LSC # 15
Action ____

COVER SHEET: Request for Approval to Use W-Designation

TYPE I. PROFESSOR COMMITMENT
(✓) Professor Sandra Newell Phone 4462
(✓) Writing Workshop? (If not at IUP, where? when? yes, IUP)
(✓) Proposal for one W-course (see instructions below)
(✓) Agree to forward syllabi for subsequently offered W-courses?

TYPE II. DEPARTMENTAL COURSE
( ) Department Contact Person _____ Phone _____
( ) Course Number/Title _____
( ) Statement concerning departmental responsibility
( ) Proposal for this W-course (see instructions below)

TYPE III. SPECIFIC COURSE AND SPECIFIC PROFESSOR(S)
(✓) Professor(s) Sandra Newell & Robert Gendron Phone 4462
(✓) Course Number/Title BI 362 Ecology
(✓) Proposal for this W-course (see instructions below)

SIGNATURES:

Professor(s) Sandra J. Newell Robert P. Gendron

Department Chairperson Allan F. Andrews

College Dean William J. Cale

Director of Liberal Studies Charles D. Cashdollar 4-12-90

COMPONENTS OF A PROPOSAL FOR A WRITING-INTENSIVE COURSE:

I. "Writing Summary"--one or two pages explaining how writing is used in the course. First, explain any distinctive characteristics of the content or students which would help the Liberal Studies Committee understand your summary. Second, list and explain the types of writing activities; be especially careful to explain (1) what each writing activity is intended to accomplish as well as the (2) amount of writing, (3) frequency and number of assignments, and (4) whether there are opportunities for revision. If the activity is to be graded, indicate (5) evaluation standards and (6) percentage contribution to the student's final grade.

II. Copy of the course syllabus.

III. Samples of assignment sheets, instructions, or criteria concerning writing that are given to students.

Provide 12 copies to the Liberal Studies Committee.
Please number all pages.

I. Writing Summary - BI 362 Ecology

BI 362 Ecology is proposed for identification as a "W" course. The course is taught every fall. Because of prerequisites, the students are junior and senior students in biology and related majors. Class size is limited to 24. This is the maximum seating capacity of the laboratory room. The course is a biology elective and counts towards a biology major or minor.

Four types of writing occur in this course.

1. Scientific Report

The student will report on research carried out in the lab. The purpose of this type of writing is to train the student in preparing manuscripts for publication in scientific journals. This type of writing follows a standard format found in scientific journals: introduction, methods, results, discussion. The report is approximately 5 pages, and the writing style is concise. The introduction is brief and contains sufficient background information to tell the reader what scientific question is being asked and why the question is important. The methods section describes the experimental design used to answer the question. The results section contains data in the form of tables and/or graphs and a brief description of the results. In the discussion section, the author interprets the results. There will be 4 or 5 of these reports submitted during the semester. There is no opportunity for revision of these reports, but the student is able to use comments on the first report to develop the second report. The reports constitute approximately 70% of the points for the laboratory portion of the course or approximately 20% of the course grade. The criteria for assigning a grade are: 1) ability to interpret the results, 2) clarity of expression, and 3) mechanics, style, and format.

2. Summary of Experimental Results

The student briefly summarizes and interprets the results of a laboratory exercise. In addition to providing an opportunity for the student to display results effectively in graphs and tables, the student must communicate an understanding of the results within the context of biological concepts. Again, the writing style is concise. Summaries constitute approximately 30% of the points for the laboratory portion of the course or less than 10% of the course grade.

The criterion for grading is the student's ability to interpret and explain results. Summaries are generally short and consist mostly of data with little writing involved. There is no opportunity for revision.

3. Writing for Evaluation of the Student

There are 3 exams, and approximately 80% of the exam grade is based on written responses. Half of these questions require the student to define a term or explain a concept. The other half are essay questions. The student is given 4 pairs of essay questions from which they choose to answer one question per pair. These essay questions tend to require greater thought, more originality, some ability to analyze and interpret new information, and an understanding beyond memorization. This writing must be well organized, but it is less formal than the other types of writing in the course. Errors in spelling and grammar do not affect the grade unless the errors are so numerous that they interfere with understanding. The criteria for grading are: 1) the essay specifically answers the question in a complete and concise way, 2) answers are in complete sentences and organized into paragraphs, 3) ideas are logically organized, 4) ideas are clearly expressed. Exams constitute approximately 50% of the course grade. (See Appendix 1 for sample exam)

