DOCUMENT RESUME

ED 098 444 CE 003 222

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TITLE Biological Features of the Soil: Advanced Crop and Soil Science. A Course of Study.
INSTITUTION Virginia Polytechnic Inst. and State Univ., Blacksburg. Agricultural Education Program.; Virginia State Dept. of Education, Richmond. Agricultural Education Service.
PUB DATE 74
NOTE 17p.; For related courses of study, see CE 002 333-337

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Agricultural Education; Agronomy; Behavioral Objectives; Biological Sciences; *Biology; Conservation (Environment); Course Content; Course Descriptions; *Curriculum Guides; Environmental Education; *Instructional Materials; Lesson Plans; Natural Resources; Plant Science; Post Secondary Education; Secondary Education; *Soil Science
IDENTIFIERS Virginia

ABSTRACT

The course of study represents the third of six modules in advanced crop and soil science and introduces the agriculture student to biological features of soil. Upon completing the two day lesson, the student will: (1) realize the vast amount of life present in the soil, (2) be able to list representative animal and plant life in the soil by size, and (3) be able to list some of the detrimental processes of soil organisms. The course outline suggests teaching procedures, behavioral objectives, teaching aids and references, problems, a summary, and evaluation. Following the lesson plan, pages are coded for use as handouts and overhead transparencies. A materials source list for the complete soil module is included. (MW)

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BIOLOGICAL FEATURES OF SOIL

Agricultural Education, College of Education
Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

In Cooperation With

Agricultural Education Service, Division of Vocational Education
State Department of Education, Richmond, VA 23216
Prepared by Larry E. Miller

Publication AP-11
1974

ADVANCED CROP AND SOIL SCIENCE
A COURSE OF STUDY

Prepared by
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ACKNOWLEDGEMENTS

Appreciation is expressed to Julian M. Campbell, State Supervisor of Agricultural Education, State Department of Education, Richmond, Virginia, for sponsoring these curriculum materials; to James P. Clouse, Professor and Head of Agricultural Education, for his guidance and direction in the preparation of these curriculum materials.

A Virginia Polytechnic Institute and State University
Extension Division
Education Field Service Publication

How to Use This Book

This course of study is divided into six modules, as enumerated in the index. Each lesson plan contains the title of the:

course,
module,
a suggested time allotment,
a suggested teaching procedure,
objectives of the lesson,
example introduction techniques,
suggested references and teaching aids,
problems,
summary,
and example evaluatory statements.

Space is provided for individual evaluation.

Modules are lettered consecutively, with numbered pages within each module. A small letter following the number denotes its position within the numbered sequence. Following the lesson plans, pages are also denoted with the letter "H", recommended as a handout; and the letter "T", recommended as an overhead transparency.

Some instructors may find it of greater convenience to assemble a "slide-bank" of these teaching aids.

Materials Source List
(Soil Module Only)

SELECTED REFERENCES:

Books:

*Profitable Soil Management, Knuti, Korpi and Hide, Prentice-Hall, Englewood Cliffs, New Jersey 07632, 1969, $6.36.
*Introductory Soils, Berger, K.C., 1965, Macmillan Company, 866 3rd. Avenue, New York, N.Y. 10022, $8.50.
*Soils: An Introduction to Soils and Plant Growth, 2nd Ed., Donahue, Prentice-Hall, 1964, $9.75.
*Approved Practices in Soil Conservation, Foster, Interstate, 1964, $3.80.
*Our Soils and Their Management, Donahue, Interstate, $5.00.
**Farm Soils, Worthen and Aldrich, Wiley & Sons.
**Fundamentals of Soil Science, Millar, Turk.
**The Nature and Properties of Soils, Buckman and Brady, Macmillan, 1969, $10.95.
**Soils and Soil Fertility, Thompson, McGraw-Hill.
**Soil Fertility and Fertilizers, Tisdale and Nelson, Macmillan, 2nd Ed. 1966, $12.95.
**Soil Use and Improvement, Stallings, J.H., Prentice-Hall, $8.36.
**Soil Management for Conservation and Production, Cook, J.W. Wiley and Sons, 1962.
**Soil Physics, Kohnke, McGraw-Hill.
**Using Commercial Fertilizers, McVicker, Interstate, 1961, $4 00 Good.
**Our Natural Resources, McNall, Interstate, 1964.
**Soil Science Simplified, Kohnke & Helmut, Bolt, 1962. Good.
**Soil Conservation, Stallings, Prentice-Hall, 1957, $11.75.
*Experiments in Soil Science, California State Polytechnic College, San Luis Obispo, California 93401, $4.00.
**Factors of Soil Formation, Jenny.

