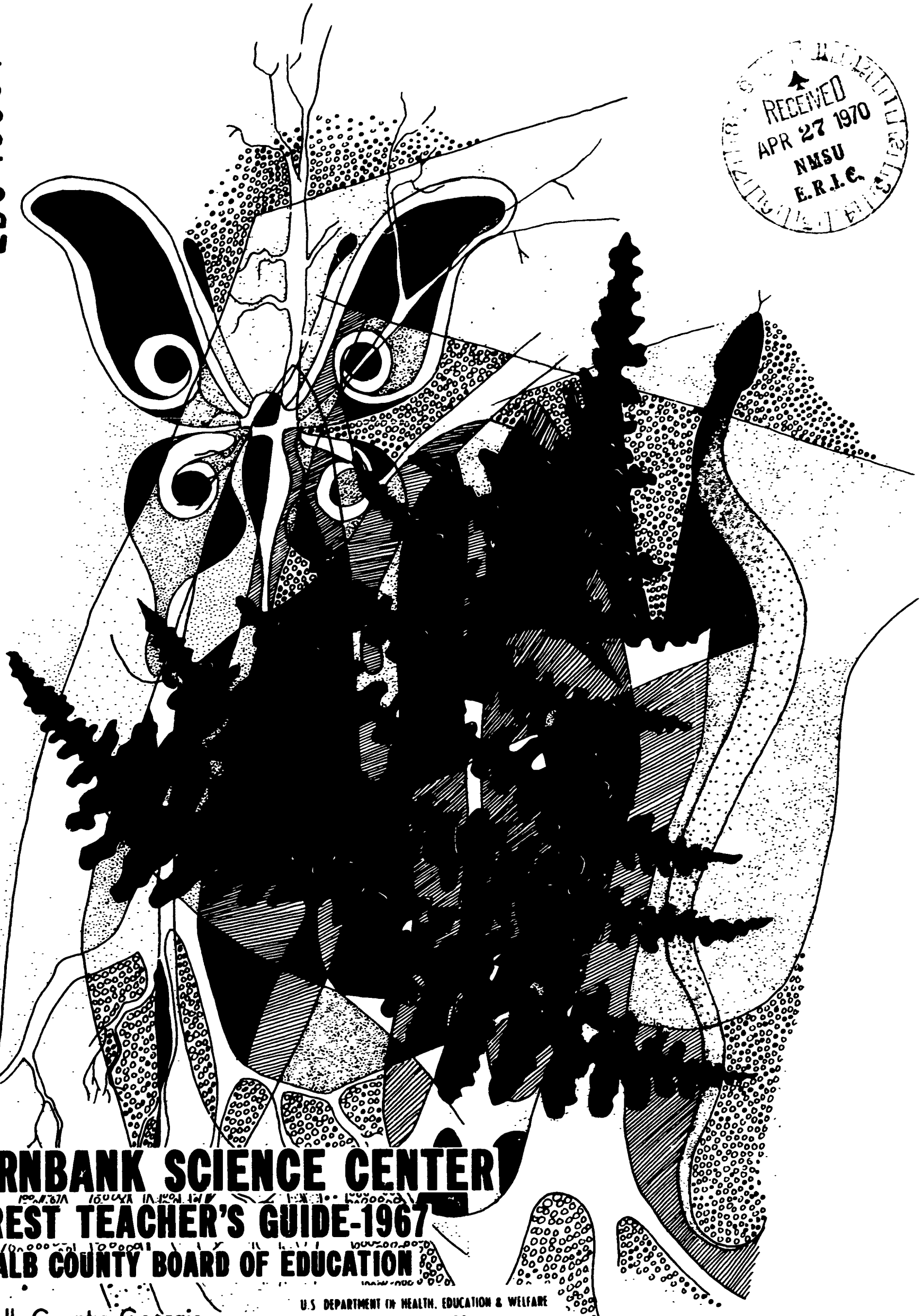
DOCUMENT RESUME

ED 040 084 SE 008 829

AUTHOR	Cherry, Jim; And Others
TITLE	Fernbank Science Center Forest Teacher's Guide-1967.
INSTITUTION	Dekalb County Board of Education, Decatur, Ga.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Elementary and Secondary Education.
PUB DATE	Jul 67
GRANT	OEG-2-6-001353-1027
NOTE	54p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$2.80
DESCRIPTORS	Biology, Course Content, *Ecology, *Elementary School Science, *Outdoor Education, Program Descriptions, *Secondary School Science, *Teaching Guides
IDENTIFIERS	ESEA Title III

ABSTRACT

This guide is designed primarily to familiarize teachers with the types of programs available through the Fernback Science Center. Instructional programs involving the use of the Fernbank Forest are outlined. Programs for secondary students include Plant Taxonomy, Field Ecology, Winter Taxonomy of Plants, and Climax Forest Succession. Elementary programs include Field Ecology, Plant Taxonomy, Ornithology, and Conservation. Listed are topics covered in the programs and concepts developed. References are given for the secondary programs and background information for the elementary programs. Appended are booklists for elementary schildren and teachers, a list of representative plants of Fernbank Forest, a classification of birds in Fernbank Forest, and supplementary references. This work was prepared under an ESEA Title III contract. (EB)



FERNBANK SCIENCE CENTER
FOREST TEACHER'S GUIDE-1967
DEKALB COUNTY BOARD OF EDUCATION

DeKalb County, Georgia
Jim Cherry, Superintendent
Lewis S. Shelton, Director

E GRAHAM

FERNBANK SCIENCE CENTER

DeKalb County Board of Education
DeKalb County, Georgia

This Project is Currently Operating Under

the U. S. Office of Education, Title III,

ESEA Grant No. OEG 2-6-001353-1027.

FOREWORD

Teachers, supervisors, principals, members of the DeKalb Board of Education, and the school administration are seeking to develop a comprehensive program of educational opportunities for DeKalb boys and girls and adults. The Fernbank Science Center for natural and space sciences is a part of the plan. It is a fine example of what is possible where an effort is made to seek ways to improve and expand educational opportunities and services.

The forest provides a living laboratory, and it is supplemented by the Science Center where boys and girls and adults will have access to an electron microscope, an observatory, and a Zeiss planetarium, with supporting laboratories and instructional facilities.

Plans for the future include a Museum of Natural History, an aquarium, and greenhouses, with a considerable acreage for botanical gardens.

A competent faculty has been developed. Instructional materials are being prepared, and already many thousands of boys and girls and adults are participating in the instructional program. This handbook on Forest Curriculum is a portion of the materials which are being developed for interpreting and for using efficiently this facility of the DeKalb County School System.

Jim Cherry

Jim Cherry,
Superintendent

July 1, 1967

FERNBANK FOREST TEACHER'S GUIDE

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DeKalb County Schools

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INTRODUCTION

The Fernbank Science Center represents a unique academic facility designed to enhance scientific literacy through a variety of programs and exhibits developed for all levels of student and community groups.

The center basically consists of two well coordinated entities. The first is represented by a majestic sixty acre primeval forest which is being utilized as a living laboratory for instruction in the life sciences. Programs provide innumerable opportunities for observation of principles basic to the understanding and appreciation of ecology, taxonomy, conservation and ornithology. Second, it is represented by a physical center second to none, in relation to its quality of total instrumentation, as well as its instructional value. Its assets will include the nation's third largest planetarium, a modern electron microscope laboratory, the second largest observatory in the eastern United States, staff and student research facilities, a controlled environment room for plant growth research and study, a professionally equipped meteorological laboratory, a science reference library of extreme merit, and modern classrooms equipped with closed circuit television. Every entity within the Fernbank Science Center is designed to contribute toward maximum utilization of the center in accord with its primary purpose of public instruction.

The Fernbank Science Center is under the supervision of the DeKalb County Board of Education, It was through the foresight and efforts of Mr. Jim Cherry, Superintendent of DeKalb County Schools, and the Fernbank Board of Trustees, that agreement was reached enabling the acquisition of the climax oak-hickory forest through an extended lease, as well as the construction of one of the nation's leading science facilities dedicated to the enhancement of public and community education.

The following material is designed primarily to familiarize teachers with the types of programs available through the Fernbank Science Center. It should be carefully noted that the center's function is a supplementary one in relation to the curriculums taught within classrooms throughout Georgia.

SCHEDULING INFORMATION

It is of primary importance that the subject matter considered at the center be coordinated with the classroom material it is intended to supplement. It is recommended that each teacher attempt to schedule field experiences early enough in the year to insure obtaining an effective correlation of field and classroom instruction.

For maximum efficiency in scheduling the following procedure should be followed:

1. Scheduling should be developed on a departmental or subject area basis in order to achieve maximum efficiency in the scheduling of transportation from a particular school. Once a desired schedule is developed it should be submitted to the principal for approval.

2. Transportation arrangements and confirmation of scheduled dates through the Fernbank Science Center shall be the responsibility of the principal. Final schedule arrangements through the center can be made by contacting the Fernbank Science Center office at 373-2561.

3. Information necessary for completion of schedule arrangements will include: school, principal, sponsoring teachers, curriculum desired, time of arrival, time of scheduled departure, and the number of students expected to attend.

4. It is important that arrival and departure times be followed according to each school's allotted period of instruction. Due to heavy demand on forest scheduling, departure times will be considered *firm* in order not to penalize later group's instruction time due to a previous group's late arrival.

5. Programs usually require fifty minutes to one hour for complete instruction in any given area. Student groups are limited to approximately thirty students per instructor in accord with forest program methodology which requires complete instructor-student communication during an instructional period. Exceptions to time and group size limitations are noted in relation to special forest curriculums. Before scheduling check with the Fernbank Science Center office to determine the total number of students who can be accommodated at any one time since this number will be determined by staff size.

PREPARATION OF STUDENTS

Each topical area in the Fernbank curriculums is designed for illustration of basic concepts contained in the related subject area course guide outline. In order to achieve maximum utility from Fernbank instruction students should be prepared in fundamental concepts (related to the subject area scheduled) prior to their arrival. Students should be prepared to share in a learning experience which will require the same attitudes and rules of behavior basic to successful classroom instruction. It is highly recommended that the students be assured of the academic purpose of Fernbank excursions. Reinforcement of the desired student attitudes may be achieved through incorporation of a prescheduled test related to the material used in the classroom and at the science center.

In order to preserve the state of balance within the forest, the following regulations basic to successful conservation practices and the establishment of an optimum field teaching environment are binding to forest visitors:

1. No plants or animals or parts of these organisms are to be removed from the forest. Conservation must be practiced in order to preserve the beauty of the forest.

2. School classes and other groups must receive thorough briefing about the forest and the scheduled

program before their arrival.

3. All groups are restricted to developed paths and observation stations in the forest. This is necessary to prevent disturbances of plant life and the natural breeding places of animal organisms.

