

2) Show students a power point project of each of the major plant divisions. Showing each phlya's identification properties and reproduction methods.

3) Introduce the terms biotic, abiotic factors and competition

4) Bring the students on a walk around the neighborhood. Students will be asked to identify tree and grass species using the field guides provided. Student should take note of density, health, shade, nearby plants and soil conditions.

If by chance the weather is uncooperative arrangements could be made to visit the local natural history museum where they may have the local flora catalogued. In New Haven we have access to the Herbanium at Yale-Peabody Museum where there are thousands of mounted specimens from the area dating back to the early nineteenth century.

Homework assignment

1) Students will make their own power point presentation on each of the major plant phyla covered. Teachers hint: Use the best ones for next year's demonstration.

2) Student will make a dried plant collection of various assigned local plants

Class 3 What are the Animals?

In this class the students look at what is the difference between a plant and an animal. The students should be clear in their understanding that animals are heterotrophs while the plants they studied earlier are autotrophs. The AP curriculum places a major emphasis on structure and function. Teachers should work on building the students vocabulary of animal anatomy. The class could be broken up into several other classes with dissections of several diversified species **.**

Objectives.

· Students will be able to identify the major properties of animal identification

Materials needed

· Microscope(s)

· Prepared slides of various animal cells

· Prepared animal specimens for demonstration

· Access to the internet.

Activities and Procedures

1) Start the class with a high level conversation of the properties of the animals. It might even be a good idea to bring in the rabbit and geranium from the first class again so the students have some thing to focus their attention on.

2) Take the students down to the computer lab with a detailed list of questions you would like them to answer about the animals.

· What are the 3 dermal layers found in many species,

· What organs will be found in each dermal layer?

· What types of symmetry do we find in animals?.

· Make sure you use high order cognitive questions since students are very tempted to use cut and paste answers

3) Have student look at the animal cells on the microscopes. See if they notice the lack of cell walls.

Evaluation

The teacher should walk around the computer lab during the research time. Ask each student a follow up question. Gage how well she or he will answer without using their notes

Homework

Have students read the chapters in their text book on the animal structure and animal phylogenetics

Complete a list of defined words.

Class 4 Animal Biodiversity

In this unit the students will begin to get a appreciation for the spectrum of animal diversity we have in our neighborhood. The class starts with exploring the terrestrial animal phylum looking at their form and structure. Emphasis will be made on evolution of features from phylum to phylum. We will also look at the properties that will allow us to identify a species. Later we will go outside to see what we have learned by trying to identify some of the animals we come across. While we are outside the students will also be encouraged to describe the surrounding biotic and abiotic factors that may affect each individual organism we encounter.

Objectives

· Students will be able to describe terrestrial animal phyla including life cycle.

· Students will be able to identify the animals found in the neighborhood.

Materials needed .

· Insect collections from around the neighborhood

· Various plant identification books

Activities and Procedures

1) Start with another brainstorming session of what is the difference between the various animals we see here. How are they the same how are they different? Look at their legs, body segments, locomotion, methods of food procurement How do they reproduce?

2) Begin a discussion on the various phyla with the division between the vertebrates and invertebrates. Emphasis should be placed on the insects since they are the most numerous in terms of total species.

3) Bring the students on a walk around the neighborhood. Students will try to identify various animals they see using the field guides provided. Student should take note of health and shade, nearby plants and soil conditions. Introduce again the terms biotic and abiotic factors and competition

Homework assignment

1) Students will make their own power point presentation on each animal phyla covered. Teachers hint: Use the best ones for next years demonstration.

2) Students will make a insect collection of various assigned local insects.

Class 5 Exploring a habitat

Up to this time all the species have been looked at in isolation. The students can identify many plant and animal species and recall their lifecycles. The students will go outside and quantify the relationship between plant and animal species in a habitat. The students will mark off an area and count the number of species they find. When they get back to the classroom they can compare notes and try to induce an explanation for their findings. In the end of this class they should come to realize how reliant each species is upon other species for food and protection.

Objectives

· Students will count the number of plant and animals species in an assigned area.

· Students will quantify the relationship between plant diversity and animal diversity.

Materials Needed

· Insect nets

· Tweezers

· Magnifying glasses

· Collecting jars

· Hand trowels

· String and stakes

· Field guides

· Meter sticks

· Soil test kit

Activities and procedures :

1). Students will go outdoors to an assigned area in teams of 2. They will mark out an area outdoors in of 1 meter by 1 meter. Now they will identify and count the different plant species in their plot. Next they will identify and count the number of animal species they find. Most probably they will mostly find insects or other Arthropods. Remind them that insect larvae can be found in the soil.

2) Have them now extend the study area out to a 2 meter by 2 meter area. Follow the same counting procedures as above

3) Extend your collection area to 9 square meters. Follow the collection and identification techniques as above. If time permits you may extend the subsequent collection areas to 16, 25 and 36 square meters

4) Have students take notes of abiotic factors in their habitat such as temperature, date, time, shade

conditions and soil condition whether the field was mowed.

5) Back in the classroom have the students share their results with each other . They should also make the following line graphs using their own team's data: Plant specie count versus size of collection area, Animal specie count versus size of collection area. Then, using combined data plot number of species of animal versus number of species of plants.

Evaluation

For classroom discussion ask the students the following questions

1) Why did each team have different specie densities? The students should be looking at possible differences in the abiotic factors. Perhaps pesticides or herbicides are used in one region of study but not in others.

2) What is the correlation between plant diversity and animal diversity? The results should produce a positive correlation between the two factors since the more types of plants there are in an area the more types of animals that can feed off it.

3) Ask the students what can be done to increase the biodiversity in their own neighborhoods.

Homework

· Students should create a lab report on their findings

Extended works

Perhaps later you can bring the students back to the same areas at a different season to compare the effects of seasonality on biodiversity. Also take a field trip to a totally different environment and perform the experiment again. This would be a good way to compare the productivity of urban versus rural areas.

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A dissertation by John Holland for his senior year thesis. Looks at the possible correlation between mowed vs. not mowed lawn and its effects upon species biodiversity of several sites around Boston. A good article to show how biodiversity studies are conducted.

http://cals.arizona.edu/pubs/adjunct/snr0704/snr07041e.pdf

A research paper which looks at the biodiversity of the European cities of Berlin and Potsdam

Similar NHTI Work on Environmental Issues in New Haven

1993 The Mill River: An Outdoor Laboratory by Lise Orville

1979 Environment of Fair Haven by David A. Cicarella