Bulletins:

*"Soil Judging in Indiana" Purdue Mimeo I.D. 72.
*"Soil Color" Voc. Ag. Service, 434 Mumford Hall, Urbana, Illinois 61801
*"Soil Texture" - Illinois V.A.S.
**"Teaching Soil and Water Conservation, A Classroom and Field Guide" PA 341 U.S.D.A.
**"Water Intake by Soil Experiements for High School Students" Misc. Publ. No. 925, U.S.D.A.
**Soils Yearbook, U.S.D.A.
**Land Capability Classification, Agriculture Handbook No. 210, U.S.D.A.
**Soil Survey Manual, U.S.D.A."
*"Sampling the Soil", National Fertilizer Association, Washington, D.C.
*"Soil Testing" Purdue University Extension Circular, 488.
**"The Fertilizer Handbook:, National Plant Food Institute (NPFI) 1700 K. Street N.W., Washington, D.C. 20006

*Student Reference
**Instructor or Classroom reference

*"Our Land and Its Care", N. P. F. I.
*"What is Fertilizer?" N. P. F. I.
*"How to Take a Soil Sample", N. P. F. I. (Leaflets** and Poster*)
*"Lime Means More Money for You", N. P. F. I. (leaflets** and Poster*)
**"How Soil pH Affects Plant Food Availability", N. P. F. I. (Poster)
**"Hunger Signs in Crops", Illinois V. A. S., VAS 4011a
*"Soil and Plant Tissue Tests", Purdue Station Bulletin 635
*"Soil Science Simplified", Kohnke, Published by Author

Films:

"The Depth of Our Roots", New Holland, C-18 Min.
"Making the Most of a Miracle" (Plant Nutrition), N. P. F. I.
"The Big Test" (Importance of Soil Testing), N. P. F. I.
"What's in the Bag" (Fertilizer) N. P. F. I.

Film Bulletin:

"Films to Tell the Soil and Water Conservation Story" 1970 Soil Conservation Service, Film Library, Rm. 503-134 So. 12th St., Lincoln, Nebraska 68508.

Film Strips:

"Soil Color" Vo-Ag. Service, 434 Mumford Hall, Urbana, Illinois.
"Soil Structure" Vo-Ag. Service, Illinois.
"How and Why Soils Differ", Vo-Ag. Service, Illinois.

Slides:

"How to Take a Soil Sample", N. P. F. I.
"Soils, Plant Nutrition and Fertilizers", N. P. F. I.
"Deficiency Symptoms" (Choice by crop, 25¢ ea.) N. P. F. I. (Send for Catalog.)
"Soil Profile Slides", 16 slides, $6.00. (Send for Catalog.)

Periodicals:

"Plant Food Review", N. P. F. I. (Free to Schools.)

TEACHER'S CURRICULUM GUIDES FOR SOILS

"Understanding the Nature and Importance of Soil", AP-1, C. E. Richard, VPI & SU, Blacksburg.

"Preparing the Soil for Planting", AP-3, C. E. Richard, VPI & SU, Blacksburg.

"Developing a Soil and Water Conservation Plan", AP-4, C. E. Richard, VPI & SU, Blacksburg.

"Testing Soils", AP-8, C. E. Richard, VPI & SU, Blacksburg.

"Determining Land Capability Classes", AP-2, C. E. Richard, VPI & SU, Blacksburg.

Extension Division Bulletins, VPI & SU,
Blacksburg, Virginia 24061.

