4-H Member Guide

Units 7 & 8

Grades 11 & 12

Agricultural Extension Service
The University of Tennessee

PB 1441

WILDLIFE

Terrestrial and Aquatic Ecology

Name

Club

Contents

Objectives

1. Better understand principles involved in both terrestrial and aquatic ecology.

2. Develop a plan and prioritize attainable goals to complete an ecology project.

3. Better appreciate the concept of the interrelatedness of life and energy sources.

4. Learn complexities of terrestrial communities and the relationships that are taking place.

5. Learn complexities of aquatic communities and the relationships that are taking place.

Requirements

To complete this project you must fulfill the following requirements:

1. Complete in detail at least one main activity among those described on pages 12 to 27 and 31 to 35. You may also want to explore some of the other activites in order to broaden your experience.

2. Keep good record and put together a record book. Be sure to include a neat copy of field notes at the end of your record.

3. Take photographs of your most interesting investigations. Include the best ones in your project activity report.

4. Give a report or demonstration to your 4-H club or other group for each activity you complete.

5. Complete at least one Leadership/Citizenship activity.

Terrestrial and Aquatic Ecology

Tom Hill, Professor, and Craig Harper, Assistant Professor,
Forestry, Wildlife and Fisheries

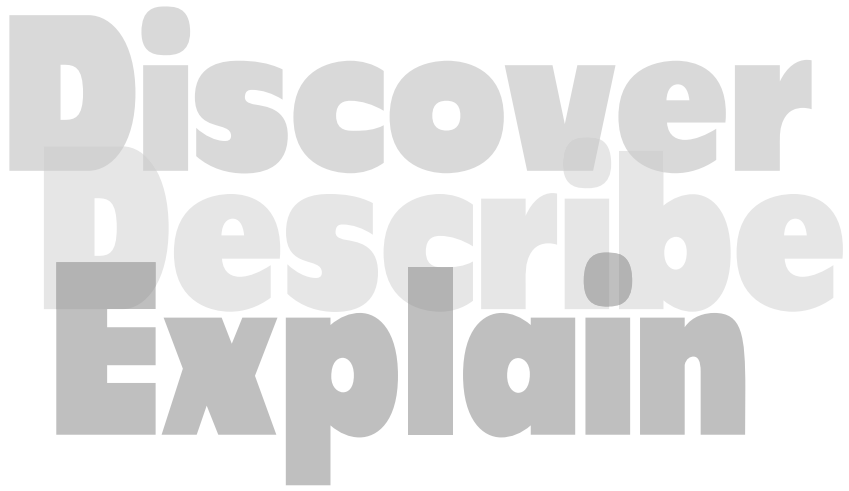
Introduction

With this manual as a guide, you will study some of the principles of wildlife and fisheries ecology. You will look specifically at plant and animal communities in different types of environments in Tennessee.

This manual is designed to give you project ideas, stimulate your interest, outline some steps to take and tell you where to go for more detailed information. Some suggested activities are listed on pages 12 to 27.

Try to do as many activities as possible, but do not become overwhelmed by trying to complete them all. It is better to do a few things well than everything half-well. You do not have to follow suggestions in the manual step by step. Be original. Come up with some ideas of your own and talk them over with your 4-H leader. Remember, the more effort you put into your project, the more you will get out of it and the better chance you will have to win awards. You can also discuss your ideas with professional natural resources people, school teachers and agricultural department employees.

A glossary and list of references are found in the back of this manual. The glossary is an alphabetically arranged list of words found in the manual, including definitions. The glossary words are bold in the text. The reference list at the end of the text is a list of books, pamphlets and Web sites for those interested in further exploring the ecology field. For films, slide sets and videos, ask your 4-H agent for a copy of *Wildlife Conservation Films, Slide Sets and Videos.*



The scientific approach is to discover, describe, and then explain "why." Once you discover something through your project, you should then attempt to describe it and explain why to others through a demonstration.

The purpose of a demonstration is to show others what you learned in the project. For example, seeds may be used to show different wildlife foods. While collecting seeds, you can learn how to identify them and also which species of wildlife eat which seeds. A seed collection in itself is not a demonstration, only a visual aid. The emphasis of the demonstration should be what was learned from collecting the seeds.

Project Plan

Project:_____ Year: _____

What I want to do and learn in this project (goals): _____

_____

_____

_____

_____

How I plan to reach my goals: _____

_____

_____

_____

_____

Resources I can use: _____

_____

_____

_____

_____

Signed:

_____ _____

4-H Member Parent/Guardian

Date: _____

Principles of Ecology

Ecology

Ecology is a word often heard on radio and TV and seen regularly in newspapers and magazines. Frequently, it is misused as a synonym for the word environment or in reference to the anti-pollution campaign. In reality, ecology is a science. It is the study of organisms (including man) in relationship to their environment.

Derived from the Greek work ***oikos***, meaning house or home, ecology is concerned with plants and animals in their homes or habitats, their interrelationships and the environmental factors that affect them. By understanding ecological principles, we gain a better understanding of the earth and how plants and animals interact and depend on one another.

The Ecosystem

The basic unit of ecological study is the ecosystem, a self-sustaining system in which living organisms and their non-living environment interact to exchange energy and materials. All systems operate to form the biosphere, that part of the earth which supports life, and includes the atmosphere, bodies of water and soil to a depth of several feet. Ecologists usually study communities which are systems (e.g., a pond, marsh, forest or self-contained aquarium). Within the ecosystem, water and materials are being recycled constantly. Energy, which originates in the sun and is necessary for life, is used by green plants to produce sugars through photosynthesis. This process manufactures fuel that keeps the whole living world going. The living organisms that make up an ecosystem can be divided into three major groups:

1. **Producers** are green plants that use sunlight to manufacture food from nutrients found in the soil.

2. **Consumers** cannot manufacture food and must obtain it by eating other animals and plants. All animals are included in this group. Herbivores, or plant-eaters, are primary consumers and are also a source of food for carnivores.

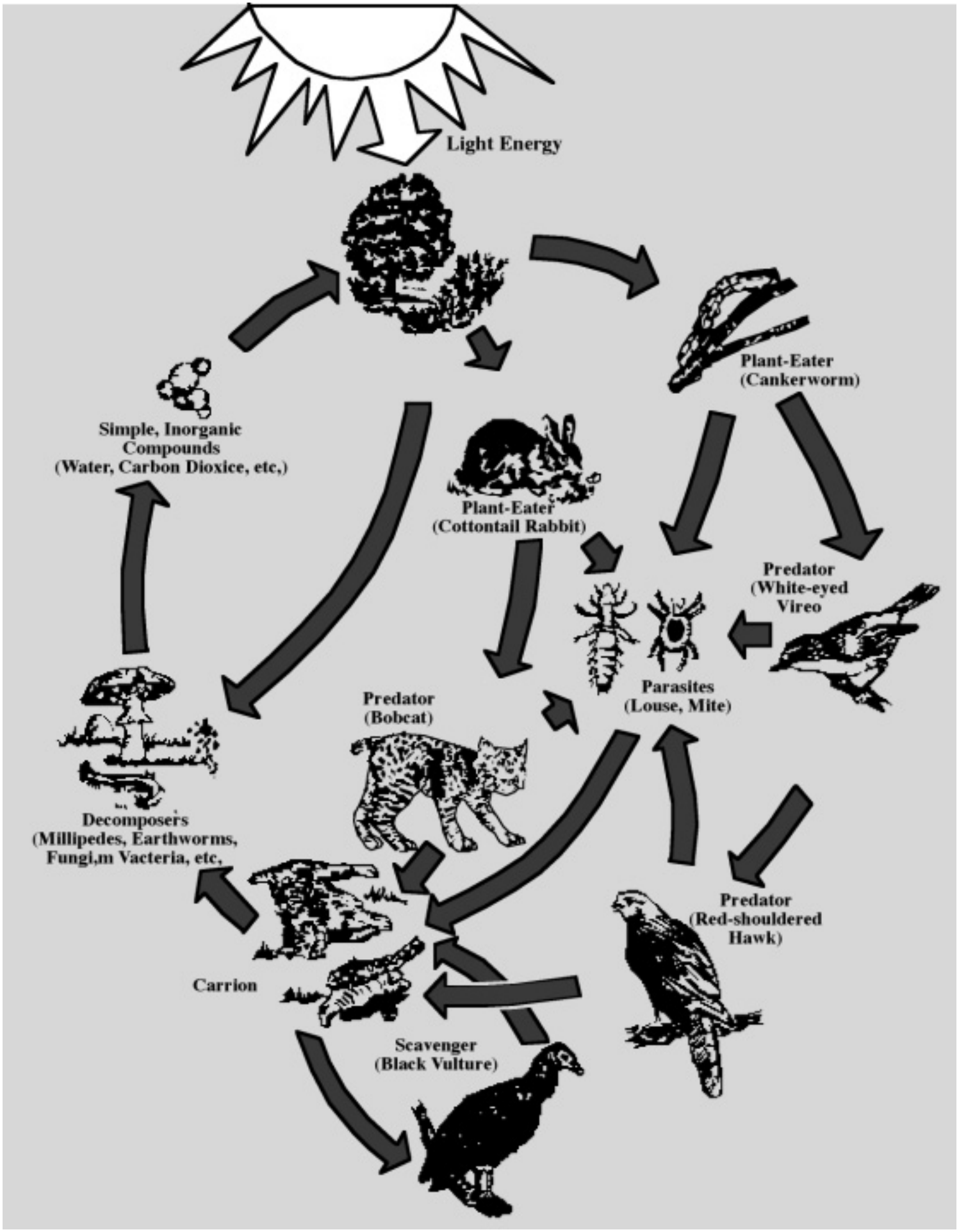
3. **Decomposers**, are usually bacteria and fungi, which break down the complex substances of dead plants and animals into simple substances, which then are available once again for use by producers.

The Energy Cycle

All of the energy of life comes from oxidation, the burning of sugars, as an infinite variety of chemical changes take place before they finally end up once more as water and carbon dioxide. Plants use some of their own sugars for living and growing, but the large surpluses they produce support the rest of the organic world.