4. Research Proposal

The student develops a scientific research proposal (10-15 pages) which incorporates an original research question and experimental design. In addition to developing skills in writing a research proposal, the student is involved in the initial stages of scientific research, i.e., formulation of an original research question, review of background information on the question, development of a suitable experimental design attempting to answer the question. The format is: introduction, literature review, methods, and literature cited. The introduction is brief with just enough background to explain why the research question is interesting. The introduction also contains an explicit statement of the research question. The literature review is extensive and conveys the theoretical context of the research question. This component involves spending much time on a library search for relevant journal articles. The methods section describes the experimental design proposed to answer the research question. The research proposal is prepared in both an initial draft and a revised draft. The two drafts are given an equal number of points. The total assignment is approximately 25% of the course grade. The criteria for grading are: 1) following correct format and specifications, 2) logical organization, 3) clarity of expression, 4) originality of the research question, and 5) mechanics and style.

Newell and Gendron - 1989

COURSE SYLLABUS

I. CATALOG DESCRIPTION

BI 362 2c-3l-3sh

This is a study of the interrelationships and adaptations of plants and animals. It includes consideration of physical as well as biotic environmental factors. Field trips are taken to study various types of ecologic situations.

Prerequisities: Plant Biology and Animal Biology

II. COURSE OBJECTIVES

A. To promote the concept of interrelationships of all things, living and non-living, on this planet.

B. To foster the development of an environmentally oriented philosophy of living.

C. To foster an appreciation for the intricate beauty of the natural world.

D. To promote understanding of some fundamentals of ecological methodology.

III. COURSE OUTLINE

A. Introduction
   1. What is ecology?
   2. Populations, communities and ecosystems

B. Evolutionary Ecology
   1. Mechanisms of evolution
   2. Coevolution
   3. Speciation

C. Autoecology: The individual in its environment
   1. Physiological ecology - the role of physical factors
      a. Light
      b. Temperature
      c. Water
      d. Soil
   2. Behavioral ecology
      a. Predators and their prey - foraging strategies
      b. Competitive interactions
      c. Habitat selection

D. Population Ecology
   1. The distribution of populations
   2. Populations dynamics
      a. Population structure: demography

b. Growth and regulation
c. Evolution of life history traits

3. Interactions between populations
   a. Competition
   b. Predation
   c. Herbivory
   d. Symbiosis

E. Community Ecology
1. The community concept
2. Community structure and stability
   a. The role of physical factors
   b. The role of species interactions
3. Island Biogeography
4. Succession

F. Ecosystem Ecology
1. Energy flow and productivity
2. Biogeochemical cycles
3. Survey of biomes

IV. EVALUATION METHODS

Grades are based on the following components:

50% - Three exams combining short-answer questions (e.g., multiple choice, true-false, definitions, short essays) with a few essay questions requiring longer and more original responses. Questions pertaining to both the lecture and laboratory material are incorporated in these exams.

15-20% - Lab reports in the format of a scientific journal article (i.e., introduction, methods, results, discussion).

5-10% - Lab summaries which briefly summarize the results of a lab exercise.

25% - Research proposal (10-15 pages) which incorporates an original research question, a literature review of relevant theoretical background, and an experimental design to answer the research question.

V. LECTURE TEXT

Krebs, C.J. 1985. Ecology. The Experimental Analysis of Distribution and Abundance. 3rd ed. Harper & Row, NY.

Other readings from primary and secondary sources may be required.

BI 362 Ecology

Newell - 1989

WRITING ASSIGNMENTS

Table of Contents

INTRODUCTION

One of the goals of this course is to help you develop your ability to think about problems and questions in ecology. Dr. Gendron and I both believe that writing is an extension of thinking, and by writing you clarify your own ideas. Consequently, we are developing this course into a writing intensive course.

In order to help you as much as possible with your writing assignments, we have developed this lengthy handout. We hope that it provides, in one package, all of the necessary information for you to do a competent job in your writing.

Since this is the first time we are using this handout, we ask that you keep track of what parts are useful and what parts make you weep and tear out your hair. At the end of the semester, we will ask you to critically review this handout.