NO.	PUBLICATION
342	"No-tillage Corn - Current Virginia Recommendations"
429	"Soil Fertility Guides for the Piedmont"
97	"Agronomy Handbook"
136	"How Soil Reaction Affects the Supply of Plant Nutrients"
297	"Soil Fertility Guides - for the Coastal Plains Region of Virginia"
299	"Soil Fertility Guides - for the Appalachian Region of Virginia"
684	"Liming for Efficient Crop Production"
36	"Your Fertilizer Use and Crop Record"
106	"Lime Use Guides - for the Coastal Plains Region of Virginia"
107	"Lime Use Guides - for the Appalachian Region of Virginia"
108	"Lime Use Guides - for the Piedmont Region of Virginia"
405	"Lime for Acid Soils"
34	"Soil and Water Conservation Record Book"
CS48	"Soil Sterilization"
47	"Know Your Soils, Unit 2, Major Soil Differences"
23	"The Story of Land"
228	"Working Together for a Liveable Land"

USDA Bulletins (1 each of 100 publications, free)
Publications Division, Office of Information,
U.S.D.A., Washington, D.C. 20250. *FOR SALE ONLY

NO.	PUBLICATION	PRICE
AH210	Land Capability Classification. 1961	.15¢
AH18	Soil Survey Manual. 1951.	$3.50*
AB320	Know the Soil You Build On. 1967.	--
L539	Land Forming, A Means of Controlling Surface Water on Level Fields. 1967	.05*
L512	Mulch Tillage in the Southeast	--
YB1957	Soil (Yearbook)	$4.00*
L307	How Much Fertilizer Shall I Use? 1963.	--
G89	Selecting Fertilizers for Lawns and Gardens. 1971.	--
TITLE	Superphosphate: Its History, Chemistry, and Manufacture. 1964.	$3.25*

*"Maintaining Organic Matter in Soils" VAS, Illinois
*"Soil Structure" VAS, Illinois

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*Student Reference
**Instructor or Classroom Reference

TEACHING AIDS:

1. Samples of Soil separates, Purdue Agronomy Club
   Life Science Building
   Purdue University
   Lafayette, Indiana 47907

2. Soil Profiles
   Information and directions necessary to make soil profiles.

3. Land Capability Maps - Local S.C.S. Office.

4. Soil Auger: Nasco, price range $4.79 - $13.50.

5. Tissue Test Kit V.A.S. $4.00/kit.

6. Transparencies.

7. Samples of soil structure.

PREPARING FOR SOILS MODULE

Proper preparation, as in all things, is one of the best assurances of success. Therefore, it is imperative that prior planning be completed before teaching each lesson.

Plans should be made several weeks or months preceding the need for much of the material. Films should be booked as soon as possible to assure their arrival when needed. This will necessitate careful thought in the preparation of your teaching calendar for this module. An inventory of present equipment should yield information necessary to securing needed teaching aids, equipment, and replenishing supplies.

Many other teaching aids can be compiled on shorter notice. Handouts and overhead transparencies can be supplied on rather short notice in most schools. Adjustments will be necessary according to the instructor's and school's clerical assistance in this area.

Short range planning varies considerably with individual instructor's competencies in the teaching area and with previous teaching experience. One may generalize, however, and conclude from good teaching methods. that films should be previewed; experiments and demonstrations "pre-run". Subject matter should be reviewed, and adapted and updated lesson plans will be of benefit for each lesson.

The author has attempted to exclude materials that were presumably taught in previous vo-ag. offerings. It will be necessary for each instructor to discern if a review of previous material is necessary. The author has attempted to provide several teaching techniques for each lesson. It is not assumed that all would be used within the time allotment, but that you may have as many alternatives as possible from which to select.

Soil Module Time Allotment
Allotted days: 15 (at 55 minutes period per day)

Lesson		Minutes
I:	What is soil?	110
II:	Physical Features of Soil	110
III:	Biological Features of Soil	110
IV:	Soil Water	165
V:	Chemical Features of Soil	220
VI:	Soil Erosion	110
	TOTAL (15-55 min. days)	825

Course: Advanced Crop and Soil Science

Module: Soils

Lesson III: Biological Features of Soil

Suggested teaching time: 2 days

Suggested teaching procedure:

1. Introduce lesson by relating objectives and motivational statements and/or using other teaching aids to stimulate interest.