Animals are consumers. They either live off green plants directly, or indirectly by eating other animals that live off plants. Animals give recyclable chemicals back to plants through excretion of body wastes or through decomposition of their dead bodies. Decomposers break down dead plants and animals and enable their components to be returned to the environment and be reused. Thus, these non-living parts of the ecosystem are cycled from the environment to living organisms and back to the environment.

At each step in the food chain, much of the potential energy is lost as heat. Such energy loss limits the number of steps in the food chain to four or five. Energy, which originates in the sun and is necessary for life, cannot be recycled and is lost as it flows one way through the system. The illustration on the next page is a good example of how this takes place.


Light Energy
Plant-Eater
(Cankerworm)
Simple, Inorganic
Compounds
(Water, Carbon Dioxice, etc,)
Plant-Eater
(Cottontail Rabbit)
Predator
(White-eyed
Vireo
Parasites
(Louse, Mite)
Predator
(Bobcat)
Decomposers
(Millipedes, Earthworms,
Fungi,m Vacteria, etc,
Predator
(Red-shouldered
Hawk)
Carrion
Scavenger
(Black Vulture)

Habitat and Niche

Habitat is the place where an organism lives. For example, the habitat of waternet (an algae) is a quiet pond, while a robin's habitat may be a suburban garden. Habitat requirements are not simple. The requirements are suitable food, cover, water and space. Physical factors such as light, heat and moisture must not exceed the organism's limit of tolerance. Through the years, plants and animals have developed adaptations such as periods of dormancy, hibernation, cyst formation and changes in body structure, which enable them to live through unfavorable periods.

Niche refers to an organism's role within its habitat. This includes all aspects of its structure, behavior and activities. For example, the ecological niche of an owl might be defined as a nocturnal, carnivorous, predatory bird. Some organisms occupy several different niches during their life histories. For example, a mosquito in the larval stage of life lives in shallow water habitats as a primary consumer, but occupies an entirely different habitat and niche as an adult.

The Community

The biotic community is the living part of an ecosystem, and may be defined as a group of plant and animal populations living together (interacting with one another) in a particular habitat. Organisms are related in food chains, and all the food chains of a community make up a food web. Each organism in the community occupies a particular niche. The most complex communities have the most niches occupied and, therefore, are more diverse. Complex communities usually are the most stable, because they are least likely to be affected by change.

In some communities, one or several species may be dominant. Dominant species are usually plants. These plants are the most common, convert the most energy, moderate the climate for the other organisms, and often provide a major source of food and shelter. Communities, such as an oak/hickory forest, often are named after the dominant species.

The kinds and numbers of species in an area typically are determined by physical environmental factors. In areas where physical factors change, there will be a transition zone between two communities called an ecotone. In an ecotone, plant species from both communities will be found and a diversity of wildlife species.

The terrestrial community on a typical farm in Tennessee includes the cottontail rabbit, hayfields, northern bobwhite quail and grain. Also present is the woodlot, containing foxes, trees, deer and songbirds. Other members of the community include the meadow mouse, stream bank willow, dogwood, opossum, skunk and sparrow hawk. Still others are fence-row trees and shrubs, groundhogs, blacksnakes and weasels. The cottontail rabbit, groundhog and meadow mouse eat from the same clover field, are found in the same fencerow and end up as food for a fox or hawk. The skunk seeks refuge in a groundhog burrow, searches fields and travel lanes for grubs and mice, and occasionally finds and feasts on birds' eggs. Eventually, an owl, nesting in an old dead snag in the woodlot, may prey upon the skunk. A hawk hovers over the hayfield and dives for insects and mice to feed itself and its young family. All plant and animal members of a community live and function in their own place, filling their niche. See how complex a community can be?

The Interrelatedness of Life

Interrelatedness is a key concept in ecology. For example, a plant may tolerate different extremes of temperature depending on the amount of moisture available. And, as environmental factors are interrelated, so are the biological factors. Man, at the top of many food chains, is dependent on phytoplankton or grasses at the bottom of those chains.

Aside from the obvious food chain relationships, relationships between predator-prey or host-parasite communities contain numerous interrelationships of which we are not fully aware. Man is now beginning to understand the

Wetland communities —

Wetland communities represent transitional areas between terrestrial and aquatic systems. The water table usually is at or near the land surface. Water creates severe physiological problems for plants and animals that are not adapted for life in water or saturated soil.

When this country was settled about 300 years ago, there were about 221 million acres of wetlands. From then until now, wetlands have been drained, dredged, filled, leveled and flooded to the extent that 22 states have lost 50 percent or more of their original wetlands, and 10 states have lost 70 percent or more of their original wetlands. Tennessee has lost 59 percent of its wetlands during this time period.

Wetlands are critical ecosystems because they help regulate and maintain the hydrology of rivers, lakes and streams by storing and slowly releasing flood waters. Wetlands also are critical to many fish and wildlife populations by providing habitat and resources needed for survival. Wetlands also serve as "sinks" for erosion and runoff, thus perpetuating a cleaner water supply.

importance of such things as **mycorrhizzal** fungi and other soil organisms for plant growth. Removal of one component of the community may cause imbalance in the complex interrelationships found in ecosystems. This may alter the carrying capacity of some habitats or cause some species to disappear and others to appear.

Man often has unknowingly been a disruptive force. Poor land management practices have had detrimental effects on rivers and streams, sometimes many miles away. Pollutants have been detrimental to many forms of life. Runoff from agricultural chemicals and household wastes have contributed to the **eutrophication** of our lakes. Discarding manmade materials (such as plastics) has disrupted ecosystems by introducing material which cannot be recycled naturally.

The U.S. Department of the Interior has reported many examples of unwise acts undertaken because of a basic lack of ecological insight. Today, on an ever-increasing scale, environmental alterations from building roads, airports, dams, cities and factories are forcing people to use sound ecological principles, because all living organisms, including humans are affected.

A mistreated environment takes its toll of life, as indicated by our endangered wildlife species. The critical status of these species is largely the result of air and water pollution, destruction of essential habitat, soil erosion and a general degradation of our land. Pessimism is not the answer for our environmental problems. By applying ecological principles to long-range projects and plans, and to all aspects of daily life, man can insure that wildlife will survive.

Evaluation of Ecological Sources

Today there are many publications providing ecological information. In your study of ecology, you may encounter conflicting claims and opinions. You always should think critically and constantly evaluate what you read. The following are some points to keep in mind:

- What are the qualifications of the writer?
- What are the sources of information?
- What research has been done?
- Who has financed the work and why? (For example, is the writer biased because he is working for a company that is guilty of pollution?)
- Test the findings against your own knowledge of ecological principles.

Ecological Activities

The following pages contain suggested activities that should demonstrate many of the ecological principles that have been discussed. Pick one or more that interest you. Activities can be done in groups or individually. You need not do all aspects of an activity or complete all steps. For example, you may want to study, in depth, only one stage of ecological succession. Or, you may want to consider one species, and thoroughly study that species' relationships to its physical environment and other members of its biotic community.

Before beginning any activity, read a general publication on ecology and one pertaining to the area of study you have chosen. Think through the activity first and modify it to fit your own interest, area and time.

Gathering Information

Notes should be taken completely and accurately in the field. Do not trust details to memory. Sketches and photographs may be used instead of lengthy descriptions, where possible. Read over your notes after completing field work to correct possible omissions or errors. Always use a pencil while taking notes in the field, since ink from a pen will smudge or smear if your notes get wet.

Specimens may be collected and preserved. A terrarium or aquarium often can serve as a living habitat studied.

Your final written record should include all pertinent information: purpose of the activity, observations made and conclusions drawn, and ways that principles learned can be applied to your own way of living. For community service activities, be sure to include the purpose of the activity, the need for such an activity, the methods and people involved, and the accomplishments. Photographs can supplement your records effectively.

Ecological Succession

Communities do not remain the same but change over a period of time. This is mostly because of a process called **ecological succession**. We see this process all around us as abandoned farmland changes to weed fields, brush land and finally to a forest. One community succeeds another in several stages as conditions change that favor another suite of wildlife species.

The first stage in succession is called the **pioneer** stage, which consists of bare habitat conditions, such as exposed rock. This stage remains until conditions change to the point that soil accumulates and plants are able to grow. These changes continue until formation of a **climax** community, which is in equilibrium with soil and climatic conditions. Species of a climax community do not create conditions unfavorable to themselves or more favorable to other species.

Bare Ground (Stage 1) ***Grassy-Weedy (Stage 2)*** ***Brushy (Stage 3)*** ***Young Woodland (Stage 4)*** ***Mature Woodland (Stage 5)***

Terrestrial Communities

Terrestrial communities — especially forests — are complex. A thorough study of such an area could take years. However, even a briefer study can give a good picture of community interrelationships. At this point in your ecological studies, this is more important than identifying every species and counting every individual of each population. Almost any habitat is suitable for a community study: forest, field, vacant lot or waste areas between buildings. Methods, procedures and equipment will vary according to the type of area you choose.

Have you ever watched the change in plants when open fields are abandoned? An old hayfield on a farm shows this rather clearly. The first plants to invade generally are annual weeds such as goldenrod, dewberry, aster, ragweed and beggartick. Woody plants move in next. Seeds from briars, shrubs, vines and trees are blown or carried by animals into the field where they germinate. Early volunteers in open fields include shrubs such as raspberry, blackberry, sumac, blueberry, hawthorn, greenbriar, witch hazel and flowering dogwood. Pioneer trees in the old fields are eastern redcedar, black locust and pines. Trees and woody shrubs soon take over the abandoned field and a new forest begins.

The meadowlark and bobwhite quail nest in the field. The cottontail rabbit, meadow mouse and groundhog find food in the herbaceous growth of early succession. These field species thrive for several years after land is retired from cropping. But as the shrubs and trees start to take over, deer and grouse use the habitat more often than the rabbit and groundhog. When the mature forest finally replaces the field, the white-footed mouse replaces the meadow mouse and wild turkeys and squirrels begin to use these stands. Wild turkeys prefer open mature forests, while gray squirrels require mature trees for mast (food) and den homes. The nuthatch, chickadee, brown creeper, downy woodpecker and other woodland birds find preferable habitat as the forest matures. They take the place of the birds in the hayfield. Slow changes in habitat take place continually, and just as surely, animal life changes too.