4. All groups must be scheduled in advance through the office of the Director of Fernbank Science Center. (156 Heaton Park Drive, N. E., Atlanta, Georgia 30307, Telephone 373-2561)

5. The forest will be used for educational purposes only. Picnics, camping and related activities are strictly *prohibited.*

6. No smoking is allowed in the forest due to the hazardous conditions which often prevail.

FERNBANK FOREST INSTRUCTIONAL PROGRAMS

Programs

The curriculums incorporated into forest instruction are of three types:

A. *Standard Curriculums* – Curriculums designed to supplement and enhance, through forest instruction, the basic areas of the natural sciences normally considered by the classroom teacher

B. *Specialized Curriculums* – Programs designed for illustration of principles and concepts not usually considered in normal classroom instruction but readily applicable to the needs of the advanced student

C. *Request Curriculums* – The Fernbank Science Center staff will design a forest program of instruction specifically to the expressed needs of an individual teacher. Such programs require careful coordination between the classroom teacher and forest instructor in order to assure maximum value to the student. Initiation of request curriculums should be made well in advance of the scheduled school participation date through completing and forwarding a form parallel to that enclosed at the end of this handbook entitled "Fernbank Science Center Special Programs Request."

Use of Program Descriptions

The following descriptive materials are designed to provide the teacher with a means of becoming familiar with each forest curriculum's content.

Each standard curriculum discussed in the following pages includes a listing of the general concepts it incorporates and a detailed outline of the subject matter entertained.

The purpose of this material is to allow the teacher to select an instructional program which will best meet the needs of his students, as well as to provide him with material which may be incorporated in pre-program student preparation and post-program testing.

Specialized curriculums which have proven successful in previous instructional programs are also included through sample content, general description, or by title. A teacher interested in the incorporation of any of these curriculums should contact the center in order to establish the specific areas of emphasis desired.

PLANT TAXONOMY CURRICULUM OUTLINE

I. Introduction to Taxonomy

A. History
   1. Ancient Greeks and Romans
      a. Theophrastus
      b. Pliny the Elder
      c. Dioscorides
   2. The Herbalists
      a. Doctrine of signatures
      b. Employment of woodcuts in illustrations
   3. The Transition Period
      a. Joachin Jung
      b. John Ray
      c. Carolus Linnaeus
   4. The Modern Period
      a. George Bentham
      b. Sir Joseph Hooker
      c. Asa Gray
      d. Charles Edwin Bessey

   (Items A-1 through 4 should be considered by the classroom teacher to some degree prior to arrival).

B. The Binomial System and Its Importance

II. Classification of Major Divisions of Fernbank Forest Flora

A. Mycophyta – No cholorophyll
   No vascular tissue
   Reproduce by spores, not seeds
   Mainly decomposers

   1. Class Basidiomycetes – Club fungi
      a. *Lenzites*
      b. *Polyporus*
      c. *Fomes*
   2. Class Ascomycetes
      a. Chestnut Blight
      b. Dutch Elm Disease

B. Bryòphyta – Chlorophyll present – food producers
   Alternation of generation with gametophyte generation more conspicuous
   Pioneer plants
   Lack vascular tissue
   Leaf-like and stem-like structures present

   1. Class Hepaticae – Liverworts – *Marchantia*
   2. Class Musci – Mosses – *Polytrichum*

C. Tracheophyta – Chlorophyll usually present – food producers
Vascular tissue always present
Alternation of generation with sporophyte generation more conspicuous
Well developed system of leaves, stems, and roots the rule rather than the exception

1. Subphylum Lycopsida – Club mosses and spike mosses
   a. *Lycopodium obscurum* – Ground-pine – Lycopodiaceae
   b. *Lycopodium lucidulum* – Shining Clubmoss – Lycopodiaceae
   c. *Selaginella apoda* – Meadow Spike – Moss – Selaginellaceae
2. Subphylum Pteropsida – Ferns, Gymnosperms and Angiosperms
   a. Class Filicineae
      (1) *Adiantum pedatum* – Northern Maidenhair Fern
      (2) *Asplenium platyneuron* – Ebony Spleenwort
      (3) *Athyrium filix femina* – Lady Fern
      (4) *Botrychium virginianum* – Rattlesnake Fern
      (5) *Camptosorus rhizophyllus* – Walking Fern
      (6) *Dryopteris hexagonoptera* – Broad Beech Fern
      (7) *Dryopteris marginalis* – Marginal Wood Fern
      (8) *Onoclea sensibilis* – Sensitive Fern
      (9) *Osmunda regalis* – Royal Fern
      (10) *Polypodium polypodioides* – Resurrection Fern
   b. Class Gymnospermae
      (1) *Pinus taeda* – Loblolly pine – Pinaceae
      (2) *Pinus echinata* – Shortleaf pine – Pinaceae
      (3) *Tsuga canadensis* – Canadian hemlock – Pinaceae
      (4) *Tsuga caroliniana* – Carolina hemlock – Pinaceae
   c. Class Angiospermae – Flowering Plants
      (1) Subclass Monocotyledoneae – usually parallel venation, one cotyledon in seed, flower parts usually in three's or multiples of three
         (a) *Sagittaria latifolia* – Arrowhead – Alismataceae
         (b) *Sorgum halepense* – Johnson Grass – Gramineae
         (c) *Uvularia perfoliata* – Merry-bells – Liliaceae
         (d) *Polygonatum biflorum* – Solomon's Seal – Liliaceae
         (e) *Smilax rotundifolia* – Greenbrier – Liliaceae
      (2) Subclass Dicotyledoneae – usually netted venation, two cotyledons in seed, flower parts usually in four's or five's or multiples of four's or five's

Dicotyledons make up a majority of the most conspicuous plants that will be identified in Fernbank

Forest; therefore, these plants will be broken down into four groups based on patterns of growth in order to make identification easier. Consult the chart on page 8 for a summary of representative flora in Fernbank Forest.

CONCEPTS

1. Man, whether he be civilized or savage, likes to arrange things in a somewhat orderly manner.

2. Early attempts to classify plants were based on artificial systems. Is the plant helpful or harmful? Can the plant be used for food? Does the plant have medicinal value or is it poisonous? Can houses, clothes, or weapons be made from the plant?

3. Among the first people to leave a written record of attempts to classify plants were the Greek and Roman philosophers.

4. Misconceptions, as well as facts, were handed down from the ancient philosophers to the Herbalists. The results of these misconceptions can still be found in the scientific names of some plants today. The Doctrine of Signatures is one of these misconceptions.

5. During the Transition Period, roughly beginning with the sixteenth century, botanists broke away from traditional artificial systems of classification and developed new systems leading toward a more natural arrangement of plant groups.

6. Progress is still being made in taxonomy as new facts and new relationships are discovered from studies in cytogenetics and comparative anatomy of flowers and embryos.

7. Although a plant may have a number of common names, there is only one legitimate scientific name. If duplicate scientific names arise through misconceptions, professional botanists rule on the legitimate name at periodic meetings known as *International Congresses*. Rules adopted and published by this Congress are known as the *International Code of Botanical Nomenclature*.

8. Fungi have no chlorophyll and cannot produce their own food; therefore, they must be either decomposers or parasites. Since it is a short step from feeding on dead organisms to attacking living organisms, some of the more destructive fungi are parasites.

9. Since mosses and liverworts do not have vascular tissue, they do not grow tall, can be found in moist places or on rocks or logs where other plants are not growing, possess chlorophyll and make their own food.

10. Tracheophytes always possess vascular tissue and usually have chlorophyll and a well developed system of leaves, roots and stems; they show much diversity in size, form, adaptations, and means of reproduction.

11. Club Mosses were formerly abundant on the earth. Any study which attempts to survey the plant life of the earth must include club mosses because a knowledge of their structure and methods of reproduction provide many clues to an understanding of the extinct species although the remaining species are of no great significance to man or to the earth's present vegetative cover.

12. Ferns are among the oldest groups of living land plants; they occur from the moist tropics to beyond the Arctic Circle. In temperate regions ferns are generally found in shady woodlands, moist meadows, and along stream banks and range in size from tiny floating ferns to tropical tree ferns that may be sixty feet tall. Although they are of botanical interest, ferns are of no great economic importance. The fern's general ecological role is comparable to that of the mosses in that they help hold and form soil.

13. Angiosperms and Gymnosperms are distinguished from ferns in that they produce seeds. These plants are of the greatest significance to man.

14. The name Gymnospermae means "naked seeds." This name was applied because the ovules are not enclosed within a pistil composed of one or more carpels. The gymnosperms in Fernbank Forest are evergreen conifers with needlelike leaves.

15. Angiosperms are the dominant plant life of the geological era in which we live. Practically all of the cultivated plants used as food for animals and for man himself are angiosperms; they also furnish materials for shelter, furniture, medicine, clothing and oils.

16. The presence of a flower that is more or less showy distinguishes angiosperms from all other groups of plants. The enclosure of the ovules within a protective covering is a unique characteristic of the angiosperms and separates them from the gymnosperms.

17. Angiosperms are divided into two subclasses – the monocotyledons which have one seed leaf in the embryo and the dicotyledons which have two seed leaves in the embryo.

18. Monocotyledons may be tree-like but they usually are herbaceous annuals or perennials. These plants are especially prominent in the tropics. Vascular bundles are scattered in a pith-like tissue instead of being grouped in a ring as in dicotyledons. Cambium is usually absent and the stem is composed of only primary tissue.

19. Dicotyledons are the larger and older of the two groups of angiosperms. Cambium is usually present and an increase in diameter occurs from year to year. Vascular tissues are arranged in a circle surrounding a central pith.

20. The plants of the forest can arbitrarily be divided into groups based on patterns of growth. A few species grow tallest and form a canopy. Smaller trees, shrubs, trailing and climbing vines, and ground cover which grow below the canopy do not receive as much sunlight as the larger trees.