LAB REPORTS

Goal: You will present scientific knowledge in a standard format to the scientific community.

Format: Imagine you are a professional ecologist. You have performed a scientific experiment; the results may or may not confirm the predictions you made before the experiment. You must report your experiment to other professional ecologists. In your lab reports you will follow a standard format found in most scientific journals.

1. The introduction should include sufficient background information so that the reader knows why you did the experiment. In other words, you asked a scientific question and then attempted to answer that question with an experiment. Why did you bother to ask the question in the first place? Why is the question interesting and important for advancing ecological knowledge. Finally, the introduction should contain a very explicit statement of the question you asked. The question might be stated as a hypothesis and/or a null hypothesis (see page 6).

2. The methods section should provide sufficient detail so that another professional ecologist can duplicate your work and confirm the results.

3. The results section contains data in the form of tables or graphs and a brief description of the results.

4. The discussion section is probably the most important section. In it, you must tell other professional ecologists what you think the results mean. In other words, you must interpret your results. If the results do not fit your expectations, do not automatically assume an error in

methods. There may be good biological reasons for unexpected results.

Criteria for a grade:

1. Ability to interpret the results
2. Clarity of expression
3. Mechanics, Style, and Format

All lab reports will be typed and submitted one week after the lab experiment. Late submission of a report will result in a lower score. Excessive errors in typing, spelling, or grammar (i.e., more than five mistakes) will result in a lower score. Allow yourself enough time to proof-read and retype your report if necessary. We strongly recommend that you prepare your reports on a word processor.

ESSAY QUESTIONS ON EXAMS

For obvious reasons, this type of writing is less formal than the writing of lab reports and a research proposal. Errors in spelling, grammar, etc. will not affect your grade unless the errors are so numerous that they interfere with understanding.

In answering an essay question, allow yourself a few minutes to compose your thoughts before you begin to write. Many of the questions will require you to extend your thinking beyond the facts learned in class. Do not make the mistake of regurgitating memorized facts; we want to see evidence of a deeper understanding.

Criteria for grade:

1. Does your essay specifically answer the question in a complete and concise way. Or, have you opened a mental file drawer and dumped out all information related to key words in the question. The former approach will get a higher score.

2. Answers should be in complete sentences and organized as paragraphs; no phrases, outlines, or lists unless specifically requested in the question.

3. Logical organization

4. Clarity of expression

RESEARCH PROPOSAL

Dates to Remember

Sept. 18	Submit choice of 3 potential topics (see page 4 of this handout).
Oct. 2	Submit final choice of topic and six relevant references (see page 5 of this handout).
Oct. 16	Make appointment for conference at which you will submit your research question(s) (see page 6 of this handout). (10 points)
Nov. 6, 1:00 p.m.	Submit Research Proposal. (60 points) Late submission of the proposal will result in zero points (see page 7 of this handout).
Dec. 4, 1:00 p.m.	Submit Revision of Research Proposal. Late submission of the revision will result in a lower score. (60 points) (see page 9 of this handout).

What is a Research Proposal?

Writing proposals is an integral part of being a scientist, and writing good proposals isn't easy. Consequently, your major writing assignment in this class is a research proposal rather than a format of more limited use such as a term paper.

A research proposal describes in detail an original research project. A scientist writes a research proposal for the purpose of requesting funds to conduct the proposed research. This is the way in which most scientific research is supported. A variety of agencies supply money for ecological research, e.g., the federal government through the National Science Foundation (NSF), private foundations, and IUP. All sources of funding for research require scientists to present their requests for money in the form of a research proposal.

Regardless of the source of the funds, the total amount of money allocated to scientific research is always much less than the total amount being requested. With only a few sources of funds, scientists compete intensely for limited resources for research. Once a research proposal is submitted, it is subjected to close scrutiny by the scientific community. The funding agency relies on other scientists to tell which proposals are the best and which proposals deserve to be funded. This peer review process can be excruciating for the writer of the proposal - no one likes to expose his or her favorite ideas and best writing to the criticism of others. After a few runs through the gauntlet of peer review, most scientists learn to take criticism in stride and use it constructively to improve future proposals.