Wild animal numbers rise and fall every year — the result of reproduction and mortality. From year to year, numbers of certain species increase and then decrease. As plant succession continues, the carrying capacity of the habitat changes. For example, in a changing area, when the carrying capacity of quail decreases, the **carrying capacity** of grouse increases. Later, when the carrying capacity of the grouse decreases, the carrying capacity of squirrels increases. Generally, there are always several of the most common species present; however, there may be more of one species at a certain stage of succession than others.

Procedures:

1. Sample the vegetation (see section on techniques). Plants of different species may be dried and preserved or kept in a terrarium as a living record of organisms found. This is a good way to study life cycles of some plants such as mosses.
2. Sample the animal populations. Identify the animal population by using keys or field guides.
   - Spread a white cloth under a tree or shrub, then shake the branches to collect a sample of the animal life found there. Look for animals hidden under the bark of tree trunks.
   - A net can be swept through tall grasses and weeds to catch all types of insects and other invertebrates. Also, examine individual plants and roots as well.
   - Collect samples of leaf litter and examine them later in a Berlese funnel. To use, place leaf letter or soil on mesh inside the funnel and suspend under a strong light. The heat and light drives hidden animals into a jar placed below.
   - Look under stones and logs and other hiding places for insects and other invertebrates such as reptiles, amphibians and small mammals.
   - Observe birds and mammals at a distance with binoculars and note their behavior. Look for tracks and other signs that indicate their presence.
3. Environmental Factors
   - Determine the temperature and relative humidity. This may vary in different strata of the community (e.g., tree tops, ground level, below ground level, etc.)
   - Determine water content of the soil. Slowly dry a pound of soil in an oven and weigh it again. The loss in weight is the soil's water content, which can be expressed as a percentage. To learn of the water-holding capacity of the soil, take one sample about 24 hours after rain and another during a drought period.

Things to Consider:

1. Look for differences among individuals of the same species. If you make a comparative study of communities, look for differences in community composition (e.g., north vs. south facing slopes, valley bottom vs. ridge top and at different elevations). Examine different microhabitats (e.g., areas shaded much of the day vs. those receiving full sunlight). In urban areas, what species seem well adapted to urban life?
2. Interrelationships
   - Determine niches, food chains and food webs. Are there daily changes or seasonal changes?
   - How do the dominant plant species modify the climate of the community?
   - How is the presence of wildlife related to the presence of mast-producing trees, den trees or other vegetation?
3. Stratification

   A community may have several strata (layers or levels). In a forest you will find a litter (leaf) layer, herbaceous layer, shrub and sapling layer and tree layer (which may comprise under story and overstory trees). Other communities probably will have fewer strata.

   — Determine the dominant species for each stratum.
   — What animals are found in the different strata?
   — Try to determine in which layer various bird species are found.
4. Has man's activity influenced this community? In what ways could man's activity do so?

Ecological Succession Activities

Select an area where you can observe the stages of ecological succession (see the techniques section on page 37).

What kinds of vegetation are present?_____

_____

_____

_____

_____

_____

What kinds of animals or sign of animals did you see? _____

_____

_____

_____

_____

_____

What environmental factors influenced the various ecological stages of succession? _____

_____

_____

_____

_____

_____

_____

_____

Ecological Succession Activities

Things to consider in your selected area:

What are some adaptations of individual plants and animals resulting from environmental factors? _____

_____

_____

_____

_____

What are some interrelationships between plants and animals and environmental factors? _____

_____

_____

_____

_____

Describe the stratification of the plants and animals? _____

_____

_____

_____

_____

How has the area been disrupted by man? _____

_____

_____

_____

Investigating Ecological Succession

Succession may be studied wherever there are areas that have been disturbed. In this activity, you will study succession in a rotten log. Your study area should be a forest environment where trees of different species can be found in all stages of growth and decomposition.

Equipment You Will Need

field clothes	tweezers
pocket knife	field identification books
hand axe	note pad and pencil
screwdriver	camera (optional)

I. Sampling the Vegetation in a Forest Community.

1. Observe and list the dominant trees present:_____

_____

_____

_____

2. What plants are in the understory? (Those plants less than 4 feet tall.)_____

_____

_____

_____

3. Which tree species occurs most frequently? _____

_____

_____

_____

4. Which tree species appear to be dying out because of competition from the other trees?

_____

_____

_____

II. Selecting and Examining Logs of the Most Common Species You Find in the Forest Environment.

Be sure to use the same species for each log:

- Standing dead tree
- Newly fallen log
- Log rotting inside, hard on outside
- Log completely rotten

Record data for each tree in answering the following questions.

1. What evidence did you find of the logs being used as nests or den sites?_____

   _____

   _____

   _____

2. What is the condition of the bark on each log? _____

   _____

   _____

   _____

3. List any plants or fungi you find growing on the logs and record what type is growing on each log at different stages of decomposition.

   _____

   _____

   _____

4. Roll over fallen logs and record the animals you find underneath (e.g., mice, snails, millipedes, centipedes, spiders, insects, earthworms or salamanders). Be sure to record the animals according to the tree's stage of decomposition.

   _____

   _____

   _____

5. Lift off pieces of bark from each log and record what you find by each log type.

   _____

   _____

   _____

6. Using your pocket knife or screwdriver, tear the logs apart and collect larvae of adult insects or other animals in your collecting jars. Identify and record the names and relative numbers of all species found in each log.

Log Type	Species Found	Number

III. Comparing Communities Found in Each Stage.

1. Write a report describing the species, abundance of species and individuals found in each stage of succession. Describe their roles and interrelationships with other members of the communities. Describe how each community contributes to the succession of the next community in the different stages of decomposition.

Investigating the Ecology of a Forest Community

During this activity you will collect and interpret information that will help you identify relationships that exist among animals in a forest environment. You also will develop skills in collecting, recording and interpreting data about the forest and associated plant communities.

Equipment You Will Need

field clothes	note pad and pencil
boots or hiking shoes	saw or hand axe
field identification books	sharp knife
field glasses	camera

I. Forest Investigations

Select a small forest stand as your study area. Trees selected should show the effects of environmental conditions such as injury, overcrowding or stunted growth from lack of sunlight. Also, find an old stump or fallen tree and make a cross-section with your saw so you can count the growth rings.

Throughly observe the forest community, making a list of all plants found in this forest and the positions they occupy within the forest. You also should note the ones which produce either mast or forage for wildlife.

Questions and Discussion

1. What are some things you noticed abut the cross-section? (Number of light and dark growth rings, varying widths of growth rings, center not in middle, burn scar.)

   _____

   _____

   _____

2. In general, what could growth rings tell us about a group of trees? (Competition climate, temperature, age.)

   _____

   _____

   _____

3. What are some major factors you think are affecting the growth of this forest?

   _____

   _____

   _____

4. What evidence of disturbance did you observe in this environment?

_____

_____

_____

Evidence of change in environment	**What might have caused them?**	**Effect on the environment**

6. List all the plants within a 0.10 A area (66 ft x 66 ft.) of your study area and record their position in the forest canopy. What are their value to wildlife?

Plant	**Where Found** (ground cover, understory, forest canopy)	**Value for Wildlife** (food, cover, nesting, etc.)

II. Observing and Measuring Animal Sightings and Evidence in the Forest Community

Using the same forest stand as your study area, observe and record the presence of wildlife. Do not overlook small rodents, birds and soil-dwelling animals, including reptiles.

Questions and Answers

1. What animals did you discover?

_____

_____

_____

2. List the plants in the forest most important to the wildlife you discovered, and how the plants were used.

Plant	Animal	How Used

3. What evidence of change did you find that wildlife might have made upon the forest? (e.g., woodpeckers, deer, wild turkeys, wild hogs and other species observed).

Animal	Change Made to Forest Environment

4. Some animals present in the forest depend on other animals for food; others depend on plants. Construct a simple food chain showing how the different species you found might fit into the forest environment.

III. Essay

Write a one page essay describing the kind of forest you studied. Make speculations as to what has happened and what will probably happen ten years from now using the information you have collected in your investigation. Rate the forest in terms of wildlife habitat and make predictions as to how productive it will be ten years from now.

Investigating Wildlife and Their Habitats

During this activity, you will identify relationships that exist between animals and their environment in different areas. Your study area may include several different habitat types (e.g., an old field, cultivated field, hedgerow, brush land, forest or marsh). Comparisons will be made between animals and their habitat, as well as needs of different animals in different areas. Also, observe changes in the habitat from ecological succession, which occurs over time by comparing different areas.

Equipment You will Need

field glasses	note pad and pencil
pocket knife	field clothes
hand axe	field identification books
collecting jars	plaster of Paris
camera	

I. Observing and Measuring Animal Sightings and Evidence

1. Observe and list the different habitats for wildlife in your study area (grass, cultivated fields, hedges, mature forest).

_____

_____

_____

2. Explore as many places as you can from _____to_____ (time) and record the animals you see (or evidence of animals). Signs of animals include such things as feathers, nests, scat, tracks and partly consumed food.

_____

_____

_____

_____

3. List animal foods observed in your study area. Do not forget worms, fungi, insects, etc.

_____

_____

_____

_____

4. Select three different habitats in your study area and record the data in the chart. Give each habitat a name based upon the characteristics, (vegetation, soils, moisture, temperature) that you record.

Habitat	I	II	III
Characteristics			
Name of habitat			
Name and number of animals (or evidence)			

5. What could account for similarities and differences between habitats?

_____

_____

_____

_____

6. What are some other animals that might live in the different habitats?

_____

_____

_____

_____

II. Observing and Studying Animal Adaptations and Relationships to Environmental Factors.

1. Animals are adapted to their environment in many ways. Determine which characteristics of an animal would determine the particular habitat it lives in.

2. Think about the characteristics, traits and adaptations of the animals you have found in your study area or that you would expect to find living there. Then fill in the following chart.