21. Some of the characteristics used in identifying plants are:

    a. Opposite or alternate leaf arrangement on stem
    b. Simple or compound leaves
    c. Size and shape of leaves
    d. Deciduous or evergreen leaves
    e. Presence or absence of corky wings, spines, thorns, and stipules
    f. Size, shape, color, and location of terminal and lateral buds
    g. Peculiarities of leaf scars, lenticels, stipule scars, and pith
    h. Presence of flowers and/or fruit
    i. Peculiarities in color and texture of bark

SELECTED REPRESENTATIVE FLORA

	Large Trees (Overstory)	Small Trees & Shrubs (Understory)	Trailing or Climbing Plants	Ground-Cover
SIMPLE ALTERNATE DECIDUOUS	Oaks, Beech Basswood Winged Elm Sycamore Sweetgum	Blackgum Sourwood Ironwood Wild Cherry Hawthorns Umbrella Magnolia	Muscadine Carolina Moonseed Greenbriers (monocot)	Solomon's Seal False Solomon's Seal (monocot)
SIMPLE ALTERNATE EVERGREEN	Southern Magnolia	American Holly Elaeagnus	Trailing Arbutus	English Ivy Pipsissewa
SIMPLE OPPOSITE DECIDUOUS	Red Maple	Dogwood Paulownia Sweet-shrub		Indian Pink
SIMPLE OPPOSITE EVERGREEN		Privet	Japanese Honey-suckle	Partridge berry
COMPOUND ALTERNATE DECIDUOUS	Hickories Pecan Black Walnut	Smooth Sumac Winged Sumac Mimosa Hercules Club	Blackberry Poison ivy Wisteria	
COMPOUND OPPOSITE DECIDUOUS	Ashes	Black Elderberry	Trumpet Creeper	

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FIELD ECOLOGY CURRICULUM OUTLINE

I. **Introduction to Ecology**

- A. Definition of Ecology
- B. Definition of Ecosystem
- C. Definition of Community
- D. Definition of Habitat
- E. Definition of Succession

(Students should have a general understanding of these terms.)

II. **Succession**

- A. Disturbed area – old field succession
  1. Relief and elevation of area
  2. Representative organisms
     - a. *Albizzia julibrissin* – mimosa
     - b. *Wisteria* – wisteria
     - c. *Andropogon virginicus* – broom sedge
     - d. *Solidago* – goldenrod
     - e. *Pinus* – pine
- B. Secondary climax area
  1. Relief and elevation of area
  2. Representative organisms
     - a. Pines
     - b. Hardwoods
     - c. Ecological interrelationships
       - (1) Greater occurrence of pines
       - (2) Many pines are dead or dying
       - (3) Greater variety of species of hardwoods
       - (4) Hardwoods replacing pines
- C. Climax area
  1. Relief and elevation
  2. Representative organisms
     - a. Canopy species
     - b. Understory species
     - c. Ground cover species

III. Specific Areas for Ecological Study

A. Microcommunity

1. Elephant rock

a. Primary Habitat

b. Primary Succession

(1) Abiotic factors

(2) Biotic factors

c. Microhabitat

2. Fallen tree-log community

a. Decomposers-fungi and bacteria

b. Consumers – insects

c. Producers – lichens

B. Ecosystem

1. Pond Ecosystem

a. Abiotic factors

(1) Aquatic habitat

(2) Temperature

(3) Solar radiation

b. Biotic factors

(1) Producer organisms

(a) Phytoplankton

(b) Rooted and floating plants

(2) Consumer organisms

(a) Insect larvae

(b) Crustacea

(c) Fish

(3) Decomposers

(a) Bacteria

(b) Fungi

(4) Interrelationships among the organisms

(a) Food chains

(b) Food web

c. Hydrarch Succession

(1) Submergent aquatics

(2) Floating aquatics

(3) Emergent aquatics

2. Forest Ecosystem
   a. Abiotic Factors
      (1) Climatic factors
      (2) Soil type
      (3) Carbon and nitrogen cycles
   b. Biotic factors
      (1) Types of organisms
         (a) Producers – green plants
         (b) Consumers – animals
         (c) Decomposers – bacteria and fungi
      (2) Interrelationships
         (a) Mutualism
         (b) Parasitism
         (c) Commensalism
         (d) Saprophytic

CONCEPTS

1. Living organisms and their nonliving environment are interrelated and interact upon each other.

2. The ecosystem is a basic functional unit in ecology; it is made up of both the abiotic environment and the biotic communities.

3. The place in which one would see an organism or the place in which the organism lives is called its habitat.

4. The role or function that an organism plays in the ecosystem is its ecological niche.

5. Ecological succession is the orderly and progressive replacement of one community by another until a relatively stable community occupies the area.

INTRODUCTION TO ECOLOGY TERMINOLOGY LIST

The following list of common ecological terms and definitions is offered as an aid to the participating teacher. As ecology is a relatively young branch of the natural sciences several individual interpretations of basic ecological terms exist. The terms and definitions below are those accepted by the Fernbank Science Center staff for incorporation into our ecology programs.

FIELD ECOLOGY TERMS

1. *Ecology* – The study of the relationships of organisms or groups of organisms between each other and to their environment; the science of the interrelations between living organisms and their environment.

2. *Biota* – The complete flora and fauna of a given area.

3. *Biome* – A climatically controlled area including a number of different communities in various stages of

succession such as a tundra, a desert, or a deciduous forest. Biomes are plant formations with the animal constituents integrated.

4. *Ecosystem* – An area that includes living organisms and non-living substances interacting to produce an exchange of materials between the living and nonliving parts.

5. *Community* – All of the populations of a given area; a general term applicable to aggregations of plants and animals of all sizes that have dynamic interactions and dependencies. Communities are usually named for their most abundant and conspicuous constituents.

6. *Population* – A group of organisms of the same species occupying a given space.

7. *Habitat* – The place where an organism lives; an area of surface with its minerals and climate. Essential features of the habitat include sunshine, rainfall, and temperature.

8. *Abiotic factors* – The specific set of physical conditions that surround the organisms, such as sunlight, soil, mineral elements, moisture, temperature, and topography; those nonliving factors which encompass organisms and exert environmental effects upon them.

9. *Biotic factors* – The living elements of an area which modify the surrounding environment; for example, all the living organisms which may affect a tree, such as bark beetles, birds, bacteria, fungi, worms, and parasites, are biotic factors.

10. *Succession* – The orderly and progressive replacement of one community by another until a relatively stable community occupies the area.

11. *Primary Habitat* – A bare area devoid of living organisms such as volcanic rock and ash, silt and sand deposited by rivers, ground left by receding waters and glaciers or wind-deposited sand and loess.

12. *Microcommunity* – A very small community in reference to spacial dimensions but not necessarily to size of population.

13. *Pioneer Community* – The first group of plants and animals to become established in a primary habitat.

14. *Secondary Community* – A community which becomes established as the pioneer species gradually disappears. The period of time that the secondary community exists and the rate of change will vary according to the surrounding factors.

15. *Climax Community* – The group of organisms that emerges in the final stage of succession and persists in remaining stable for an indefinite period of time in a given area.

16. *Microsuccession* – Succession that occurs in a very small area such as gradual changes which take place in a fallen log on the floor of the forest.

17. *Primary Succession* – Succession that begins in an area which has not been occupied previously by living organisms.

18. *Secondary Succession* – Community development proceeding in an area from which a community was removed; succession which proceeds from a state in which other organisms already were present.

19. *Hydrarch Succession* – Succession which takes place where water is plentiful; the sequence of communities which occurs in ponds, lakes, streams, swamps, or bogs where movement of water is relatively slow.

20. *Mesarch Succession* – Succession which takes place where moisture is present in adequate amounts. The

succession series is much shorter because moisture conditions are more ideal.

21. *Xerarch Succession* – Takes place where moisture is present in minimal amounts; succession that originates in a relatively dry place.

22. *Sere* – A series of ecological communities succeeding one another in the biotic development of an area; the whole series of communities that terminates in a final stable community.

23. *Seral Stage* – Each of the changes that takes place in a sere; the transitory communities that make up a sere.

24. *Ecotone* – A transition between two or more diverse communities as, for example, between forest and grassland; a zone of change between two adjacent ecological communities.

25. *Stand* – A localized sample or portion of an associational community. A stand is the largest concrete community included in a scheme of community classification; this can be a particular forest, river, or lake and occupies a specific area which will exist for a specific interval of time.

26. *Producers* – The autotrophic organisms in a community, largely the green plants.

27. *Consumers* – The heterotrophic organisms, chiefly animals that ingest other organisms or particulate organic matter.

28. *Decomposers* – Organisms that break down the complex compounds of dead protoplasm, absorb some of the decomposition products, and release simple substances usable by producers.

29. *Autotrophic Organisms* –Organisms able to fix light energy and manufacture food from simple substances.

30. *Heterotrophic Organisms* – Organisms which utilize, rearrange, and decompose the complex materials synthesized by autotrophs.

31. *Food Chain* – The relationship in which the energy stored by plants is passed along through the community in a series of steps of eating and being eaten. At each step a large proportion of the potential energy is lost as heat.

32. *Food Web* – A combination of interlinked food chains.

33. *Intraspecific Relationships* – Relationships between members of a particular species.

34. *Interspecific Relationships* – Relationships between members of different species.

35. *Ecological Niche* – The position or status of an organism within its community and ecosystem resulting from the organism's structural adaptations, physiological responses, and specific behavior; the function a species performs in the community.

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WINTER TAXONOMY OF PLANTS
CURRICULUM OUTLINE

I. Introduction to Winter Taxonomy of Deciduous Trees and Shrubs

A. Terminology of twig structures

1. Leaf buds

a. Arrangement of lateral buds

(1) Opposite

(2) Alternate

b. Terminal bud

(1) True

(2) False

c. Bud scales

(1) Presence and/or number

(2) Absence and/or naked or unprotected

2. Leaf scars

a. Arrangement of leaf scars

(1) Opposite

(2) Alternate

b. Bundle scars in leaf scars

(1) Arrangement

(2) Number

3. Stipule scars

a. Presence

b. Absence

4. Bud scale scars

5. Lenticels

a. Color

b. Shape

c. Size

6. Thorns and spines

a. Absence or presence

b. Size

c. Shape

7. Composition and shape of the pith

a. Continuous or homogeneous

b. Spongy or porous

c. Excavated or hollow

8. Twig surfaces
   a. Glabrous (smooth)
   b. Pubescent (hairy)
   c. Glaucous (covered with a bloom)
9. Cross section of twigs
   a. Terete (circular to oval)
   b. Three to five angled

B. Terminology of fruit types
1. Compound
   a. Aggregate
   b. Multiple
2. Simple
   a. Fleshy
      (1) Drupe
      (2) Berry
      (3) Pome
   b. Dry
      (1) Dehiscent
         (a) Legume
         (b) Follicle
         (c) Capsule
      (2) Indehiscent
         (a) Achene
         (b) Samara
         (c) Nut