How to Choose a Topic

The key to success in writing a research proposal is choosing a topic that is so fascinating you will actually enjoy writing it. However, choice of a topic comes early in the semester, before you have had the chance to learn much ecology. Begin by looking at the list of lecture topics. These can be put into the broad categories of evolutionary ecology, behavioral ecology, physiological ecology, population ecology, community ecology, and ecosystem ecology. You may want to consult your textbook or any other ecology book to decide which of these broad categories are most interesting. And, feel free to consult with us.

After choosing a general category, there are two approaches. You may consult the section VI of this handout for potential topics. Alternatively, peruse the bookshelves of the library for ideas. In particular, consult the Annual Reviews of Ecology and Systematics (ARES). These are published every year and contain many review papers on a variety of topics in ecology. For example, you may choose the topic evolutionary ecology and within that general topic the more narrow topic of sexual selection. As you delve into the scientific literature on sexual selection, you will find the topic to be much too broad. At this point the

review papers of ARES can help you to further narrow your topic. For example, in 1974 a specific type of sexual selection was reviewed. This 1974 paper discusses frequency-dependent sexual selection (i.e., do females prefer to mate with rare or common types of males?).

How to Review the Scientific Literature on your Topic

This is a time-consuming process, so begin as soon as you have chosen a general topic. For each topic listed in this handout we have tried to give you at least one reference to help you get into the literature.

You may find it convenient at this point to get a package of 3 x 5 index cards and fill out a card for each reference you locate. By putting the complete reference on a card, you will be able to type the literature cited section on your research proposal directly from cards. Also, it is easy to alphabetize your references before you type them. (See Appendix B for samples of reference formats).

Do not expect to find the most useful references first. You may have to look up hundreds of references just to find a dozen appropriate articles. Obviously, you are not going to have time to read several books and a couple hundred journal articles before you submit your list of relevant references to us. Use a stepwise approach to locating the appropriate literature for your proposal. First, locate relevant books, monographs, and review articles. Read the table of contents, then go directly to the bibliographies where you will find hundreds of references to journal articles. Read the titles of the journal articles and choose the most relevant. At this point you may be in the process of narrowing your topic (e.g., from sexual selection to frequency-dependent sexual selection). Narrowing your topic is not an easy task; allow the available literature to guide you. If you suddenly realize that most of the journal articles on frequency-dependent selection are written in French or published in China, you may want to shift your topic to a related topic (e.g., sexual selection and mate choice in plants) for which the literature is more readily available.

If you have two hundred titles of journal articles, you should be able to choose 30-50 of the most relevant articles to look up in the library. At this point, read only the abstracts or summaries and do not try to photocopy everything. Based upon the contents of the abstracts, you may find 10-20 papers that will be useful in writing your research proposal. These papers must be read in their entirety; then use the bibliographies of these articles to find other appropriate articles.

In the process of narrowing your search from 50 to 20 articles, you should have in mind a specific hypothesis or question to ask in your research proposal. Without that question in mind, it becomes impossible to choose the most relevant articles.

The only problem that can arise with the above procedure is that you may miss the most current articles on your topic. The best way to get the most recent articles on your topic is to note which journals contain the good articles, then go into the stacks of the library and skim the contents of recent issues of these journals. This sounds like an inefficient method, but other methods (e.g., BIOABSTRACTS) are more inefficient. DO NOT USE THE BIOABSTRACTS or computer literature search facilities unless you have a very specific topic. Expect 90% of the articles located in this way to be useless.

Formulating a Research Question

At this point you should have chosen a general topic (e.g., sexual selection) and perhaps a specific topic (e.g., frequency-dependent sexual selection). You should have proceeded far enough in your literature review to have read the abstracts of some 50 articles. If you are not overwhelmed by the complexity and enormity of your topic, consider yourself very lucky. To begin your task of formulating a research question, list on paper every question you can. Don't worry about how silly or confusing the questions are; write for at least 20 minutes just to fill up the page. Put this page of questions aside until the next day, then study your questions carefully to distill from the list one to six questions that seem to need an answer. Can your questions be answered from existing knowledge from the journal articles you've seen? If so, note the answer, then ask yourself what is presently unknown. What questions can be answered only by looking at nature? After giving some thought to your questions, you will prepare a typed list to bring to your first conference with us. Also, bring all of your index cards with references.

If you are familiar with concept maps you may want to prepare a concept map for your topic before developing your questions. (Examples of concept maps are provided in Appendix C.)