Animal	Things that enable them to live in your study area (characteristics, traits, adaptations)	How they benefit by living there
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

3. What characteristics of an animal would we look at to determine what it eats?

_____

_____

_____

_____

4. What characteristics of an animal would we look at to determine why other animals eat it?

_____

_____

_____

_____

5. What do we mean when we talk about predator/prey relationships?

_____

_____

_____

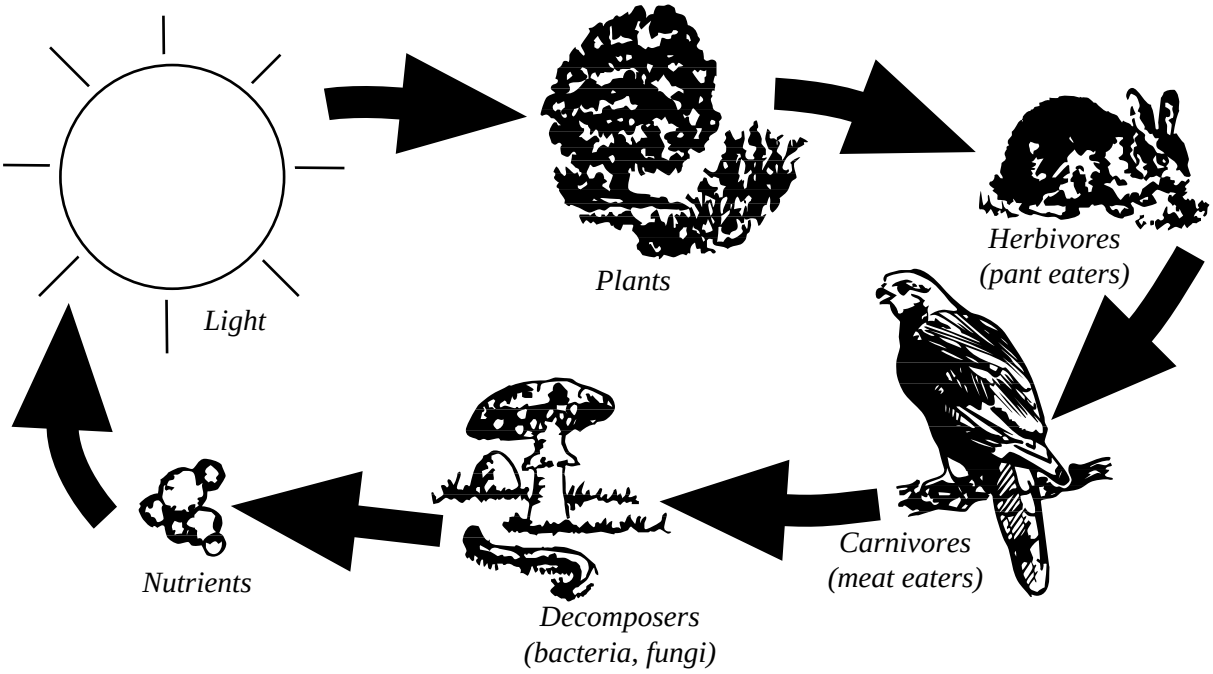
_____

6. One relationship among animals living in a particular community is a food chain, which shows what animals eat and what eats them. Using the chart of animals and their adaptations prepared in Section II, construct a food chain showing how each animal might fit into the community in a predator/prey relationship.

III. Studying Energy Flow

Food chains illustrate the movement of energy through only a portion of the environment. Animal adaptations determine an animal's position in the food chain.

1. The diagram represents the energy cycle in the ecosystem. What is the function of each part of the energy cycle?



1. (Light)_____
2. _____
3. _____
4. _____
5. _____
6. _____

2. Place the animals you recorded in your study area in the appropriate places for energy flow and draw arrows. Don't forget to include plants and other organisms from your study area.

3. What do you think would happen if any one of the groups represented in the energy cycle was eliminated from the ecosystem?

_____

_____

_____

_____

_____

IV. Changes in Animal Habitat "Succession"

The composition of a community does not remain the same. It changes over a period of time, largely due to activities of plants and animals themselves, in a process called ecological succession. We can see this process all around us as abandoned farmland changes to grass field, then to bush or shrubs and finally a forest.

1. Choose one of the animals found in your study area and rate the area for the animal's following needs:

A. General habitat _____

B. Winter and summer food supply_____

C. Evidence of predators _____

D. Other factors _____

2. Which of the other habitat types in your study area will this animal use?

_____

_____

_____

_____

3. How does this animal affect your study area?

_____

_____

_____

_____

4. In which habitats would you NOT expect to find this animal?

_____

_____

_____

_____

5. What do you think is the limiting factor for this animal in each habitat of your study area?

_____

_____

_____

_____

6. Arrange the different habitats observed in your study area in the order you think they should occur in terms of ecological succession. Write a report describing your study area and make predictions as to what will occur during the next ten years. What animals would you expect to find then?

Aquatic Communities

The aquatic communities in Tennessee are diverse. Including naturally formed Reelfoot Lake and the other man-made lakes, there are 35 reservoirs covering over 500,000 acres. There are more than 200,000 farm ponds throughout the state covering 100,000 acres. Additionally, there are more than 19,000 miles of warm water and cold water streams. Each of these freshwater environments has its own particular plant and animal inhabitants, though some species may be common to all.

Freshwater habitats may be considered in two broad types: standing water or lentic habitats, which include lakes, ponds and swamps, and running water or lotic habitats, which include springs, creeks and rivers.

A very important type of life (and most abundant) found in a pond is the phytoplankton or microscopic plants. The entire life of the pond depends upon these tiny plants to supply food and oxygen.

On the pond edge and extending out into the water are rooted plants growing from the bottom called emergent aquatic vegetation. Also found in aquatic systems are zooplankton (microscopic animals) which consume phytoplankton, and larger animals such as snails and insect larvae, which feed on the plants. Animals such as sunfish, at various stages of development, feed on zooplankton, insects, snails and smaller fish. Finally, predator fish such as largemouth bass feed on the sunfish.

Streams generally have two major zones: rapids and pools. The plant and animal life present in streams is determined by how fast the zones flow. The rapids zone has shallow water where current velocity is great enough to keep the bottom clean of silt and other loose materials. The pool zone has deeper water where current velocity is reduced and silt and other loose materials settle to the bottom. The current velocity varies from stream to stream and within the stream itself; and depends upon the size, shape and steepness of the stream channel, roughness of the bottom, depth and rainfall.

In the rapids, only the plants and animals that can adapt to rapid currents are found. Included in this group are plants such as mosses clinging to rocks; animals such as damselfly and dragonfly larvae; and fishes such as trout, shiners and darters that hide under rocks and plants on the bottom. In the pools you will find rooted vegetation and small animals such as snails, crayfish, aquatic insects and bloodworms, which live among the stems and leaves of the rooted vegetation. Larger animals found in pools consist of bullhead catfish, pickerel, sunfish, and bass — essentially the same animal forms found in lakes and ponds.

A Pond Community and Its Environment

Physical Studies of the Pond

1. Start by mapping the pond. Show its shape, surrounding vegetation and physical features. Depth can be determined by taking measurements with a weighted line from a boat. Take these measurements in several locations scattered all over the pond. Types of vegetation should be indicated.

2. Determine the depth of light penetration. Lower a Secchi disk from a boat or dock. Note the depth at which it disappears from view. Lower further, then raise it until it appears again. Note this depth. Average the two readings for an estimate of light penetration. Does this change with the seasons? After rainstorms?

3. Bodies of water, even quite shallow ones, often are distinctly layered by temperature. This phenomenon is termed thermal layering, and has a profound effect on the ecology of ponds and lakes. For shallow depth, a dial thermometer performs satisfactorily. For deeper measurements, a stoppered bottle can be used. Experimentation is required to determine the right amount of sand for weight and arrange-

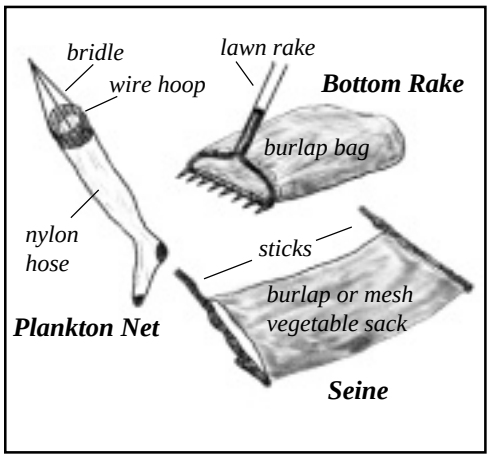
ments for tipping the stopper. Lower the device to the desired depth and pull the stopper. Allow time for the temperature within the bottle to stabilize, raise it quickly and read the temperature immediately. Repeat for each desired depth.

Studying Life in the Pond

1. Identify the different vegetation types: **submergent, floating and emergent**.

2. Collect **plankton** using a plankton net or a nylon stocking. By attaching a test tube at the end, microscopic organisms can be collected from open water.

   Drag the plankton net or a nylon stocking at very slow speeds behind a boat or back and fourth across a farm pond. Avoid areas with a lot of surface debris. The organisms collected in the test tube may be studied using either a hand lens or microscope. Plankton samples should be studied as soon after collection as possible. If samples must be kept for a short time, dilute with pond water and keep in a cool place. Plankton can be kept in an aquarium for longer periods.



3. Larger organisms can be collected using a large strainer. Note the micro-habitat in which they are found. Examine stones, leaves and stems of pond vegetation for small animals.

4. Sample benthic (bottom) organisms from shallow to deeper water using a burlap bag and yard rake as a bottom dredge. Hold the rake vertically with the teeth directed toward you and slightly downward. Drag it across the bottom towards you and examine contents in the burlap bag for organisms.

5. Observe vertebrate life in the pond (fish, reptiles, amphibians). Observe and look for evidence of mammals and birds along the edges of the pond.

   A. According to their place in the food chain:

   Producers- plant life

   Consumers-
   1. feeders on phytoplankton
   2. feeders on zooplankton
   3. feeders on larger invertebrates and small fish

   Decomposers- feeders on decaying matter

   B. According to their life habitat:

   Benthos- organisms living on the pond bottom

   Periphyton- organisms attached or clinging to plants or other objects

   Plankton- floating organisms

   Nekton- swimming organisms

   Neuston- surface organisms

C. According to their habitat within the pond:

Littoral zone- shallow water area where light penetrates to the bottom

Limnetic zone- open water to the depth of light penetration

(The **euphotic zone** comprises the littoral and limnetic zones.)

Profundal zone- area beyond depth of light penetration.

(In a pond, the littoral zone probably will cover most of area.)

Determine the ecological relationships among members of the pond community (niches, food web, etc.) Study the organisms found in different habitats (different vegetation zones, etc.), and exposed to different environmental factors (depth, light, temperature). How are organisms adapted to the habitat in which they were found?