II. Identification of Deciduous Trees and Shrubs (Winter Structures)

A. Arrangement of leaf scars
1. Opposite
   a. Red Maple
   b. Dogwood
   c. Ashes
   d. Elderberry
2. Alternate
   a. Oaks
   b. Beech

c. Sweetgum

d. Tulip Poplar

e. Sumac

f. Hercules Club

g. Mimosa

h. Hickories

i. Hawthorns

j. Umbrella Magnolia

k. Sycamore

l. Pawpaw

B. Number of bundle scars

1. Four to many with opposite leaf scars

a. Paulownia

b. Ashes

c. Elderberry

d. Sycamore

e. Pawpaw

f. Umbrella Magnolia

2. One to three with opposite leaf scars

a. Dogwood

b. Red Maple

3. Four to many with alternate leaf scars

a. Beech

b. Tulip Poplar

c. Oaks

d. Hickories

e. Sumacs

4. Three with alternate leaf scars

a. Sweetgum

b. Mimosa

5. One with alternate leaf scars

a. Sourwood

b. Sassafras

C. Presence of thorns

1. Thorns long and slender

a. Hawthorns

b. Japanese Barberry

2. Thorns short and stout
    a. Hercules Club
    b. Rose

III. **Identificction of Deciduous Trees and Shrubs (Fruits)**

A. Compound fruits
    1. Multiple
        a. Capsules (ex. Sweetgum)
        b. Achenes (ex. Sycamore)
    2. Aggregate
        a. Samaras (ex. Tulip Poplar)
        b. Follicle (ex. Umbrella Magnolia)

B. Simple fruits
    1. Fleshy
        a. Drupe (ex. Dogwood, Elderberry, Sumac, Hercules Club)
        b. Berry (ex. Pawpaw, Barberry)
        c. Pome (ex. Hawthorns)
    2. Dry
        a. Dehiscent
            (1) Legume (ex. Mimosa, Black Locust)
            (2) Follicle (ex. Umbrella Magnolia)
            (3) Capsule (ex. Paulownia)
        b. Indehiscent
            (1) Achene (ex. Sycamore)
            (2) Samara (ex. Maple, Ash)
            (3) Nut (ex. Oak, Beech, Hickory)

CONCEPTS FOR WINTER TAXONOMY CURRICULUM

1. Plant structures are available, even during the winter months, which aid in identification of many plants.

2. In addition to the outstanding bark characteristics on certain species of adult trees, there are several "winter features" which aid in identification of deciduous trees and shrubs.

3. The winter bud is an embryonic branch of either the leaves or the flowers. The normal position for the leaf buds is either in the axil, upper angle between the leaf and stem, or at the apex of the twig. The buds found in the leaf axils are called lateral or axillary buds and those at the apex of the stem are called terminal buds. The terminal bud, depending on the species in question, may be either a true or false terminal bud.

4. The leaf scars and bundle scars are important in winter taxonomy. The leaf scar is a structural characteristic that remains on a twig following the fall of a leaf; this occurs when the communication between the leaf and the twig lessens until the petiole becomes weakened to the point that the leaf falls off, the breakage occurring at absciss layer, which is a layer of cells which are more or less corky. When the leaf falls the corky layer remains marking the previous position of the leaf. The falling of the leaves is a drastic change for the tree to undergo and marks the beginning of the resting stage which characterizes deciduous trees during the winter months. The bundle scar is found on the leaf scar. It is indicated by one to many dots or lines which indicate where the channels of sap conduction entered or passed from the leaf to the stem.

5. The presence of stipule scars is found in certain groups of plants. The stipules are small leaf-like organs occurring in pairs on the twig, one at each side of the petiole; they usually fall during the summer and usually leave a small narrow scar on the twig.

6. Thorns and spines are sharp outgrowths of the twig but presumably have different origins. Thorns are modified branches while spines are considered to be modified persistent stipules.

7. The shape of the lenticels found on the stem is a key characteristic. The lenticels are pores through which exchange of gases occurs.

8. The composition of the pith is helpful in distinguishing various species. The pits may be continuous, spongy, or excavated.

9. The type of fruit that a plant bears is often helpful for identification. If the fruit is not present, often the seed pods are present.

10. The characteristics of the winter structures are used in the following manner for identification purposes:

    A. Arrangement of the leaf scars – opposite or alternate

    B. The number of bundle scars in the leaf scar

    C. Presence of a true or false terminal bud

    D. Presence or absence of stipule scars

    E. Presence or absence of thorns or spines

    F. The shape and color of the lenticels

    G. The type of fruit or seed pod that the plant bears

REFERENCES FOR WINTER TAXONOMY

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CLIMAX FOREST SUCCESSION
CURRICULUM OUTLINE

I. **Effects of Climate and Soil on a Regional Climax**

- A. Climatic factors
- B. Factors determining soil type

II. **The Eastern Deciduous Forest Province**

- A. General boundaries
- B. Divisions of southern portion
  1. Oak-hickory forest
     - a. Average rainfall
     - b. Patterns of growth
       - (1) Crown cover
       - (2) Understory
       - (3) Ground cover
  2. Pinelands
  3. Magnolia maritime forest
- C. Fernbank Forest
  1. Patterns of growth
     - a. Crown cover – Largest trees
     - b. Understory – Smaller trees
  2. Climax portion – West side
     - a. Description
     - b. Lack of suitability for domestication
  3. Secondary succession portion
     - a. Description
     - b. Suitability for domestication
  4. Surviving American Chestnuts

CONCEPTS

1. Climate is the principal factor determining the general nature of the vegetation in a specific area.

2. The group of plants which emerges and persists in a specific area for an indefinite period of time is referred to as the "regional climax."

3. Soil type is also a factor in determining the general nature of the vegetation in a specific area although it too is dependent to a large extent on climate.

4. In addition to climate soil type is dependent on parent material, length of time that weathering has taken

place, number and kinds of plant and animal organisms present in the soil, and the relief and elevation of the area.

5. The Eastern Deciduous Forest Province extends from southern Canada to the coastal plain of the southern states. Soils in this area vary greatly as do the trees that form the climax forest in specific geographical locations.

6. Pines, rather than deciduous hardwoods, make up many of the forests in the southern part of Georgia. The frequency of fires plus management by man prevent replacement of the pines by hardwoods.

7. The larger trees of the forest form a canopy which prevents much direct sunlight from reaching the forest floor. Many herbs produce flowers and complete most of their growth in the early spring before the larger trees have completely leafed out.

8. The most common large angiosperm trees in Fernbank Forest are the tulip poplar, beech, the oaks, and the hickories. Approximately ten species of smaller trees are very common. The most numerous gymnosperms are loblolly and shortleaf pines.

9. The Chestnut Blight is an example of a disease that attacked a particular species of plant and drastically changed the regional climax in certain areas.

Background Material

Climate is the principal factor determining the general nature of the vegetation in a specific area. An indirect factor is the nature of the soil although soil type is dependent to a large extent on climate. Climatic conditions such as amount and frequency of rainfall at a given time (month or season), photoperiod, temperature variables, and variation in wind velocity all help to determine what species of plants are found in a regional climax. The group of plants that emerges and persists in remaining stable for an indefinite period of time in the final stages of succession is the regional climax. Soil type is determined by the following factors: climate, the parent material from which the soil is derived, the length of time that the parent material has been weathered, the number and kinds of organisms present, and the relief and elevation of the area under consideration.

Most of the eastern part of the United States, exclusive of the southeastern coastal plain, belongs to the Eastern Deciduous Forest Province (as named by Gleason and Cronquist in *The Natural Geography of Plants).* It is limited on the north by progressively decreasing mean temperatures, by increasing aridity in the west, and by a change in soil type at the Fall Line in the south. Most of the southern portion of the Eastern Deciduous Forest Province can be divided into the oak-hickory forest, the pinelands, and the magnolia maritime forest. The oak-hickory forest would replace the pinelands if it were not for frequent fires. The rainfall in the oak-hickory portion varies from forty to seventy inches per year. Rainfall is greatest in the spring and summer. The trees of the deciduous forest form an almost complete crown cover, and as a result, very little direct sunlight reaches the ground in summer. There is generally a well-developed understory of shrubs and herbs, but walking through the forest can be done with little difficulty. Some herbs, such as spring beauty, hepatica, trillium, and violets bloom in early spring, before the trees have leafed out, and complete most of their growth within a few weeks. Although there are many plants that bloom later in the spring and early summer, those are usually not as numerous as the early spring flowers because of an inability to receive sunlight after the trees have produced leaves. Plants which can grow with less sunlight, such as ferns. will be found on the forest floor but do not restrict forest travel.

In Fernbank Forest the largest angiosperms belong to four genera which include the oaks, hickories, tulip poplar, and beech. Other large trees found in smaller numbers include winged elm, black walnut, basswood, southern magnolia, sweetgum, red maple, and sycamore. Among the gymnosperms there are two species of pines, the loblolly and the shortleaf, along with a few hemlocks and one species of *Chamaecyparis*. Under these large trees are a number of species of smaller trees which never attain the maximum height and diameter

of the above trees. These include dogwood, blackgum, sourwood, ironwood, wild black cherry, umbrella magnolia, hawthorn, American holly, red mulberry, and redbud.

The part of Fernbank Forest that most nearly approaches climax is the area from Elephant Rock up to the pond and then on toward the fence on the west side of the stream. This area is more rugged and less adaptable for cultivation or domestication than the area on the east side of the stream; therefore, it has been probably disturbed less than any other area in the forest. The part of the forest from the pond ranging toward the building site is more nearly level than the other part of the forest. Since the trees found in this area are smaller and perhaps younger than those in the Elephant Rock portion of the forest, it may be speculated that this portion of the forest was used for pasture land and has been disturbed more than other portions. (There is a larger number of pines in this region indicating that the forest is changing from a pineland to a hardwood forest.) Since many of the pines here are dead or dying one may also speculate that they are being replaced with hardwoods of various species.

A few American chestnut trees still grow in Fernbank representing the last of a major species of hardwoods that formerly inhabited the Eastern Deciduous Forest Province. The blight that entered the United States around 1900 and annihilated practically all of the native chestnuts is still destroying them today. The largest American chestnuts in Fernbank Forest are only an inch or less in diameter. Their mere presence brings to mind one of the aims of Fernbank Science Center – the conservation of the natural flora and fauna of the United States.

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SPECIALIZED TAXONOMY PROGRAMS

Description

Advanced programs in taxonomy are provided for second year Biology classes which require greater basic knowledge on the part of the individual students. A more extensive study into the broad aspects of the taxonomy of trees, shrubs, flowering plants, herbs, and ferns is available and a narrower study on specific groups of plants, such as ferns or flowering plants, can be offered. In the advanced courses more attention is given to the genus, family, and order relationships of the plants studied.

A. Supplementary Materials

1. Terminology lists for taxonomy
2. Keys to Fernbank Forest flora
3. Herbarium specimens
4. Collections of fruits and seeds

B. Taxonomy Programs Available by Request

1. Herpetology
2. Ornithology
3. Entomology

These programs are being developed and will be taught during the school year 1966-1967 and thereafter.

Teachers will receive additional information pertaining to the specialized curriculums noted above upon request.

Background Information – Second through Sixth Grade

1. Living things are interrelated with each other and with their non-living or physical surroundings in the forest. These relationships create a balance of nature in the forest called "dynamic equilibrium."