Hypothesis, null hypothesis, and experimental design

The core of any research proposal is one or more hypotheses which the investigator wishes to test. While philosophers of science may argue over the exact nature of a hypothesis, we will give it a very simple definition. A hypothesis is a prediction. You have asked a specific question, e.g., When selecting mates, do female <u>Drosophila</u> show a preference for rare or common types? You have surveyed the relevant literature. Based upon the observations made in previous studies you make a prediction; you predict that females will show a preference for common types, rejecting males with unusual appearance or behavior. You design an experiment to test your hypothesis. In your experiment, previously unmated females are allowed to choose among males of two different types, one of which is more common than the other (e.g., 90% A, 10% B). This experiment is replicated fifty times. To determine whether frequency alone is influencing female

choice, you must reverse the proportions of males (e.g., 10% A, 90% B) and replicate this experiment fifty times. The choices of the females constitute your results. The null hypothesis in this experiment states that the female will choose her mate randomly, regardless of the type or frequency of the male. ("Null" means zero, nothing, no effect. A null hypothesis is the situation where no specific factors influence the results, i.e., the results are dependent on random processes only.) It is this null hypothesis you wish to reject. Given certain statistical tests used on the data, you may or may not be able to reject the null hypothesis, and the data may or may not support the prediction or hypothesis you made. Note that it is possible to reject the null hypothesis without supporting your prediction. The results might show that females prefer type A males regardless of their frequency. Note also the potential for error in interpretation if you perform only half of the experiment. If you just did the first part of the experiment where type A males are more common, you might erroneously conclude that females prefer the common type, when, in fact, they simply prefer type A.

Writing the proposal

Again, imagine you are a professional ecologist. You have a terrific idea for a research project, you've posed a specific question, formulated a hypothesis, and have in mind an experiment to test your hypothesis. Now you want to convince the National Science Foundation (NSF) to give you money to do the research. You'll need money for equipment and supplies, salaries for yourself and two research assistants. In addition, you want NSF to pay for the costs of publishing your results in a scientific journal and to support your travel to Sweden and Australia to present your results at international scientific meetings. We are talking about a lot of money, so you had better write a very convincing research proposal.

When NSF receives your proposal it will distribute copies to ten other professional ecologists for their opinions. This is called peer review. Dr. Gendron and I happen to be two of the ten ecologists who receive your proposal for review.

What do we look for as we review your proposal? First, can you follow directions? Does the proposal fit these specifications?

1. Typed (left-justified), double-spaced, 1-inch margin, 10-15 pages in length, not including the literature cited section.

2. Component sections: Introduction, Literature Review, Methods, Literature Cited.

The introduction should be brief with just enough background to explain why your research question is interesting and then an explicit statement of the research question. The literature review is *not* an exhaustive survery of every word ever written about your topic. The content of the literature review should

convey the theoretical context of your research question. Why is the question interesting and exciting? Who cares whether female Drosophila swoon over type A males and haven't got the time of day for type B males? How can a specific question be fit into a more general framework of knowledge? And, how will answering your question provide new knowledge? Direct your literature review to justify why you asked your specific question. Finally, in the methods section you will develop a brief description of an experimental design to test your hypothesis. The format of the literature cited section will be described later.

In addition to following the above specifications, other factors considered in reviewing your proposal are:

3. Logical organization beyond the format described above. Logical organization is heavily dependent on your ability to organize within and among paragraphs. Remember, each paragraph begins with a topic sentence; and the entire content of the paragraph must relate to the topic of the paragraph. Paragraphs must be logically tied together. See the first sentence of this paragraph for an example.

4. Clarity of expression. Have a friend read your proposal before you submit it. If your friend cannot understand the proposal, you have not clearly written it. If a friend helps you by identifying problems in your writing, or helps you to clarify your thinking about your research question, include an acknowledgements section at the end of your proposal. You will notice acknowledgements sections in almost all journal articles. Everyone needs help from time to time.

5. Originality of the research question. Did you adequately review the literature to determine whether the answer to your question is already available?