Stream Communities

Many of the methods used to study a pond community can be applied to the study of a stream, but there are certain differences you should keep in mind:

1. Because of a stream's shallower depth and mixing of water, certain environmental conditions such as temperature, light and oxygen supply are much more uniform than in a pond or lake.

2. For the same reasons, the oxygen content of a stream usually is much higher than that of a lake or pond. Stream organisms are less tolerant of a decrease in their oxygen level and are affected greatly by organic matter pollution, which uses up oxygen in its decay. Changes in the organisms of a stream community often indicate the presence of pollution.

3. Streams usually have fewer producers than lakes or ponds. For this reason, they are more dependent on surrounding lake areas for input of organic material to provide food for consumers.

4. Current (rate of stream flow) is a major environmental factor. To measure stream flow rates using a fishing bobber, place stakes in a free flowing area of the stream (5-10 feet distances will usually suffice). Record the number of seconds required for the bobber to travel between the markers. Repeat several times and convert to feet per second.

A fabric window-screen net can be used to collect organisms where the current will force them against the net. Turn over rocks and stir up the bottom upstream from the net. Empty the organisms into a pail or sorting pan. When studying these organisms look for adaptations (both structural and behavioral) for maintaining their position in a moving stream.

If other members of your group are studying a pond community, compare your findings with theirs. Compare the community of a swift-flowing stream with that of a slow-moving one. Were certain organisms more prevalent in one than another? How are organisms adapted for each environment? Compare the stream communities above and below a source of discharge into a stream.

A Pond Community - Activities

Select a pond or small lake for study. Be sure to get permission from the owner and offer to share the information you find.

1. Study the physical characteristics of the pond.

Pond Map

What is the light penetration?

On a clear day_____

In winter_____

In spring _____

In summer _____

In fall _____

After a rainstorm _____

Check the thermal layering.

In winter _____

In spring _____

In summer _____

In fall _____

With a plankton bloom_____

Without a plankton bloom_____

2. Study life in the pond.

What different kinds of plants are present?

Organism	Place
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

What are the larger invertebrates and where are they found?

Organism	Place
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

What kinds of vertebrates are in and around the pond?

_____

_____

_____

_____

_____

_____

_____

_____

Investigating the Ecology of a Stream, Pond or Lake

In this activity, you will study the ecology of a water community while developing skills collecting and interpreting information about the water environment.

Equipment You Will Need:

old shirt and trousers or swimsuit
tennis shoes
field identification books
magnifying glass
white dishpan
bucket
minnow seine
plankton net or old stocking (women's hose)
Bottom rake or small-mesh dip net

I. Observing the (Stream-Pond-Lake) Community:

As you approach the water, observe and record your observations. You will be interested in the creatures living in the water; however, do not overlook shore birds and fur-bearing mammals that are a part of water life. Examine the shoreline for signs of their activity. You are apt to find the following life forms along the shore and in the shallows: frogs, tadpoles, crawfish and small fish. Snakes and turtles may be found sunning themselves on banks or logs.

Plants_____

Animals_____

Air_____

Rocks_____

Logs_____

Water_____

Questions and Discussion

1. What are some things you noticed as you approached the water?

_____

_____

_____

_____

_____

2. What plants were growing in the water and along the shore?

_____

_____

II. Observing and Collecting Aquatic Life:

Using collecting equipment (dip net, plankton net, bottom rake, etc.), collect as many types of aquatic animals as possible. Tow your plankton net through the water for at least two minutes. Turn it inside-out and wash the contents into a white dishpan by pouring water though it. Using your magnifying glass, see if animals are moving in the water. Place the animals you catch while seining in knee-to-waist-deep water in your bucket. Other animals you catch by dredging with your rake can be placed in the bucket or dishpan. You can stir up bottom dwellers and catch them in a bag. Examine the muck and pick out the captured animals.

Questions and Discussion

1. What was the color of the water? (clear, brownish, greenish)

_____

2. Which method of collecting caught the most?

_____

3. What type of bottom did you find?

_____

4. Prepare a demonstration using preserved specimens, charts or posters and collecting equipment for various groups, including your 4-H Club.

III. Identifying and Recording Aquatic Animals:

Using reference books such as the *Golden Nature Guide Pond Life* books or *Peterson's Field Guide* series and attached picture keys, generally identify the specimens you collected. It will be necessary to identify some animals with your magnifying glass.

List or sketch the animals you found below and on page 35.

Description of where found	Type (name or sketch)	Number

Questions and Discussion

1. What animals did you find?

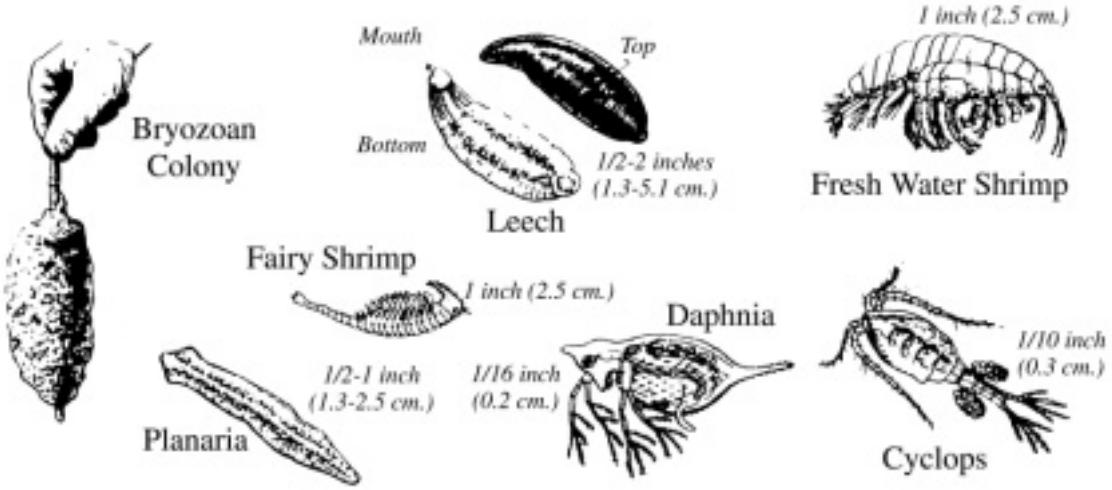
2. Where did you find most of the specimens?

3. What similarities are there among the specimens? Differences?

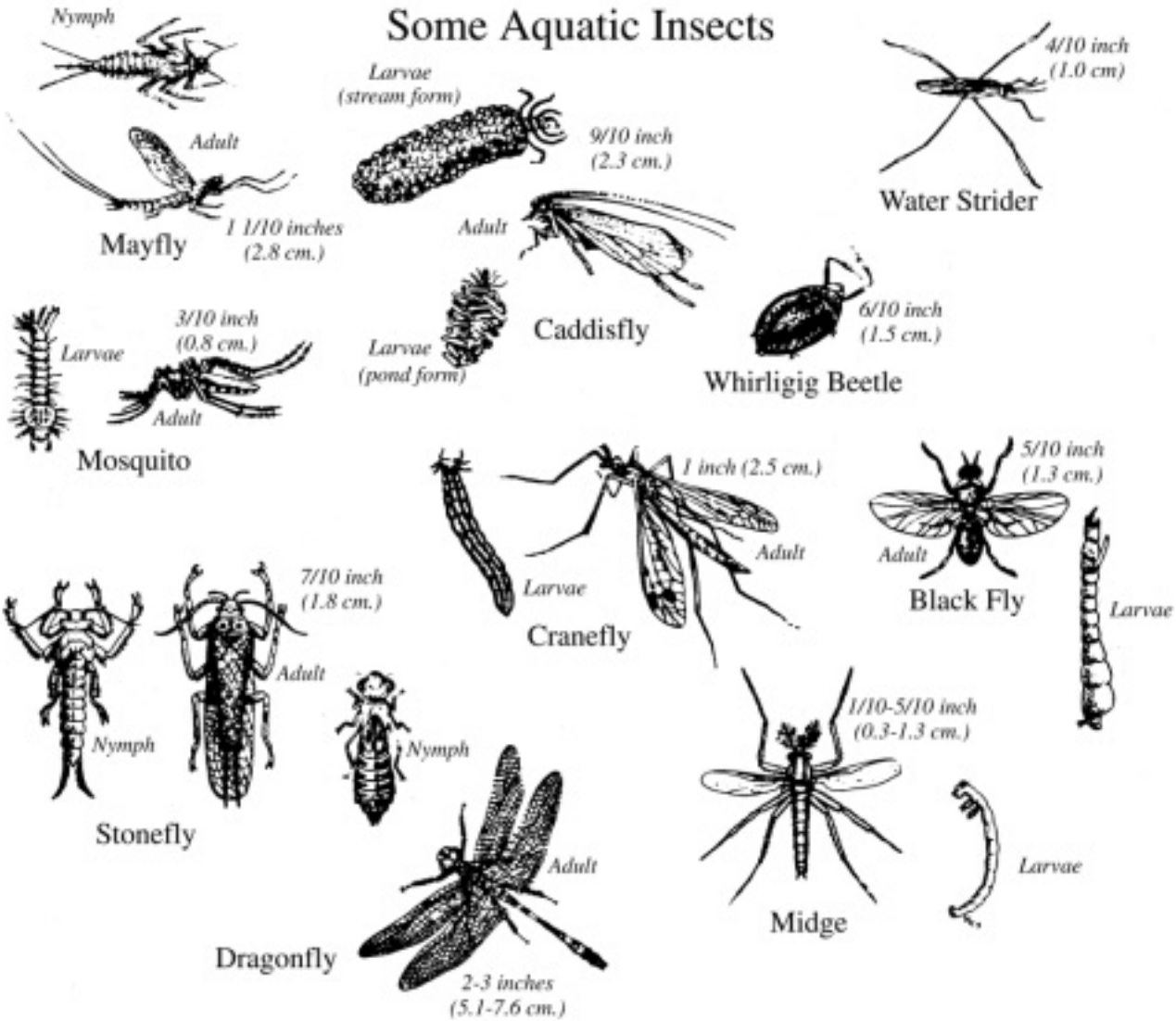
4. What other life would you expect to find in this water **community?**

5. Would you find the same specimens in a different aquatic environment? Why or why not?

Some Sub-surface Fresh Water Organisms



Some Aquatic Insects



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Techniques

Vegetation Sampling

The numbers and kinds of plants in the area can be determined by counting and identifying all plants within a given sample area. These sample areas may be squares (quadrats), strips (transects) or both.