   Many relationships among the various species and their physical surroundings can be visualized as one thinks of the world of life – from the simplest ameba to the most complex mammal. To be interrelated with one another means that plants and animals in the forest must have a "give and take" nature; this signifies that no one plant or animal is completely independent or able to live alone. Evidence of this concept may be found in the forest through the following examples:

   Parasitism – Aphids parasitizing beech trees
   Dodder parasitizing English ivy
   Beech drops parasitizing beech tree roots

   Mutualism – Algae cooperating with fungi in common lichen forms

   Commensalism – A bluebird's nest acquired from a previous resident, perhaps a woodpecker

   Producer-consumer relationships – As seen by observing a squirrel eating an acorn

   In a similar manner all living things are also influenced by the nonliving constituents which make up their surroundings. These elements include climate, gravity, soil, minerals and chemicals within the environment, light, water and temperature. Examples of relationships involved among living things with their physical environment may be easily illustrated through the following examples:

   a. Green plants utilizing carbon dioxide and oxygen in photosynthesis and respiration respectively

b. The general dependence of plants on an adequate water supply

c. Erosion produced by the lack of adequate ground cover

d. Loss of leaves through change in photoperiod

2. The food chains and webs are important aspects of a plant-animal community.

Living things are dependent on each other for food and for energy. Because plants and animals are not able to create energy their existence depends upon the successful transfer of energy among the various members of the community. A green plant uses radiant energy from the sun and through the process of photosynthesis converts that radiant energy into chemical energy. Through chemical changes in the plant sunlight can be used to make food for green plants. The food chain begins with the green plant. If this plant is eaten by an animal, a transfer of food and energy occurs.

Living things are linked together by way of their eating habits. Numerous food chains exist in a forest; for example, one may experience the visual concept of the food chain when a transfer of energy occurs from the acorn to the squirrel to the owl. A food chain helps to maintain the balance in nature by preventing the excessive dominance of one species. At each step of the food chain there is a definite loss of energy. Only a fraction of the sun's energy is initially trapped by the green plant and used in making foods containing energy; the rest escapes as heat. Similarly, when an animal eats the plant there is a further loss of energy as heat and the animal actually utilizes a very small portion of the original energy. Therefore food chains are no longer than four or five steps due to the loss of energy at each step. Many food chains often overlap each other forming a more complicated food web; for example, when the chain of acorn-squirrel-owl is observed one may readily see that the squirrel may also obtain food from other sources than those which produce acorns. Likewise the owl does not necessarily get all of its food from the squirrel. The broadened selections made by the organisms in a food chain create the more complex food web.

3. Specific relationships exist in living things among the producers, the consumers, and the decomposers.

All green plants are able to make their own food through the process of photosynthesis; for this reason they are known as the producers in the world of living things. Since animals are not capable of manufacturing their own food supply they are dependent on an outside source for their nutrition. Animals are known as the consumers among the living organisms in the forest. Decomposers (bacteria, yeasts, molds, fungi) may be thought of as special kinds of consumers as they rely on other sources for their food supply. The relationships among the producers, consumers, and decomposers are those which exist in the food chains and food webs. The consumers are dependent upon the producers for their direct food supply. However, a consumer may derive food and energy by eating another consumer with an indirect reliance upon the initial producer for the basic energy supply. Decomposers are important in the food chain in that they release carbon, calcium, and minerals from dead substances thus aiding in the growth and development of new plants or producers. Every living thing contains carbon. Without the aid of the decomposers, eventually most carbon would be locked up in the dead organisms and life as we know it would slowly come to a halt. Green plants must have carbon dioxide along with various other elements to make food. When an animal eats a green plant it obtains a certain amount of energy from the carbon compounds in that plant. The animal digests the food and gives off water and carbon dioxide as wastes. Carbon dioxide in turn is used by plants in photosynthesis.

4. The succession of plants in an ecosystem is influenced by the abiotic (nonliving) and the biotic (living) conditions of that area.

The gradual replacement of one plant community by another over a period of time is known as plant succession. Primary succession involves the growth of plants on a barren area which previously has not supported any plant life. Beginning stages in primary succession of plants may be studied by observing the first community of living things to appear on a rock. Here the abiotic factors which limit life are rather severe – high temperatures during the day, low temperatures at night, with little or no absorption of water. In this area plant life is generally confined to the more simple organisms, such as the lichens.

Carbon dioxide from the lichens combines with water from the atmosphere to form carbonic acid which helps to etch the rock, leading to the formation of a simple soil. As lichens decay more organic material is added to the soil so that it is able to hold water and to support a moss community. More soil accumulates and larger plants are able to grow and to develop. Over a period of years, through succession, trees and a forest area may develop. It is evident that abiotic and biotic modifications within the plant community, including increased amounts of shade, changes in soil, climate changes and changes in life cycles, play an inherent role in the nature of succession. These same forces greatly influence the developmental growth of plants in a disturbed area which incurs secondary succession. Here the succession generally begins with the presence of annual weeds followed in time by perennial plants and trees. Pond succession, influenced by temperature, light, climate, et cetera, influences the biotic or living organisms found in that area; hence, structural differences are found among plants which in turn, influence various food chains and webs.

5. Each organism has its own ecological niche or function in the forest ecosystem. The niche of one organism differs from that of another.

   The niche of an organism refers to the role that organism plays in the ecosystem; it is the organism's profession. Each plant in the forest has its own niche which includes all biotic and abiotic relationships present in the area. The relationships of any particular organism are unique to *that* organism; no two organisms have the same niche simultaneously in a given community. If one were to study the niche of the pine it would be necessary to include abiotic relationships (those concerned with amounts of illumination, temperature, moisture, et cetera) as well as biotic relationships, or those presented by the pine's total involvement with other living organisms.

6. Man's survival is directly related to the conservation of natural resources.

   Conservation involves the wise use of natural resources. Some of our natural resources include soil, water, minerals, forests and wildlife. Man's survival is directly or indirectly dependent upon plants. If the soil is depleted of its fertility it can be seen that man's very life is related to the wise use of his resources. Ecology stretches out the hand which guides conservation in the right direction.

7. Basic similarities and differences exist among the species of plants.

   Man uses these differences and likenesses in a system of classification. Plants are grouped primarily according to reproductive characteristics, life histories, and structural composition. Taxonomy, the classification of plants, is important to man because it helps him to identify plants, as well as to study the relationships which exist among the species. Every known plant may be identified by its scientific name which consists of the genus and species of that plant.

SECOND GRADE
CURRICULUM OUTLINE

I. **Introduction to Fernbank Forest**

- A. Brief history
- B. Rules governing use of forest

II. **Discussion of the Likenesses and Differences Between Plants and Animals**

- A. Observation of plants and animals
  - 1. Characteristics of living organisms
  - 2. Basic needs for all living things
    - a. Water
    - b. Oxygen
    - c. Light
    - d. Food
- B. Diversity among living things
  - 1. Observation of the variations among living things
  - 2. Manifestations of differences within and between different plant and animal groups
    - a. Size
    - b. Form
    - c. Structure
    - d. Capacity to react to the environment
  - 3. Observations anddiscussion pertaining to the reason scientists place in individual groups those animals or plants that have similar functions and structures
    - a. Animal groups
      - (1) Warm blooded animals
      - (2) Cold blooded animals
    - b. Plant groups
      - (1) Plants without seeds
      - (2) Plants that produce seeds
    - c. Special adaptive structures of all living things that help them to cope with their environment

III. **Need of Plants and Animals for Each Other**

- A. Discussion of a balanced wildlife community
  - 1. Components of a balanced community
    - a. Plants that make their own food
    - b. Plants that do not maketheir own food
    - c. Animals that eat plants

d. Animals that eat other animals

2. Loss of balance within the community

a. Cause

b. Result

B. Observation of relationships among specific plants and animals within the community

C. Development of conservation problems when man upsets the natural balance

IV. **General Discussion and Review**

CONCEPTS

1. Plants and animals have some characteristics that are different and some that are alike.

2. Special parts of plants perform certain functions for the plant.

3. Plant parts (leaves, stems, roots, flowers, seeds, et cetera) may be different. The different plant parts help to identify the plant.

4. Some plants are able to make their own food.

5. Some plants cannot make their own food.

6. All plants must have some form of nourishment to exist.

7. Animals need plants.

8. The size, color, body covering and way of moving of an animal can be used to identify that animal.

9. Plants and animals are placed in special groups according to their similarities and differences.

10. Living things are adapted to their environment.

FOURTH GRADE
CURRICULUM OUTLINE

I. **Introduction to Fernbank Forest**

- A. Brief history
- B. Rules governing use of forest

II. **The Forest**

- A. Observation and discussion of living organisms
  - 1. Plant life
  - 2. Animal life
- B. Observation and discussion of non-living (physical) elements
  - 1. Soil
  - 2. Rocks
  - 3. Other elements in the abiotic environment
- C. Study of relationships involved between the living and non-living components within the forest
- D. Balance as a concept within the forest

III. **Plants in the Forest**

- A. General observation of plant structure
  - 1. Identification and location of special plant parts
  - 2. Variations among different plant families
- B. Life functions related to specific plant parts
  - 1. Photosynthesis
  - 2. Conduction
  - 3. Reproduction
  - 4. Growth
  - 5. Nutrition
    - a. The green plants
    - b. The non-green plants
- C. Factors influencing growth and distribution of plants
  - 1. Physical factors
    - a. Light
    - b. Air
    - c. Water
    - d. Terrain
    - e. Climate

2. Observation of habitats for the following organisms:
    a. Lichens
    b. Ferns and mosses
    c. Pines
    d. Oaks, et cetera

D. Identification by common names of conspicuous plant life

IV. Animals in the Forest

A. Identification of conspicuous animal life

B. Observation of variations among the species

V. Relationships Involved Among Plants and Animals

A. Concept of food chains and webs

B. Pathways of energy through living organisms

VI. Conservation as a Way of Life

A. Description of Conservation

B. Importance

CONCEPTS

1. Ecology concerns the interrelationships of plants and animals with one another and with the physical features of their surroundings.

2. The physical features of a natural community that affect all living things are temperature, moisture, climate, and terrain.

3. A community is balanced when all conditions help living things to survive and to reproduce.

4. Variations exist between each living organism of the same kind. These variations may account for the many different kinds of living things on the earth.

5. Plants or animals that have similar structures are put into individual groups in a way that will make them easier to study.

6. The sun is the source of energy for beginning the synthesis of food that takes place in plants bearing chlorophyll. The process by which this synthesis occurs is known as photosynthesis.