2. Make assignment and supervise study period.

3. Discuss results using teaching aids:

   a) Show transparencies "Breakdown of Animal Life in the Soil" and discuss life present and benefits received by the soil. Use "Earthworms and Soil" demonstration to inspire interest.
   b) Show transparency "Detrimental Processes of Organisms" and "Conditions Necessary for Optimum Growth of Organisms" and discuss.

4. Summarize and evaluate lesson.

Objectives:

1. Students should realize the vast amount of life present in the soil.

2. Students should be able to list representative animal and plant life in the soil by size.

3. Students should be able to list some of the detrimental processes of soil organisms.

Motivation:

If one were to walk into an average field and pick up soil in his cupped hands, there would be more living organisms present than there are people on the face of the earth!

Reference:

Text: Selected reference

Problems:

1. What are some large (macro) animals commonly found in the soil? How does each aid the soil?

2. What small (micro) animals exist in the soil? What benefits do they provide?

3. What plants exist in the soil? What benefits do they provide?

4. Are all plants and animals beneficial to the soil? Give examples of detrimental organisms and their affect.

Summary:

Many types and kinds of organisms exist in the soil. By far, they are beneficial ones and we want to contribute to their well being. Primarily a soil that produces good crops provides an environment conducive to good organism growth.

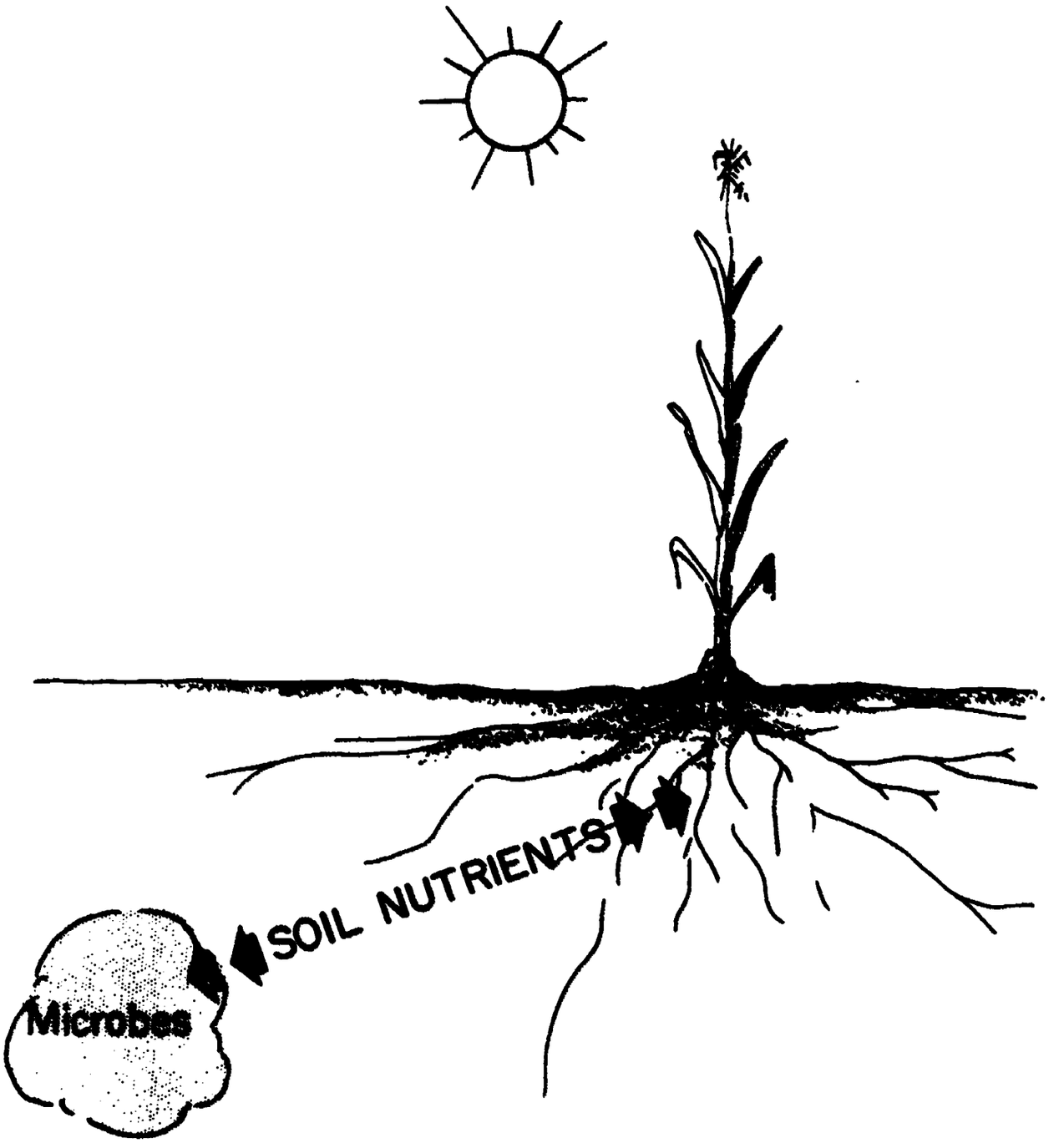
Evaluation:

A. Did the students grasp the concept of the vastness of the soil organism population?

B. Do the students understand the different animal and plant life present in the soil?

C. Do the students understand that most organisms are beneficial?

Student evaluation:


SOIL NUTRIENTS
Microbes

H

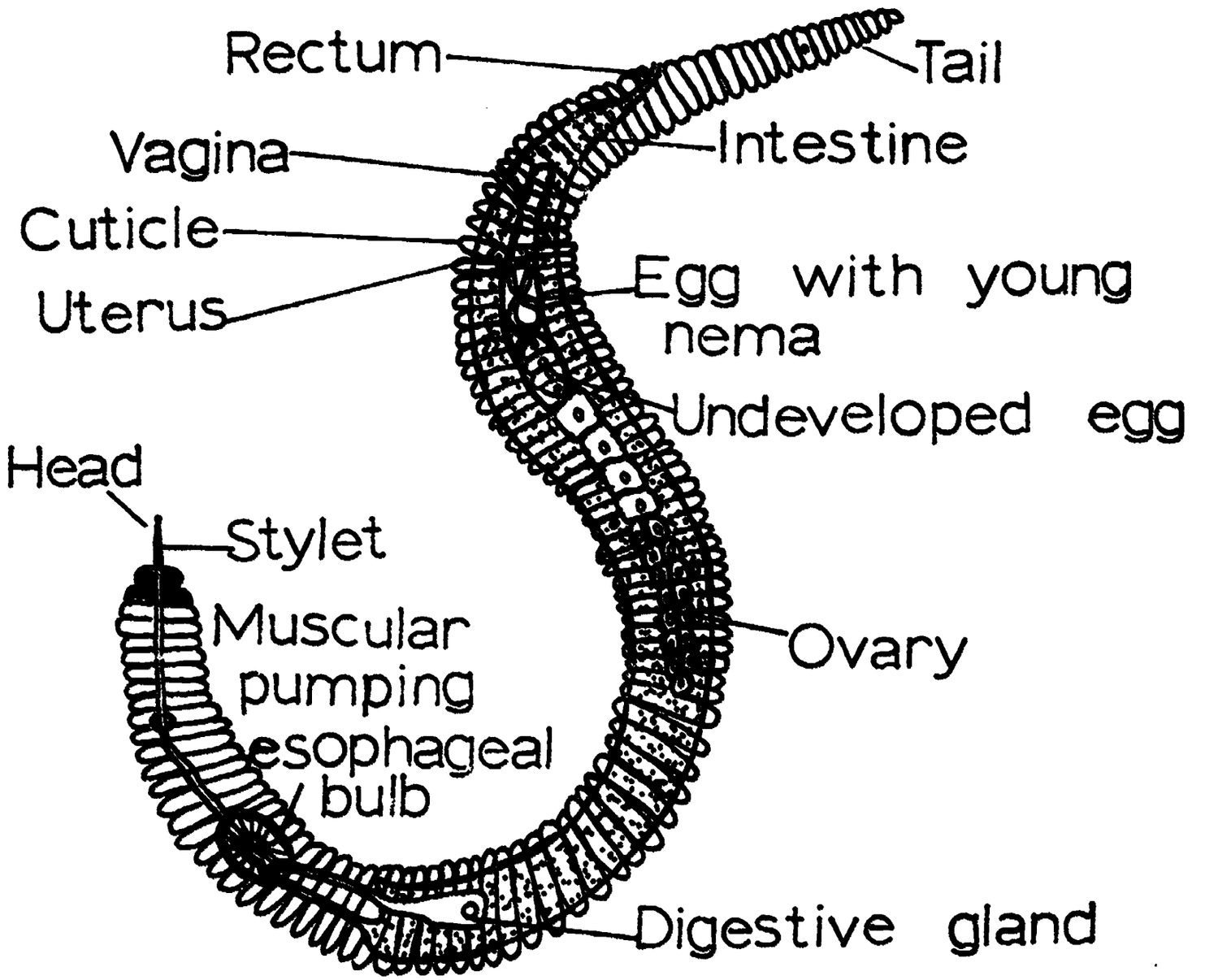
BREAKDOWN OF ANIMAL LIFE IN THE SOIL

MACRO-ANIMALS:

A. SUBSIST LARGELY ON PLANT MATERIAL
   1. SMALL MAMMALS
   2. INSECTS
   3. MILLIPEDES
   4. SOWBUGS (WOODLICE)
   5. MITES
   6. SLUGS
   7. SNAILS
   8. EARTHWORMS

B. LARGELY PREDATORS
   1. SNAKES
   2. MOLES
   3. INSECTS
   4. MITES
   5. CENTIPEDES
   6. SPIDERS

MICROANIMALS: PREDATORY, PARASITIC AND LIVING ON PLANT TISSUES.
   1. NEMATODES
   2. PROTOZOA
   3. ROTIFERS



PLANT DESTRUCTIVE NEMATODE

H

BREAKDOWN OF PLANT LIFE IN THE SOIL

A. ROOTS OF HIGHER PLANTS

B. ALGEA
   1. GREEN
   2. BLUE-GREEN
   3. DIATOMES

C. FUNGI
   1. MUSHROOM FUNGI
   2. YEASTS
   3. MOLDS

D. ACTINOMYCETES OF MANY KINDS

E. BACTERIA
   1. AEROBIC
      1. AUTOTROPHIC