1. Quadrats

a. How big? The size of the square sample area depends upon the type of vegetation being sampled. A square with sides 10 yards long may be used for trees, 5 yards for shrubs and 1 yard for smaller vegetation (herbs). The smaller squares may be within the larger one. Multiply the number of herbs in the 1-yard square by 100 and the number of shrubs in the 5-yard square by 4 to get a picture of the total vegetation within the 10-yard square.

b. How many? If you can establish only a few quadrats, select them to include what seems to be a representative number of different kinds of plants. If more are established, they should be selected randomly or at regular intervals along a line. A sufficient number of sample areas can be determined by means of a species-area curve. On a graph, plot the number of different species against the number of quadrats. Such a curve usually rises sharply at first as many new species are found in the samples taken. The curve then levels off as the number of new species decreases when additional samples are plotted. The number of quadrat samples, which is indicated at the point where the curve levels off, should be sufficient to include most of the species present in the stand.

c. What can be learned? There are many formulas used by plant ecologists to organize and interpret data obtained in quadrat sampling. These can be found in ecology lab manuals and often require the use of a calculator. However, density of each species (the number of individuals per-unit-area sampled), and frequency (the number of quadrats in which a species occurs divided by the total number of quadrats sampled) are easily determined.

2. Transects

A transect is a line extending through a community. All plants along the line should be identified and counted. This method indicates:

a. Which species are found within a community.
b. The number of times each species appears along the line.
c. The percentage of occurrence for each species in relation to the total.
d. The percentage of herbaceous or woody cover represented by each species.

A transect may be used to determine vegetation changes in different environments.

Collecting, Pressing and Mounting Specimens

1. For trees or shrubs, collect the terminal (end) twigs with at least two leaves, preferably more. For flowering plants and weeds, it is preferable to have the entire plant where possible, including the flower and fruit. For aquatic vegetation, collect enough of the terminal section of the plant to show the mature foliage. Usually it is best to collect two or more specimens of each plant and mount the best one in your final collection.

2. Specimens may be placed between sheets of newspaper for pressing. Plywood should be used for the backs to keep the newspaper flat. Specimens collected in midsummer are easier to press and, because of maturity, may be more typical than those collected earlier. Two or three weeks in a warm, dry place are required for pressing. Changing the newspaper every two or three days prevents leaf discoloration. One leaf of each specimen should be pressed with the underside of the leaf up.

3. Herbarium sheets are available from supply houses for agriculture and botanical materials, or you can make your own.

4. When mounting specimens on the herbarium sheets, use transparent tape cut into small thin strips. Make sure specimens are well fastened.

Sample the Air Around You

Millions of fine solid and gaseous particles are being dumped into the atmosphere daily. Many of man's activities result in the discharge of such airborne foreign materials. The burning of fuels for heat and power, waste material disposal, manufacturing operations and construction activities all add their share. The automobile is one of the worst offenders. Practically everyone contributes to air pollution. Once in the air, reactions take place between solid and gaseous particles, producing pollutants. Often these are far different and more troublesome than the particles were when in their original form.

Determining the condition of the atmosphere has been the task of highly-trained individuals with expensive monitoring equipment. But every individual should be able to assess the condition of his/her own local environment to some degree. The following activities are recommended. No method has been standardized, but by comparison of the information from one location against another, a definite "feel" can be developed for certain types of "dirt" in the air.

Magnetic Materials - "star dust" (or meteorite remains) filters down from the sky and a small amount of magnetite is available in the earth. The majority of magnetic material in our environment is a result of manufacturing processes or transportation activities.

Place a small magnet in a plastic sandwich bag and drag it over a certain size area of the ground (the magnet size is your choice and the ground area covered is up to you). Go over the area a few times to pick up all of the available material. Put the collected material into a measuring container for comparison with collections from other areas. A good tube for measuring volume is a plastic soda straw with the bottom end taped (a small funnel made of paper will help in filling the tube). Comparisons of this relatively heavy material by volume or weight can be obtained from different areas, such as a main highway, secondary road, near a manufacturing plant with machinery, downwind verses upwind of an urban area, in a field or wooded area.

Dirt - Sedimentation devices are used to determine the total solid material accumulating in one area over a period of time. These could be called "dirt collectors." (Do not confuse "**dirt**" with "**soil**.")

Type # 1:

Punch a 1/4-inch hole (standard paper punch) about one inch from the edge of a 3"x 5" file card or any other piece of thin cardboard or heavy paper. Cover the hole with a small piece of gummed tape. Notice that some of the sticky stuff is exposed through the hole. Carefully fold the card in half so this sticky area is protected for transportation to the exposure site. Open and allow this to remain, tacked to a post, tree or house for a period of time (eight hours seems good in most cases but this is up to the observer). Analyze for the number of particles adhering to the exposed tape by using a small magnifying glass or a low-power (10x) microscope. An analysis also can be made by separating the particles into different sizes or even different shapes or colors. Only count those you can see. There will be many, many more that you cannot see. Again, make comparisons from place to place, to get a "feel" for the distribution of this type of pollution.

Type # 2:

A more detailed method of determining the amount of dirt which falls from the atmosphere can be developed as follows:

Place a few clean, large sauce pans or deep, glass baking dishes in an open area away from trees or buildings. Keep them about half full of clean, distilled water for 30 days. Evaporate the water over a slow heat being careful not to burn the dust particles. Weigh the containers and their contents on a milligram scale. Wash and dry the containers throughly and weigh again. The difference in weight will be the total dust collected.

Figure the area of each container's mouth in square centimeters. Then divide the amount of dust (milligrams) by this figure to give the amount of dust that fell on one square centimeter. Air pollution scientists convert figures similar to this on a regular basis. They use 28.6 as a conversion factor which when multiplied by the number of milligrams per centimeter, gives tons per square mile per month.

By averaging the weight from a few containers, a realistic figure can be found for the amount of solid dust-like material being deposited at any given time.

Example:

Diameter of mouth of container .....20 cm.
Radius of mouth (1/2 dia.).....10 cm.
Square of radius (radius x itself).....100 sq. cm.
Area of container mouth (3.14 x square of radius).....314 sq. cm.
Milligrams of dust (from container).....140 mg.
Amount of dust that fell on 1 sq. cm. 140.....0.44 mg.
Tons of dust/sq. mi./month
(dust/sq. cm. X 28.6).....12.6 tons/sq. mi.

Sedimentation devices use glycol (common auto anti-freeze), special silicone glue, liquid plastics and other non-drying sticky materials spread on glass microscope slides. These are carried in many types of collecting contraptions. As an example, a simple whirling anemometer (an instrument for measuring wind force and speed) equipped with a pinch clothespin will keep a petroleum jelly (vaseline) -covered slide exposed to the prevailing wind. If exposed for certain periods of time each day, an interesting picture of contamination can be established relating to wind direction and position sources.

Naturally, dust can be found everywhere in varying amounts. An average of 10 tons of dust settles on every square mile of land each month. Natural or manmade pollution sources, wind speed and direction, humidity and rainfall as well as altitude, are factors that influence the amount of a particular location.

In some areas man is pouring so much effluent into the environment that natural processes are unable to digest or utilize it as fast as it is being released. Using the environment as a dump cannot continue without adverse consequences.

Environmental Activities

Our studies should make us aware that we all must apply ecological principles to our daily lives if environmental problems are to be solved. Your 4-H group can become involved in a community service activity aimed at solving such problems. Since action will depend on local conditions, much thought and planning will be necessary to locate problems and causes, as well as evaluate the merits of alternative solutions. In the reference section of this booklet, you will find books and materials to help in this process.

The following are suggestions from the U.S. Department of the Interior and from other 4-H materials which could be adapted to your local conditions.

Environmental Activities

Make a community inventory and record with photographs and written data.

Water:_____

_____

_____

_____

Air:_____

_____

_____

_____

Land:_____

_____

_____

_____

Sound:_____

_____

_____

_____

Educational efforts:_____

_____

_____

_____

Environmental Activities

Make a conservation checklist.

Being Done	Needs to be Done
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Activities for you and your 4-H friends to do to increase awareness.

_____

_____

_____

_____

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_____

Making a Community Inventory

Before a community can act intelligently to protect its environment, it needs to know its problems. You can help by taking part in a community-wide inventory, recording your findings with photographs and written data. Such a survey could be the basis for an effective photographic essay. Here are some things to look for:

Water Pollution: Is your town water supply taken from protected sources, or must it depend on water that has been used before by cities or industries upstream? Is your water supply adequately protected from encroachment, or do zoning authorities permit building of new sources of pollution within the watershed? Does your city live up to its obligation to downstream neighbors by properly treating sewage? Which polluters are lax in their treatment of plant water? What are their attitudes toward pollution and what are their plans for the future pollution abatement? Check with your city/county water manager to obtain information.

Air Pollution: Does your community have a program for reducing air pollution? Is the program enforced? Does the city permit open burning of trash, garbage or industrial wastes? Does the community require automobiles to have effective emission control devices? Are they checked periodically? Who are the polluters who contribute measurably to air pollution? What are their plans for abatement? Can you identify apartments or office buildings whose heating plant send up clouds of smoke? City/county managers may help with needed information.

Agricultural Pollution: Check with your county Extension office for information about approved farming practices in your areas. Where are livestock feedlots located and what facilities are provided to prevent harmful runoff into water resources? Are local farmers using pesticides and fertilizers in a proper manner to protect themselves, their employees, consumers and wildlife?

Land Pollution: Does your community have adequate zoning ordinances to encourage good land use by planning? Are industries permitted to destroy future productivity of land by dumping industrial wastes or mine tailings? Does the city have adequate litter laws, coupled with enough litter receptacles to encourage people to properly dispose of trash? How are abandoned cars disposed of in your community and at whose expense? How does your community dispose of its garbage? Do you have a community dump that is open at reasonable hours to encourage its use? What recycling possibilities are being explored? Again, contact city/county manager for help with these questions.