7. All plant and animal organisms depend directly or indirectly on the sun's energy for survival.

8. Conservation problems develop because man upsets the natural balance of living things.

OUTLINE FOR SIXTH GRADE ECOLOGY CURRICULUM

I. **Fernbank Forest**

- A. Brief history
- B. Rules governing use of forest

II. **The Forest as an Ecosystem**

- A. Illustration of ecosystem
- B. Representative environmental factors
  1. Abiotic (physical)
     - a. Heat
     - b. Light
     - c. Gravity
     - d. Soil
  2. Biotic
     - a. Plants
     - b. Animals
- C. Balance within the ecosystem

III. **Interrelationships Among Plants and Animals**

- A. Nutritional relationships
  1. Food chains and webs
     - a. Producers
     - b. Consumers
     - c. Decomposers
  2. Interspecific organism relationships
     - a. Parasitism
     - b. Mutualism
     - c. Commensalism
- B. Ecological relationships
  1. Habitat (address)
  2. Niche (profession)

IV. **Study of the Plant Community**

- A. Primary succession (Elephant Rock)
  1. Biotic elements present
     - a. Lichens
     - b. Mosses
     - c. Liverworts

2. Abiotic elements present
    a. Temperature
    b. Light
    c. Moisture

B. Pond succession
    1. Biotic elements present
        a. Submerged aquatics
        b. Emergent aquatics
        c. Floating aquatics
        d. Plankton
    2. Influential abiotic elements
        a. Temperature
        b. Light
        c. Oxygen
    3. Food chains and webs

C. Secondary succession
    1. Biotic elements present
        a. Annual weeds
        b. Perennial Plants
        c. Trees
    2. Abiotic elements
        a. Light
        b. Temperature
        c. Soil

V. Ecological Conservation

A. Discussion of concept

B. Practical application to Fernbank Forest

C. Importance to man

CONCEPTS

1. Living things are interrelated with each other and with their nonliving or physical surroundings in the forest. These relationships create a balance of nature in the forest sometimes known as "dynamic equilibrium."
2. The food chains and webs are important aspects of a plant-animal community.
3. Specific relationships exist in living things among the producers, the consumers, and the decomposers.
4. The succession of plants in an ecosystem is influenced by the abiotic (nonliving) and the biotic (living) conditions of that area.
5. Each organism has its own ecological niche or function in the forest community. The niche of one organism differs from that of another organism within the community.
6. Man's survival is directly related to the conservation of natural resources.

OUTLINE FOR SIXTH GRADE TAXONOMY CURRICULUM

I. **Plant Taxonomy – The "Family Tree" of Living Things**

- A. Characteristics of living things
- B. Basic criteria for classification

II. **Classification Within the Plant Kingdom**

- A. Vascular Plants: the Tracheophytes
  - 1. Angiosperms: the flowering plants
    - a. Observation and discussion of distinguishing characteristics
      - (1) The flower
      - (2) The fruit
    - b. Introduction to representative species
    - c. Observation concerning diversity among the species
  - 2. Gymnosperms: the "naked" seed plants
    - a. Observation and discussion of distinguishing characteristics
      - (1) The modified leaf (cone)
      - (2) The seed
    - b. Introduction of representative species
      - (1) Loblolly pine *(Pinus taeda)*
      - (2) Shortleaf pine (*Pinus echinata)*
    - c. Observation concerning diversity among the species
  - 3. The Ferns
    - a. Observation and discussion of distinguishing characteristics
      - (1) The fronds (sterile and fertile)
      - (2) Spore cases
    - b. Introduction to representative species
      - (1) Christmas ferns
      - (2) Others
    - c. Observation concerning diversity among the species
- B. Non-vascular plants
  - 1. The Bryophytes
    - a. Mosses
      - (1) Presence of rhizoids
      - (2) Stalks with leaf-like structures
      - (3) Capsule containing spores
    - b. Liverworts
      - (1) Prostrate growth
      - (2) Ribbon-like branching

2. The Fungi

   a. Observation of distinguishing characteristics

      (1) No vascular tissue

      (2) Absence of chlorophyll

      (3) Reproduction (in part) by spores

   b. Representative species

      (1) Field Mushrooms

      (2) Bracket fungi

      (3) Polypore fungi

      (4) Stinkhorns (devil's horn fungi)

   c. Observation concerning diversity among the species

III. General Review

CONCEPTS

1. Basic similarities and differences exist among the species of plants.

2. Plants differ from each other chiefly by their life histories, reproductive characteristics, and structural traits.

3. Man uses differences and similarities to classify plants.

4. Plant classification may begin with the broad characteristics which exist among plants and work toward the specific.

5. The smallest taxonomic group containing all of the individuals of a particular type of plant is known as the species of that plant; the genus of a particular plant is composed of a number of species.

6. The smallest two categories to which a plant belongs constitute its scientific name. Any scientific name therefore consists of the genus and the species of that particular plant.

7. Plant taxonomy (classification) has two aims: the universally accepted identification of all plants and the ability to understand the vast number of relationships which exist within the plant kingdom.

   In general the higher the category the more individuals one can expect to find in that group. The following system commonly accepted is one which has been developed for classification, beginning with the largest group and working toward the individual species – kingdom, division, subdivision, class, order, family, genus, and species.

SPECIALIZED PROGRAM IN ORNITHOLOGY – INTRODUCTORY

Introduction

The Fernbank Forest, in accord with its great degree of species diversity, provides migratory or permanent habitat for almost one hundred different species of birds. The center's program in ornithology is designed to utilize this resource as a means of stimulating interest in the identification, habits, and adaptations of birds.

Bird study provides an interesting and stimulating hobby for individuals of every age. Its success, in part, may be attributed to the virtually unrestricted opportunity for the bird watcher to practice and develop his skills through observation and discovery.

Field Experience

1. Learning to identify some of the area's common birds through sight and song.
2. Observing the food and nesting habits of various species.
3. Observing the various adaptations present among different species of birds which afford each its own ecological niche, such as beak design which enables the particular organism to eat different kinds of food, and feet constructed in particular designs each adapting individual birds to different walking, perching and food searching habits.
4. Listening and identifying particular bird songs and calls.

Background Information

(Group size is limited to 12 per class. Early morning and late afternoon hours provide the most ideal observation periods.)

It is an accepted ecological principle that no two different species of organisms occupy the same ecological niche. In accord with this principle birds are distributed among various habitats within the forest according to their particular adaptations. The forest canopy, for example, provides an ideal feeding ground for many birds. Birds such as the Kentucky warbler, ovenbird, and wood thrush live almost entirely in the herb layer of the forest. Others such as the rufous-sided towhee, cardinal and many species of warblers, live at the forest's edge. There are also a variety of deep wood species which include the woodpeckers, blue jays and nuthatches.

Identification of individual species is most easily accomplished through the characteristic coverings of of feathers and down. Song patterns also vary with individual types and, as a result, provide a means of both locating and identifying each bird.

Several varieties of birds that nest in the temperate zone migrate in the late summer and return to their breeding places in early spring. Scientists have many theories as to why birds migrate and how they are able to navigate large distances with uncanny accuracy. Observations show that the periodic migrations of birds are related to a change in the photoperiod rather than in response to a change in temperature or a decrease in food supply.

Most male birds migrate north ahead of the female of the species in order to select an area in which they can feed and raise their young.

Bird songs are heard more often during the breeding season at which time the male utilizes his voice to declare the boundaries of his territory and to attract the female.

Bird eggs are fertilized before they are laid. Some species of birds raise several families of young during the spring and early summer months. When eggs are laid incubation begins. The eggs of birds vary greatly in size, color, number and period of incubation.

Some species of birds walk as soon as they hatch, while others are helpless for several weeks. The parent birds usually care for their young until the down that covers the body of the young has been replaced by feathers, allowing flight.

CONSERVATION CURRICULUM

Introduction

The practice of conservation is vitally important to every living person. Wise use of our natural resources in this century has a direct bearing on the successful existence of generations to come. The study of conservation is meaningful only when it is introduced in a logical manner. Ecology provides the scientific guidelines which give conservation direction and principle. The aim of this program is to help the student view his total surroundings with a knowledgeable understanding of the relationships which exist in his environment so that he may gain insight into the role that conservation plays within his world.

I. Conservation and the Forest

A. Discussion of meaning of conservation

B. Introduction to concept involving an ecological approach to conservation

1. Distinction between ecology and conservation
2. Interacting relationships involved in ecology and conservation

II. Ecological Guidelines for Conservation

A. Adaptation of plants and animals to abiotic environment

1. Physical factors affecting distribution
   a. Light
   b. Terrain
   c. Precipitation
   d. Temperature
2. Observation of some adjustments by living organisms to the physical environment
   a. Aquatic plant life
   b. Warm blooded and cold blooded animals
   c. Structural adaptations – examples:
      (1) Fish
      (2) Pine tree
      (3) Woodpecker's beak, et cetera

B. Adaptation of plants and animals to biotic environment

1. Concept of ecological niche
2. Presence of food chains and food webs
   a. Existent trophic levels
      (1) Producers
      (2) Consumers
      (3) Decomposers
   b. Transfer of energy at various levels
   c. Man's involvement and dependence on other living organisms

III. **Functional Conservation through Ecology**

A. Ecological ramifications of forest land conservation

1. Production of food
2. Regulation of water flow
3. Shelter for wildlife

B. Discussion of *possible* disturbances which may occur in the forest

1. Natural
   a. Erosion
   b. Disease
2. Human
   a. Construction of trails
   b. Introduction of English ivy
   c. Water pollution
3. Fire

C. Discussion of consequences to total ecosystem as a result of disturbances

D. Importance of conservation of forest to man

1. Observation of man's direct or indirect dependence upon plants
2. Appreciation of aesthetic values
3. Housing of renewable and nonrenewable resources
4. Recognition of man's perceptive knowledge of the ecological principles which are applied toward the total structure of conservation

ELEMENTARY CURRICULUM

RELATED BOOKLIST FOR CHILDREN

1. Bancroft, Henrietta, & R. G. Van Gelder, *Animals In Winter.* New York: Thomas Y. Crowell Co., 1963.
2. Campbell, E. A., *Fins and Tails.* Boston, Mass.: Little Brown & Co., 1963.
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4. Craig, M. J., *Spring is Like the Morning.* New York: G. P. Putnam's Sons, 1965.
5. Ertel, James, *Adventures of a Squirrel.* Chicago: Encyclopedia Britannica Press, 1962.
6. Fenton, C. L., and Pallas, *Insects and Their World.* New York: John Day Company, 1956.
7. Glemser, Bernard, *All About Biology.* New York: Random House, Inc., 1964.
8. Hirsch, S. Carl, *The Living Community.* New York: The Viking Press, 1966.
9. Huntington, H. E., *Let's Go Outdoors.* Garden City, N.Y.: Doubleday & Co., Inc., 1939.
10. Hutchins, R. E., *Lives of an Oak Tree.* Chicago, Ill.: Rand McNally & Co., 1963.
11. Jauss, Anne Marie, *Under A Green Roof.* (Animals and Birds of our Woods). New York: J. B. Lippincott Co., 1960.
12. McClung, R. M., *Mammals and How They Live.* New York: Random House, 1963.
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14. Schoenknecht, C. A., *Frogs and Toads.* Chicago, Ill.: Follett Pub. Co., 1960.
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16. Sterling, Dorothy, *Caterpillars.* Garden City, N.Y.: Doubleday & Co., Inc.
17. _____ , *Trees and Their Story.* Garden City, New York: Literary Guild & Doubleday & Co., Inc.