6. Mechanics and Style. This is not an English course. We assume that you are proficient in the mechanics of the English language. If you need help in grammar, word usage, and composition, consult an appropriate reference guide (Walsh and Walsh, 1966; Turabian, 1973; Jordan, 1976; Strunk and White, 1979). No more than five technical errors are allowed in your proposal. The same mistake made twice counts as two errors. If there are more than five errors of spelling, grammar, punctuation, etc., you will lose points for excessive sloppiness. In other words, proofread carefully; we will not do it for you. For helpful strategies in proofreading see Walvoord (1988). We strongly recommend that you use a word processor rather than a typewriter. Corrections are much easier on a word processor. Apple computers are available for student use in Davis Hall. If you are unfamiliar with the word processor, ask us for help.

Revising the proposal

In reviewing the proposal, I will try to identify both the good and the bad, using the cover sheet developed for the review (see appendix A). You will schedule a conference time to discuss the review with me. My review will identify the most important problems to be addressed, not necessarily all of the problems in your writing. Consequently, we cannot guarantee you an A just for turning in a revised proposal. Your revised proposal will be an improvement over your initial proposal, but it may not be perfect.

Literature Citations

Within the text of your research proposal you will cite references by last name of the author(s) and date of publication. Any time you make a statement of scientific fact, you should acknowledge the source of the information. For example, in writing about sexual selection I may say "Frequency-dependent sexual selection is important in Drosophila (Ayala and Campbell, 1974)." This indicates that this statement of fact is obtained from the paper by Ayala and Campbell.

At the end of the proposal is a literature cited section. Every journal article or book referred to in the text of the proposal must be listed in the literature cited section. Every citation in the literature cited section must appear in the text. I will check for correspondence between the text and the literature cited section.

The literature cited section contains an alphabetical listing of references. If the same author has more than one article in the list, these articles are listed chronologically from the oldest article. We will use the journal Evolution as a model for our citations. A photocopy of literature citations from this journal is attached to this handout (Appendix B.)

A NOTE ON PLAGIARISM

The penalty for plagiarism is severe - a zero for the assignment. Plagiarism is defined by The Random House Dictionary as "to steal (the language, ideas, or thoughts) from (another), representing them as one's own original work." Using the words exactly as they appear in the dictionary requires quotation marks. Please keep this in mind as you write your proposal. We want your ideas and your writing, not someone else's. Minimize the use of quotes; you can probably write your proposal without quoting anyone verbatim. It is sometimes necessary to paraphrase. I could write that plagiarism is using someone else's writing as your own. I'm conveying a meaning similar to the one given in the dictionary definition, but I'm putting the concept into my own words. A form of paraphrasing that, in spirit, is plagiarism involves the slight modification of someone's words. It would be

wrong for me to take the above dictionary definition and write that plagiarism is stealing the language or ideas from another, representing them as one's own work. It's not an exact quote, so there are no quotation marks. But, it is not my writing either. We expect you to write your proposal in your own words, not in the slightly modified voice of someone else.

POTENTIAL TOPICS FOR A RESEARCH PROPOSAL

I. Evolutionary ecology
   A. Sexual selection
      1. frequency-dependent sexual selection (e.g., do females prefer rare or common types of males?)
      2. in bowerbirds
         Ann. Rev. Ecol. Syst. 17:17-39
      3. in plants (e.g., to what extent can plants choose mates?)
         Willson, M.F. and N. Burley. 1983. Mate choice in plants. Princeton Univ. Press. Princeton, NJ
      4. and evolution of song
         Ann. Rev. Ecol. Syst. 17:507-533
      5. in polygynous animals
         Ann. Rev. Ecol. Syst. 18:43-70

   B. Sexual dimorphism
      1. in zooplankton (e.g., why are male rotifers smaller than females?)
         Ann. Rev. Ecol. Syst. 14:1-35

   C. Mimicry
      1. deceitful flowers (e.g., can pollinators distinguish between flowers with and without nectar?)
         Ann. Rev. Ecol. Syst. 15:259-278

   D. Coevolution
      1. figs and pollinators
         Ann. Rev. Ecol. Syst. 10:1-13
         Ann. Rev. Ecol. Syst. 10:13-53
      2. host and parasite
         Ann. Rev. Ecol. Syst. 14:465-485

   E. Speciation
      Otte, D. and J.A. Endler (eds.) 1989. Speciation and its consequences. Sinauer Associates, Inc. Sunderland, Mass.
      1. molecular species barriers
         Ann. Rev. Ecol. Syst. 17:465-485
      2. in cave fauna
         Ann. Rev. Ecol. Syst. 16:313-338
      3. hybrid zones
         Ann. Rev. Ecol. Syst. 16:113-149
         Ann. Rev. Ecol. Syst. 16:85-113
      4. founder effect