Noise Pollution: Does your community require that automobile and motorcycle exhausts be properly muffled, and is the law enforced? Is construction work confined to reasonable hours? Are low-flying aircraft prohibited? Are loudspeakers and other noise-makers regulated?

Environmental Education: Does the public school system use its resources for environmental education? Are there outdoor classrooms and are they being used? Are teachers required to have training in environmental education? Are children being neglected in outdoor education programs? Are adult Extension courses offered to help create an informed body of citizens?

Ecological Awareness: Has the community taken steps to preserve unique natural environments such as swamps and marshes, streambanks and forests, rare and endangered species? Are land developers permitted to alter watersheds at will, creating erosion or causing downstream flooding by increasing run-off of surface water from paved lots and roof-tops? Are pesticides regulations enforced locally?

These are some questions that might be asked in your community environmental inventory; there are others that will be equally important in your locality. After you've completed your inventory, discuss alternative solutions to the problems you've uncovered with local officials and concerned citizens. Concerned informed citizens must—and can—get results. It is everyone's world and everyone is responsible to make it better.

Make a Conservation Checklist

The recipe for a clean, appealing environment has one basic ingredient for which there is no substitute — CONSERVATION AWARENESS AT THE LOCAL LEVEL. The checklist below is offered as a partial list of conservation projects. It is designed to help you start thinking about the world of natural resources and how you can make it more liveable.

1. Join a group in your school that works for a better environment. If no group exists, organize one. Be a leader.
2. Urge your own organization to undertake a conservation project.
3. Clean-up trash around your home and neighborhood.
4. Use pesticides judiciously, reading labels for correct application procedures.
5. Write to local newspapers on behalf of conservation projects.
6. Speak before your school classes in support of good conservation practices.
7. Help set-up a Beautification Conference in your school.
8. Help promote a school clean-up day or week.
9. Organize a clean stream day and clean-up a section of stream bank along a nearby stream or river.
10. Write your elected representatives on behalf of good conservation projects.
11. Urge your parents to support conservation practices to build a better community environment.
12. Set an example you are proud of for others to follow.

Start a Recycling Campaign

Our environment would be a better place for all living things if we could kick our habit of using containers once and then throwing them away. In addition to disposal in home garbage cans, large numbers of wrappers, bottles and cans are tossed on road shoulders, picnic areas, beaches, in lakes and in the woods. The sight of all this debris is offensive, and plastic, aluminum and glass containers never disintegrate. They will be here hundreds of years from now—a safety hazard to man and all other animals.

Youth Groups Can Do Something in the Way of an Action Program

1. Get pledges of everyone in your community to buy beverages only in returnable containers. It is part of the environmental quality solution and it is cheaper.
2. Let merchants know you want returnable containers.
3. Organize campaigns to gather bottles and cans to return to recycling factories.

4. Organize paper drives (newspapers) to return papers for recycling. In many communities, payments will be made for paper.

5. If a recycling program already exists in your community, volunteer your help. It is a waste of our natural resources to use them once and then discard them:

    • most of our goods can be recycled

    • labor is employed in recycling

    • natural resources are conserved

Community Beautification

Survey Sheet

How does the traveler on our roads see your neighborhood? Are there problems and blemishes that detract from the beauty that can be corrected by effort of 4-H members? Take a drive through your community and fill-in the chart below.

The View From The Road

Problems	Location	Slight	Serious
Litter and junk on road right-of way			
Absence of litter bags in our cars			
Billboards abandoned or needing attention			
Unsightly views; dumps			
Gravel pits			
Junk or debris on beaches or lakes and streams			
Abandoned autos			
Visible erosion on any part of highway right-of-way			
Condition of our lawns, neatness, landscaping			
Other problems (name them)			

Action Program

How can these problems be corrected? Can the work be done by your 4-H club? Decide which problems your club will help solve.

What cooperation do you need from others such as the town board, village board, highway commissioner, etc? Who will make such contacts? Work out a time schedule (dates) for doing the job.

Careers Related to Ecology

Renewed interest in environmental issues have heightened awareness of many job opportunities. Interest in ecological concepts may lead you to think about choosing a career in this important field. There are many interesting and rewarding jobs both in the public and private sectors where well-trained people can have a positive influence. A high school education is required for most any job. Advanced education from a college where you get a strong background in the sciences and natural resources is highly desirable. Courses which help you develop good communications skills and team building characteristics are very important. Consider the University of Tennessee for both undergraduate and graduate training.

Here are some careers for you to think about where ecological principles will be needed. Farming or ranching, wildlife, fisheries and forestry biology, Agricultural Extension Service, law enforcement, teaching, park naturalists, environmental agencies, water resources, soil conservation, health, industry and business, engineering, geology, meteorology, oceanography, and many other areas. As you make decisions about career opportunities that appeal to you, interview people already working in those fields. Include these questions in your interview and share the information you learn with your 4-H friends.

1. **Do they enjoy their work?**
2. **What are the advantages of the work?**
3. **What are the disadvantages of the work?**
4. **What training is needed to prepare for the work?**
5. **How does their work help in the conservation of natural resources?**
6. **Do they believe the work will be important and needed in the 21st century?**

Project Plan Evaluation

What I did: _____

_____

_____

_____

_____

I met my goals because: _____

_____

_____

_____

_____

I did not meet my goals because: _____

_____

_____

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Other things I would like to do: _____

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Signed:_____ Signed:_____

4-H Member Parent/Guardian

Date:_____

Other Community Service Ideas

1. Assist local fish and game officers in a wildlife habitat improvement program, such as providing nest boxes for cavity-nesting wildlife species like wood ducks or bluebirds. Most natural resource/fish and game agencies readily accept volunteer work from interested individuals.

2. Establish a backyard wildlife program where you plant shrubs and trees beneficial to wildlife, nest boxes and bird feeders can be built and monitored for usage.

3. Clean debris or litter from a publicly used stream, pond or recently flooded area.

4. Plant and care for trees, shrubs and grasses in a local park, schoolyard or public property for a wind break, beautification or erosion control.

5. Prepare a nature trail at a local park or near your school. Provide a method for hikers to identify plants on the way.

Glossary

abiotic - refers to the non-living parts of an environment

adaptation - the process by which an organism becomes better suited to its environment for particular functions

amphibia - a class of vertebrates comprising frogs, toads, salamanders and related animals which usually spend their larval life in water and their adult life on land

annuals - plants in which the entire life cycle is completed in a single growing season

autoecology - the study of an individual organism in relation to its environmental conditions

autotrophic - refers to organisms which are capable of producing organic substances from inorganic materials by means of energy received from outside the organism

benthic - refers to the bottom of any body of water

benthos - organisms which live upon or in the bottom of a body of water

Berlese funnel - an apparatus in which soil or debris is placed in a funnel, heat and light are applied from above and organisms are forced into a vessel below

biomass - the total quantity of living organisms of one species per unit of space (species biomass), or of all the species in a community (community biomass)

biosphere - the portion of the earth and its atmosphere capable of supporting life

biotic - refers to the living part of an environment

canopy - the uppermost layer in a forest consisting of crowns of trees or shrubs

carnivore - an animal that feeds almost entirely on the flesh of other animals

carrying capacity - the number of animals of a given species that the environment of a specified area can support

climax - the last stage of succession under prevailing environmental conditions

commensalism - the relationship between two or more organisms with benefit usually to one and injury to none

community - an interdependent group of plant and animal populations living together in a particular habitat

competition - the effect of a common demand by two or more organisms on a limited supply of needs

consumers - organisms which ingest other organisms or food particles; may be classed as primary, secondary, etc., depending upon their position in the food chain

cyst - the stage of an organism when it is encased in a resistant wall

decomposers - organisms, (e.g., bacteria, fungi and certain invertebrates), that break down dead plants and animals into simpler compounds

density - the number of inhabitants per unit of area

dirt - a filthy or soiling substance such as dust or mud

diversity - having a variety of different and distinct forms

dominance - the condition in a community in which one or more species, by means of their number, coverage or size, have considerable influence or control upon the conditions of other species in that community

ecology - the study of the relationships of organisms to one another and to their environment

ecosystem - an interacting system which influences communities (the living part of the environment) together with the non-living part of the environment

ecotone - a transition zone between two habitats which has characteristics of both, as well as characteristics of its own

edge effect - the influence of two habitats which adjoin one another upon the composition and density of local populations

effluent - an outflow, such as a stream flowing out of a lake or sewage from a pipe

emergent vegetation - aquatic plants growing from the bottom but with their tips showing above the surface of the water

energy flow - the intake, conversion, and passage of energy through organisms or through an ecosystem

energy transformers - plants and animals which convert and pass-on energy, originally secured from sunlight by plants, from one organism to another as in a food chain

environment - all the external conditions that affect the life and growth of plants and animals

epiphyte - a plant growing upon or attached to another plant, or some non-living support, deriving no sustenance from the supporting structure

equilibrium - the condition of an ecosystem in which the interrelationships of organisms to one another and to their environment are harmonious

euphotic zone - the uppermost portion of a body of water which receives sufficient light for photosynthesis

eutrophication - the condition of a body of water in which excessive nutrients (often caused by pollution) have caused excessive plant growth in the water

evapotranspiration - the sum total of water lost from the land by evaporation and plant transpiration

floating vegetation - aquatic plants that float on top and draw their nutrients from the water

food chain - the transfer of energy stored in plants to animals which eat them (herbivores) to animals which eat them (carnivores)

food pyramid - a graphic representation of the food chain which indicated the large numbers of producer organisms at the base and the progressively decreasing numbers of herbivores and carnivores above

food web - all the interconnecting food chains in a community

forbaceous plants (forbs) - broadleaf herbaceous plants

frequency - the degree of distribution of individuals of a species in an area

fungi - organisms, mostly decomposers, that absorb nutrients obtained by breaking down molecules of dead organisms and waste such as leaf litter and feces; lacking chlorophyll; including molds, yeasts, mildews, rusts and mushrooms

habitat - the environmental conditions of a specific place occupied by an organism or population

herbivore - an animal that feeds almost entirely on plants

hydrology - the scientific study of the entire water cycle

hydrologic cycle - the cycle of the movement of water from the atmosphere by precipitation to the earth and its return to the atmosphere by interception, evaporation, run off, infiltration, percolation, storage and transpiration.