ELEMENTARY CURRICULUM

RELATED BOOKLIST FOR TEACHERS

1. Bates, Marston, et al, *BSCS Green Version High School Biology.* Chicago, Ill.: Rand McNally & Co., 1965.
2. Blough, G. O., & J. Schwartz, *Elementary School Science (And How to Teach It).* New York: Holt,Rinehart, and Winston, 1964.
3. Farb, Peter, & Editors of Life, *Ecology-* Chicago, Ill.: Time, Inc., 1963.
4. Hamm & Nason, *An Ecological Approach to Conservation.* Minn.: Burgess Publishing Co., 1964.
5. Hirsch, S. Carl, *The Living Community.* New York: The Viking Press, 1966.
6. Knight, Clifford B., *Basic Concepts of Ecology.* New York: Macmillan Company, 1965.
7. Robbins, Chandler S, B. Bruun & H.S. Zim, *Birds of North America.* New York: Golden Press, 1966.
8. Selsam, Millicent E., *Birth of a Forest.* New York: Harper & Row Publishing Co., 1964.
9. Stupka, Arthur, *Wildflowers in Color.* New York: Harper & Row Publishing Co., 1965.
10. Editors of Time, *The Forest.* Chicago, Ill.: Time, Inc.

REPRESENTATIVE PLANTS OF FERNBANK FOREST

DIVISION: Spermatophyta

Sub-division: Gymnospermae

Family: Pinaceae

Pinus taeda	Loblolly
Pinus echinata	Shortleaf
Tsuga canadensis	Eastern Hemlock
Tsuga caroliniana	Carolina Hemlock

Sub-division: Angiospermae

Family: Aceraceae

Acer negundo	Boxelder
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple

Family: Anacardiaceae

Rhus copallina	Winged Sumac
Rhus glabra	Smooth Sumac
Rhus radicans	Poison Ivy
Rhus typhina	Staghorn Sumac

Family: Annonaceae

Asimina triloba	Pawpaw

Family: Apocynaceae

Vinca minor	Periwinkle

Family: Aquifoliaceae

Ilex opaca	American Holly

Family: Araceae

Arisaema quinatum	Five-leaved Jack-in-the-Pulpit
Arisaema triphyllum	Jack-in-the-Pulpit
Symplocarpus foetidus	Skunk Cabbage

Family: Araliaceae

Aralia spinosa	Hercules Club
Hedera helix	English Ivy
Panax quinquefolium	Ginseng

Family: Aristolochiaceae

Asarum shuttleworthii	Wild Ginger
Asarum virginicum	Wild Ginger

Family: Asclepiadaceae

Asclepias tuberosa	Butterfly Weed
Asclepias variegata	Variegated Milkweed

Family: Betulaceae

Carpinus caroliniana	Ironwood

Family: Berberidaceae

Berberis thunbergii	Japanese Barberry
Caulophyllum thalictroides	Blue Cohosh
Diphylleia cymosa	Umbrella-leaf
Mahonia bealii	Mahonia
Podophyllum peltatum	Mayapple

Family: Bignoniaceae

Campsis radicans	Trumpet Creeper

Family: Calycanthaceae

Calycanthus floridus	Sweet Shrub

Family: Campanulaceae

Lobelia cardinalis	Cardinal Flower

Family: Caprifoliaceae

Lonicera japonica	Japanese Honeysuckle
Sambucus canadensis	Elderberry
Viburnum acerifolium	Maple-leaved Viburnum

Family: Caryophyllaceae

Silene virginica	Firepink

Family: Celastraceae

Euonymus americanus	Strawberry Bush

Family: Commelinaceae

Tradescantia fluminensis	Wandering Jew
Tradescantia virginiana	Virginia Spiderwort

Family: Compositae

Ambrosia artemisiifolia	Common Ragweed
Erigeron philadelphicus	Daisy Fleabane
Erigeron ramosus	Horseweed
Rudbeckia hirta	Black-eyed Susan
Senecio smallii	Squaw Weed
Solidago spp.	Goldenrod
Vernonia noveboracensis	Common Ironweed

Family: Convolvulaceae

Cuscuta spp.	Dodder

Family: Cornaceae

Cornus florida	Dogwood

Family: Crassulaceae

Sedum ternatum – Three-leaved Stonecrop

Family: Diapensiaceae

Galax aphylla Galax

Family: Ebenaceae

Diospyros virginiana Persimmon

Family: Ericaceae

Epigaea repens Trailing Arbutus
Kalmia latifolia Mountain Laurel
Oxydendrum arboreum Sourwood
Rhododendron calendulaceum–Flame Azalea
Rhododendron carolinianum Carolina Rhododendron
Rhododendron catawbiense Catawba Rhododendron
Rhododendron maximum Rosebay Rhododendron
Rhododendron vaseyi Pinkshell Azalea
Rhododendron viscosum Swamp Azalea

Family: Fagaceae

Castanea dentata American Chestnut
Fagus grandifolia American Beech
Quercus alba White Oak
Quercus falcata Southern Red Oak
Quercus rubra Northern Red Oak
Quercus stellata Post Oak
Quercus velutina Black Oak

Family: Galacaceae

Shortia galacifolia Oconee Bells

Family: Gentianaceae

Gentiana andrewsii Closed Gentian
Obolaria virginica Pennywort

Family: Geraniaceae

Geranium maculatum Wild Geranium

Family: Gramineae

Andropogon virginicus Broom Sedge
Cynodon dactylon Bermuda Grass
Sorghum halpense Johnson Grass

Family: Guttiferae

Hypericum punctatum St. John's Wort

Family: Hamamelidaceae

Hamamelis virginiana Witch Hazel
Liquidambar styraciflua Sweetgum

Family: Iridaceae

Iris verna Vernal Iris
Sisyrinchium graminoides–Blue-eyed Grass

Family: Juglandaceae

Carya glabra Pignut Hickory
Carya illinoensis Pecan
Carya tomentosa Mockernut Hickory
Juglans nigra Black Walnut

Family: Labiatae

Monarda didyma Oswego Beebalm
Prunella vulgaris Heal-all
Salvia lyrata Lyre-leaved Sage

Family: Lauraceae

Lindera benzoin Spicebush
Sassafras albidum Sassafras

Family: Leguminosae

Albizzia julibrissin Mimosa
Baptisia tinctoria Yellow Wild Indigo
Cassia nictitans Sensitive Plant
Cercis canadensis Redbud
Desmodium rudiflorum Tick-trefoil
Lathyrum pusillus Perennial Pea
Trifolium pratense Red Clover
Trifolium procumbens Low Hop Clover
Trifolium repens White Clover
Vicia sativa Common Vetch
Wisteria floribunda Wisteria

Family: Liliaceae

Chamaelirium luteum Fairy-wand
Erythronium celbidum var. albidum Trout Lily
Hemerocallis fulva Day Lily
Lilium carolinianum Carolina Lily
Lilium superbum Turk's-cap Lily
Lilium tigrinum Tiger Lily
Melanthium virginicum Bunch flower
Polygonatum biflorum Solomon's Seal
Polygonum pensylvanicum–Smartweed
Smilacina racemosa – False Solomon's Seal
Smilax bona-nox Greenbriar
Smilax ecirrhata Carrion Flower
Smilax glauca Greenbriar
Smilax rotundifolia Greenbriar

Family: Liliaceae (Contd.)

Trillium cernuum	Nodding Trillium
Trillium erectum var. album	White Wax Trillium
Trillium grandiflorum	Large flowered Trillium
Trillium luteum	Yellow Trillium
Trillium sessile	Sessile Trillium
Trillium undalatum	Painted Trillium
Uvularia grandiflora	Merrybells
Uvularia perfoliata	Merrybells
Yucca filamentosa	Spanish Bayonet

Family: Loganiaceae

Gelsemium sempervirens	Yellow Jessamine
Spigelia marilandica	Indian Pink

Family: Magnoliaceae

Liriodendron tulipifera	Yellow Poplar
Magnolia acuminata	Cucumber Tree
Magnolia fraseri	Fraser Magnolia
Magnolia grandiflora	Southern Magnolia
Magnolia tripetala	Umbrella Magnolia

Family: Moraceae

Morus alba	White Mulberry
Morcus rubra	Red Mulberry

Family: Nyssaceae

Nyssa sylvatica	Black Gum

Family: Oleaceae

Fraxinus americana	White Ash
Ligustrum vulgare	Privet

Family: Orchidaceae

Coralliorhiza odontorhiza	Coral Root
Cypripedium acaule	Pink Lady's-slipper
Cypripedium pubescens	Yellow Lady's slipper
Cypripedium spectabile	Showy Lady's-slipper
Goodyera pubescens	Rattlesnake Plaintain
Habenaria ciliaris	Yellow Fringed Orchis
Orchis spectabilis	Showy Orchid
Oxalis violacea	Violet Wood-Sorrell

Family: Orobanchaceae

Epifagus virginiana	Beechdrops

Family: Oxalidaceae

Xanthoxalis stricta	Upright Yellow Wood-Sorrell

Family: Papaveraceae

Dicentra canadensis	Squirrel-corn
Dicentra cucullaria	Dutchman's Breeches
Dicentra eximia	Bleeding Heart
Sanguinaria canadensis	Bloodroot

Family: Phytolaccaceae

Phytolacca americana	Pokeweed

Family: Platanaceae

Platanus occidentalis	American Sycamore

Family: Polemoniaceae

Phlox divaricata	Blue Phlox

Family: Polygalaceae

Polygala senega	Seneca Snakeroot

Family: Polygonaceae

Persicaria persicaria	Heartweed
Rumex acetosella	Red Sorrell
Rumex obtusifolius	Broad-leaved Dock

Family: Portulacaceae

Claytonia americana	Spring Beauty

Family: Pyrolaceae

Chimaphila maculata	Pipsissewa
Monotropa uniflora	Indian Pipe

Family: Ranunculaceae

Acetaea pachypoda	White Baneberry
Acetaea rubra	Red Baneberry
Anemonella thalictroides	Rue Anemone
Aquilegia canadensis	Wild Columbine
Cimicifuga racemosa	Black Cohosh
Clematis virginiana	Virgin's Bower
Hepatica americana	Round-lobed Liverleaf
Thalictrum polyganum	Tall Meadowrue