      2. HETEROTROPHIC
   2. ANAEROBIC

DETRIMENTAL PROCESSES OF ORGANISMS

1. PRODUCTION OF PLANT AND ANIMAL DISEASES (PATHOGENS)
   A) WILTS
   B) ROTS
   C) GALLS (NEMATODE INJURY)

2. DENITRIFICATION: REVERSE RELEASE OF NITROGEN FROM SOIL.

3. COMPETITION FOR AVAILABLE NUTRIENTS TIE UP NITROGEN IN THEIR BODIES WHEN A LOT OF CARBON IS PRESENT.

4. PRODUCE TOXIC COMPOUNDS
   A) METHANE
   B) HYDROGEN SULFIDE
   C) PHOSPHINE
   D) OTHER ORGANIC ACIDS

CONDITIONS NECESSARY FOR OPTIMUM GROWTH OF ORGANISMS

1. TEMPERATURE - 80-90°F
2. MOISTURE - AROUND FIELD CAPACITY
3. ACIDITY - pH OF 6.8
4. OXYGEN - AERIATE SOIL

h

EARTHWORMS AND SOIL

Purpose: To show the effect of earthworms on soil

Materials: Two transparent plastic containers filled with soil
Earthworms

Procedure: Fill the two plastic containers with fairly compact soil and add worms to one. Note differences in volume, compactness and permeability. The mixing of soil can be illustrated best if layers of white sand and dark soil are alternated at the beginning of this demonstration.