inorganic - refers to habitat components that are not organic

interspersion - where habitat components are distributed and supplied at irregular intervals

juxtaposition - refers to habitat components that are side by side

key-industry animals - herbivorous animals which are so numerous that a large number of other animals are dependent upon them for food

Liebig's law of the minimum - the generalization that the growth and reproduction of an organism is dependent on the nutrient (such as nitrogen, oxygen, carbon dioxide) that is available to the organism in the smallest quantity

limiting factor - the environmental influence that is most limiting in a given habitat, thus affecting an organism's well-being

limnetic - refers to the open water of a pond or lake

limnology - the study of aquatic systems and their functions

littoral - refers to the marginal zone in a lake or pond that extends outward from the shore to the maximum depth at which plants are rooted

mast - fruits of woody plants; may be hard (e.g., acorns, beechnuts, hickory nuts) or soft (e.g., grapes, cherries, apples, persimmons), and are used as food by animals

microclimate - the climatic conditions within a microhabitat

microcommunity - a small community, such as the plants and animals living in and on a decaying log; or in an ephemeral wetland

microhabitat - a small habitat for an organism, such as a tree stump or a space between clumps of grass

midstory - the layer of trees growing between the taller tree overstory and the understory shrubs

mutualism - a relationship of two or more organisms that is both necessary and beneficial to all participating organisms

mycorrhiza - a fungus living with the roots of certain plants

natural resources - both renewable (e.g., fish, trees) and non-renewable (e.g., coal, oil) materials

natural selection - the process that allow organisms to adapt to changing environmental conditions – ones with suitable adaptations ensure survival of the fittest to produce like kind, and ones without these adaptations die

nekton - swimming organisms able to navigate at will

neuston - organisms dependent upon the surface film of water

niche - the role of an organism in its environment – its activities and relationships to the living and non-living environment

nitrogen cycle - the transfer of nitrogen, chiefly by means of organisms, from the inorganic nitrogen in the atmosphere to nitrates, into proteins and protoplasm in plants and animals, to ammonia, and return to nitrites and nitrates

nutrient - something that nourishes

omnivore - an animal that feeds on both plant and animal life

organic - pertaining to or derived from living organisms

organism - a living plant or animal

overpopulation - a population density in excess of the capacity the environment can support (carrying capacity), usually accompanied by a high mortality rate because of inadequate nutrition; insufficient shelter; and increased predation, disease or parasitism

overstory - the layer of trees in a forest that forms the canopy

parasite - an organism which lives on or in another living organism from which it receives an advantage without compensation

perennials - those herbaceous and woody plants living from year to year, not dying after once flowering

periphyton - plants and animals attached or clinging to stems and leaves of rooted plants or other things in the water

phytoplankton - small, usually microscopic-sized plants in water

pioneer - a plant or animal that first invades a bare area

plankton - the floating or weakly swimming animal and/or plant organisms occurring at any depth in lakes, ponds, streams or seas – often microscopic in size

pollution - contamination of a habitat with substances that usually make it less favorable for most organisms

predator - an animal that attacks, kills and feeds on other animal life

prey - an animal hunted, killed and eaten by a predator

primary succession - the first stages of plant succession on a bare area, not previously occupied by plants or animals

producer - an organism that can use the sun's energy to make organic substances from inorganic materials

profundal - the bottom and deep water area which is beyond the depth of light penetration

pyramid of numbers - the concept that in most food chains the number of individuals decreases in each succeeding stage; large numbers of animals occur at the base, a few at the top

quadrat - a square sampling area used for analyzing vegetation

random sample - a sample of plants, animals, soil or other materials in an area in which the sample is located by chance—in contrast to selected samples

saprophyte - a plant that obtains food from dead or decaying organic material

scat - solid feces often used to identify wild animals

secchi disk - a white and black disk used to measure transparency of water

secondary succession - succession that takes place following the destruction of part or all of the vegetation in an area

sere - the series of stages that follow one another in succession

soil - the weathered layer of the earth's crust with living organisms and products of their decay intermingled

standing crop - the total amount of biomass of organisms of one or more species within an area

stratification - division of a community in horizontal layers

submergent vegetation - aquatic plants that grow under the surface of the water

succession - the replacement of one kind of community by another – the progressive changes in vegetation and animal life that may end in a climax type

symbiosis - two or more organisms of different species living together (including parasitism, mutualism and commensalism)

synecolgy - the study of the environmental relations of communities

transect - a line extending across or through a community used for sampling one or more natural resources

transpiration - the loss of water vapor from a plant

trophic level - a level of a food pyramid in which a group of organisms secure food in the same general manner. The first or lowest trophic level consists of producers (green plants), the second level of herbivores, the third level of primary carnivores and the forth level of secondary carnivores. Bacteria and fungi are organisms in the decomposer trophic level.

understory - the trees, shrubs and herbaceous vegetation in a forest below the upper and mid canopies

zooplankton - small, usually microscopic-sized animals living in water

References

These books should be available in your school or public library. Many are available in paperback. If you can't find these particular books, look up others on the same subject.

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New York: MacMillan, 1990

Buschbaum, Ralph and Mildred. *Basic Ecology*. Pittsburg; Boxwood Press, 1972.

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Carson, Rachel. *Silent Spring*. Greenwich, CT: Fawcett Publications, Inc., 1962.

Commoner, Barry. *The Closing Circle: Nature, Man and Technology*. New York: Knopf, 1971.

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Habitat Information

Much information about specific habitats can be found in books of general ecology by Odum and by Smith listed above.

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Field Guides

Peterson's Field Guide Series. New York: Houghton-Mifflin Co.

Golden Nature Guides and Field Guides Series. New York: Golden Press.

Techniques

Benton, Allen and William E. Weiner. *Manual of Field Biology and Ecology*. Minneapolis: Burgess Publishing Co., 1961.

Bookout, Theodore A. *Research and Management Techniques for Wildlife and Habitats.* Bethesda, MD: The Wildlife Society, 1994.

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Miniature Environments. *An Environmental Education Guidebook.* Available from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Smith, Robert L. *Ecology and Field Biology*. 4th. edition. New York: Harper and Row., 1990.

Environmental Activities

Conservation News and Conservation Reports. (Weekly reports of Congressional and other environmental action. (Free) National Wildlife Federation, 1412 Sixteenth Street, NW Washington, D.C.

Environmental Action Kit. (Free) Hudson Pulp and Paper Co., 477 Madison Ave. New York, NY. 10022

Fanning, Odom. Opportunities in Environmental Careers. New York: Vocational Guidance Manuals, 1971.

Leopold, Aldo. *A Sand County Almanac*. New York: Ballentine Books, Inc. 1970

Trial Planning and Layout. ($3.00) National Audubon Society, Nature Center Planning Division, 950 Third Ave. New York, NY 10022.

Wildlife Habitat Improvement. ($2.50) National Audubon Society, Nature Center Planning Division, 950 Third Ave. New York, NY 10022.

Some Web Sites Related to Natural Resources:

American Fisheries Society
www.fisheries.org

Backyard Birds
www.nhg.nres.usda.gov/CCS/Backyard.html

Bats Conservation International
www.batcon.org

Census of Agriculture
www.usda.gov/nass

Cornell Laboratory of Ornithology
www.ornith.cornell.edu

Deer Hunting in Tennessee
www.tndeer.com

Duck Hunting in Tennessee
www.duckhunter.net

Ducks Unlimited
www.ducks.org

Environment news
enviro-news@warp.nal.usda.gov

Environmental Protection Agency
www.epa.gov
www.epa.gov/owow/birds

Environmental Stewardship Team @ UTK Extension Related Clip Art
http://leviathan.tamu.edu:70/7c/clipart/

Enviro - Water Quality - Fisheries
www.nhq.nrcs.usda.gov/CCS/conbeat.html
www.asafishing.org/newsroom/pressreleases/NRCS.htm
www.ncg.nrcs.usda.gov/tech_notes.html

EPA Effluent Guidelines
www.epa.gov/OST/guide/

EPA's Fish Contamination Program
www.epa.gov/ost/fish

Farm-a-syst, Home-a-syst @ UTK
web.utk.edu/~ExtAgEco/farmsyst/homesyst/

Fishing in Tennessee
www.fishin.com

Grass Varieties in the US
www.forages.css.orst.edu/Topics/Species

Grant information
www.grantsnet.org/

How to conduct Research on Your Farm or Ranch
www.sare.org/san/htdocs/pubs/

National Park Service
www.nps.gov

National Wild Turkey Federation
www.nwtf.org

Journal of Extension, Extension programming
www.joe.org

Outdoor World-Bass Pro Shops
www.outdoor-world.com

Partners for Fish and Wildlife Program (US F&WL Service)
www.fws.gov/r9dhcpfw/

Purdue Forage Information
www.agry.purdue.edu/agronomy/ext/forages

Purdue University Aquaculture with slides and images
http://ag.ansc.purdue.edu/aquanic/images/slides/slides.htm

Quality Deer Management Association
www.qdma.com

Seafood Industry Web site
www.fishmonger.com

Southern Appalachian Man and Biosphere Cooperative
Sunsite.utk.edu/samab

Stream Corridor Restoration
www.usda.gov/stream_restoration

Supplier Directory Aquaculture
www.aquafind.com

Tall Timbers Research Laboratory
www.talltimbers.org

Tennessee Department of Environment and Conservation
www.state.tn.us/environment/state_env

Tennessee Wildlife Resources Agency (TWRA)
www.state.tn.us/twra/

The Wildlife Society
www.wildlife.org/index.html

The Wildlife Society - Southeastern Section
www.dnrec.state.de.us/fw/south/

University of Tennessee, Department of Forestry, Wildlife and Fisheries
www.fwf.ag.utk.edu/

University of Tennessee Web Page to all Departments
web.utk.edu

USDA Farm Bill Home Page
www.fb-net.org

US Fish and Wildlife Service
www.fws.gov/

US Forest Service
www.usgs.gov

Water Data Base
www.waterdatabase.org

Water Quality Team @ UTK
web.utk.edu/~ExtAgEco/water/html

Visit the Agricultural Extension Service Web site at:
http://www.utextension.utk.edu/
and the Forestry, Wildlife and Fisheries Web site at:
http://fwf.ag.utk.edu/

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