Family: Rosaceae

Amelanchier laevis	Smooth Juneberry
Aruncus sylvester	Goat's Beard
Crataegus spp.	Hawthorn

Family:	**Rosaceae (Contd.)**	
	Duchesnea indica	Indian Strawberry
	Gillenia trifoliata	Bowman's Flower
	Potentilla candensis	Five-Finger
	Prunus caroliniana	Laurel Cherry
	Prunus serotina	Wild Black Cherry
	Pyrus malus	Domestic Apple
Family:	**Rubiaceae**	
	Houstonia serpyllifolia	Creeping Bluets
	Mitchella repens	Partridge berry
Family:	**Salicaceae**	
	Salix nigra	Black Willow
Family:	**Saxifragaceae**	
	Heuchera americana	Alumroot
	Hydrangea arborescens	Wild Hydrangea
	Hydrangea paniculata-var. grandiflora	Large-panicled Hydrangea
	Mitella diphylla	Bishop's Cap
Family:	**Scrophulariaceae**	
	Paulownia tomentosa	Princess Tree
	Pedicularis canadensis	Wood Betony
Family:	**Solonaceae**	
	Solanum carolinense	Horse-nettle
Family:	**Styracaeae**	
	Halesia carolina	Silverbell
	Halesia tetraptera	Great Silverbell
Family:	**Tiliaceae**	
	Tilia heterophylla	Basswood
Family:	**Ulmaceae**	
	Ulmus alata	Winged Elm
	Ulmus americana	American Elm
Family:	**Umbelliferae**	
	Daucus carota	Queen Anne's Lace
Family:	**Violaceae**	
	Viola blanda	Sweet White Violet
	Viola canadensis	Canada Violet
	Viola hastata	Halberd-leaved Violet
	Viola pedata	Bird's-foot Violet
Family:	**Vitaceae**	
	Parthenocissus quinquefolia–	Virginia Creeper
	Vitis rotundifolia	Muscadine Grape

FERNS

Family:	**Ophioglossaceae**	
	Botrychium dissectum var. tenuifolium	Coarse-leaved Grape Fern
	Botrychium virginianum	Rattlesnake Fern
Family:	**Osmundaceae**	
	Osmunda cinnamomea	Cinnamon Fern
	Osmunda regalis	Royal Fern
Family:	**Polypodiaceae**	

Adiantum pedatum–Northern Maidenhair Fern
Asplenium platyneuron–Brownstem Spleenwort
Athyrium filix-femina–Lady Fern
Athyrium thelypterioides–Silvery Spleenwort
Camptosorus rhizophyllus–Walking Fern
Dennstaedtia punctilobula–Hay-scented Fern
Dryopteris goldiana–Goldie's Fern

Family:	**Polypodiaceae (Contd.)**	
	Dryopteris hexagonoptera	Broad Beech Fern
	Dryopteris marginalis	Marginal Fern
	Dryopteris noveboracensis	New York Fern
	Lygodium palmatum	Climbing Fern
	Onoclea sensibilis	Sensitive Fern
	Polypodium polypodioides	Ressurection Fern
	Polystichum acrostichoides	Christmas Fern
	Pteretis nodulosa	Ostrich Fern
	Pteridium aquilinum	Bracken Fern

FERN ALLIES

Family:	**Lycopodiaceae**	
	Lycopodium lucidulum	Shining Clubmoss
	Lycopodium obscurum	Ground-pine
Family:	**Selaginellaceae**	
	Selaginella apoda	Meadow Spikemoss

CLASSIFICATION OF BIRDS IN FERNBANK FOREST

Kingdom – Animal Phylum Chordata Class – Aves

Order – Falconiformes: Diurnal Birds of Prey

Family: Cathartidae — American Vultures

Cathartes aura — Turkey Vulture

Family: Accipitriadae — Kites, Hawks & Allies

Buteo jamaicensis — Eastern Red-tailed Hawk

Buteo lineatus — Red-shouldered Hawk

Order – Galliformes: Gallinaceous Birds

Family: Phasianidae — Partridges & Quails

Colinus virginianus — Bob White

Order – Charadriiformes: Shorebirds, Gulls, & Alcids

Family: Scolopacidae — Woodcock, Snipe, & Sandpiper

Actitis macularia — Spotted Sandpiper

Order – Columbiformes: Pigeon-like Birds

Family: Columbidae — Pigeons and Doves

Zenaidura macroura — Mourning Dove

Order – Cuculiformes: Cuckoos, Road-runners, & Anis

Family: Cuculidae: Cuckoos

Coccyzus americanus — Yellow-billed Cuckoo

Coccyzus erythropthalmus – Black-billed Cuckoo

Order – Strigiformes: Owls

Family: Strigidae: Typical Owls

Otus asio — Screech Owl

Order – Caprimulgiformes: Goatsuckers

Family: Caprimulgidae: Goatsuckers

Chordeiles minor — Common Highthawk

Order – Apodiformes: Hummingbirds

Family: Trochilidae — Hummingbirds

Archilochus colubris — Ruby-throated Hummingbird

Order – Paciformes: Woodpeckers

Family: Picidae — Woodpeckers

Colaptes auratus — Yellow-shafted Flicker

Family: Picidae — Woodpeckers (Contd.)

Dryocopus pileatus — Pileated Woodpecker

Centurus carolinus — Red-billed Woodpecker

Melanerpes erythrocephalus – Red-headed Woodpecker

Sphyrapicus varius — Yellow-bellied Sapsucker

Dendrocopos villosus — Hairy Woodpecker

Dendrocopos pubescens — Downy Woodpecker

Order – Passeriformes: Perching Birds

Family: Tyrannidae — Tyrant Flycatchers

Tyrannus tyrannus — Eastern Kingbird

Myiarchus crinitus — Great Crested Flycatcher

Sayornis phoebe — Eastern Phoebe

Empidonax virescens — Acadian Flycatcher

Contopus virens — Eastern Wood Pee-wee

Family: Corvidae — Jays, Magpies, and Crows

Cyanocitta cristata — Blue Jay

Corvus branchyrhynchos — Common Crow

Family: Paridae — Chickadees

Parus atricapillus — Black-capped Chickadee

Family: Sittidae — Nuthatches

Sitta carolinensis — White-breasted Nuthatch

Sitta canadensis — Red-breasted Nuthatch

Sitta pusilla — Brown-headed Nuthatch

Family: Troglodytidae — Wrens

Troglodytes trogledytes — Winter Wren

Thryothorus ludovicianus — Carolina Wren

Family: Mimidae — Mockingbirds & Thrashers

Mimus polyglottos — Mocking Bird

Dume ella carolinensis — Catbird

Taxostoma rufum — Brown Thrasher

Family: Turdidae — Thrushes, Bluebirds and Solitaires

Turdus migratorius — Robin

Family:	**Turdidae (Contd.)**	
	Hylocichla mustelina	Wood Thrush
	Hylocichla guttata	Hermit Thrush
	Hylocichla minima	Gray-cheeked Thrush
	Hylocichla fuscescens	Veery
	Sialia sialis	Eastern Bluebird
Family:	**Sylviidae**	**Gnatcatchers & Kinglets**
	Polioptila caerulea	Blue-gray Gnatcatcher
	Regulus satrapa	Golden-crowned Kinglet
	Regulus calendula	Ruby-crowned Kinglet
Family:	**Bombycillidae**	**Waxwings**
	Bombycilla cedrorum	Cedar Waxwing
Family:	**Sturnidae**	**Starlings**
	Sturnus vulgaris	Starling
Family:	**Vireonidae**	**Vireos**
	Vireo flavifrons	Yellow-throated Vireo
	Vireo olivaceus	Red-eyed Vireo
Family:	**Parulidae**	**Wood Warblers**
	Mniotilta varia	Black-and-White Warbler
	Protonotaria citrea	Prothonotary Warbler
	Helmitheros vermivorus	Worm-eating Warbler
	Vermivora chrysoptera	Golden-winged Warbler
	Vermivora peregrina	Tennessee Warbler
	Parula americana	Parula Warbler
	Dendroica magnolia	Magnolia Warbler
	Dendroica tigrina	Cape May Warbler
	Dendroica coronata	Myrtle Warbler
	Dendroica virens	Black-throated Warbler
	Dendroica caerulescens	Black-throated Blue Warbler
	Dendroica cerulea	Cerulean Warbler
	Dendroica fusca	Blackburnian Warbler
	Dendroica pensylvanica	Chestnut-sided Warbler
	Dendroica castanea	Bay-breasted Warbler
	Dendroica striata	Blackpoll Warbler
	Dendroica pinus	Pine Warbler
	Dendroica discolor	Prairie Warbler
	Dendroica palmarum	Palm Warbler
	Seiurus aurocapillus	Oven-bird
	Seiurus noveboracensis	Northern Waterthrush
	Geothlypis trichas	Yellow throat
	Icteria virens	Yellow-breasted Chat
	Oporornis formosus	Kentucky Warbler
	Wilsonia citrina	Hooded Warbler
	Wilsonia canadensis	Canada Warbler
	Setophaga ruticilla	American Redstart

Family:	**Icteridae**	**Blackbirds and Orioles**
	Agelarius phoeniceus	Red-winged Blackbird
	Euphagus carolinus	Rusty Blackbird
	Quiscalus quiscula	Common Grackle
	Molothrus ater	Brown-headed Cowbird
	Icterus spurius	Orchard Oriole
	Icterus galbula	Baltimore Oriole
Family:	**Thraupidae**	**Tanagers**
	Piranga olivacea	Scarlet Tanager
	Piranga rubra	Summer Tanager
Family:	**Fringillidae**	**Grosbeaks, Finches, Sparrows, and Buntings**
	Richmondena cardinalis	Cardinal
	Pheucticus ludovicianus	Rose-breasted Grosbeak
	Hesperiphona vespartina	Evening Grosbeak
	Passerina cyanea	Indigo Bunting
	Carpodacus purpureus	Purple Finch
	Spinus pinus	Northern Pine Siskin
	Spinus tristis	American Goldfinch
	Pipilo erythrophthalmus	Rufous-sided Towhee
	Junco hyemalis	Slate-colored Junco
	Spizella passerina	Chipping Sparrow
	Spizella pusilla	Field Sparrow
	Passerella iliaca	Fox Sparrow
	Melospiza melodia	Song Sparrow

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Fernbank School

FERNBANK SCIENCE CENTER
156 Heaton Park Drive, N. E.
Atlanta, Georgia 30307

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