Ann. Rev. Ecol. Syst. 15:97-133
Ann. Rev. Ecol. Syst. 15:133-165

5. in rodents
Ann. Rev. Ecol. Syst. 14:139-158

6. mechanisms
Ann. Rev. Ecol. Syst. 12:23-48

7. in the deep sea environment
Ann. Rev. Ecol. Syst. 18:185-208

F. Breeding systems and sex

1. evolution of sex
Michod, R.E. and B.R. Levin (eds.). 1988. The evolution of sex. Sinauer Associates, Inc., Sunderland, Mass.

2. breeding systems in plants
Ann. Rev. Ecol. Syst. 19:177-206
Ann. Rev. Ecol. Syst. 11:15-40
Willson, M.F. 1983. Plant reproductive ecology. John Wiley & Sons, N.Y.

3. sex change (e.g., Why change sex? Is it better to be a male or a female first?)
Ann. Rev. Ecol. Syst. 13:471-496

4. inbreeding and cleistogamy
Ann. Rev. Ecol. Syst. 18:237-268
Ann. Rev. Ecol. Syst. 14:411-442
Ann. Rev. Ecol. Syst. 7:469-495

5. mating systems in animals
Krebs, C.J. and N.B. Davies. 1984. Behavioural ecology. An evolutionary approach. 2nd ed. Sinauer Associates, Inc., Sunderland, Mass., pp.201-278.
Ann. Rev. Ecol. Syst. 11:197-232
Ann. Rev. Ecol. Syst. 9:123-155

6. maternal effects in plants
Ann. Rev. Ecol. Syst. 18:209-236

G. Kin selection and altruism
Ann. Rev. Ecol. Syst. 13:23-57
Ann. Rev. Ecol. Syst. 3:193-232

1. recognizing kin
Ann. Rev. Ecol. Syst. 19:543-572

II. Behavioral ecology

A. Predator-prey interactions and optimal foraging

1. frequency-dependent predation (e.g., Do predators ignore rare prey?)
Ann. Rev. Ecol. Syst. 5:115-138

2. optimal foraging theory
Krebs, J.R. and N.B. Davies. 1984. Behavioural ecology. An evolutionary approach. 2nd ed. Sinauer Associates Inc., Sunderland, Mass.
Ann. Rev. Ecol. Syst. 15:523-575
Ann. Rev. Ecol. Syst. 7:235-257

3. bumblebee foraging tactics
Heinrich, B. 1979. Bumblebee economics.

Harvard Univ. Press, Cambridge, Mass.
Ann. Rev. Ecol. Syst. 6:139-170

4. insect foraging strategies
Ann. Rev. Ecol. Syst. 9:75-98
Ann. Rev. Ecol. Syst. 4:231-258

5. in birds
Ann. Rev. Ecol. Syst. 14:231-254

B. Social behavior
E.O. Wilson. 1975. Sociobiology. Harvard Univ. Press, Cambridge, Mass.
Ann. Rev. Ecol. Syst. 15:165-189
Ann. Rev. Ecol. Syst. 5:325-383

1. in insects
Krebs, J.R. and N.B. Davies. 1984. Behavioural ecology. An evolutionary approach. 2nd ed. Sinauer Associates, Inc., Sunderland, Mass.

2. in primates
Ann. Rev. Ecol. Syst. 17:111-135
Ann. Rev. Ecol. Syst. 15:191-232

C. Communication
Ann. Rev. Ecol. Syst. 5:385-417

1. in the ultraviolet
Ann. Rev. Ecol. Syst. 10:373-398

2. olfactory communication
Ann. Rev. Ecol. Syst. 3:1-32

D. Habitat selection

1. genetic basis in Drosophila
Ann. Rev. Ecol. Syst. 14:35-55

2. choice of shells by hermit crabs
Ann. Rev. Ecol. Syst. 12:1-22
(e.g., can a big crab evict a smaller one from its shell? Do crabs "trade" shells?)

III. Physiological ecology (There are numerous textbooks on this general topic. e.g., Fitter, A.H. and R.K.M. Hay. 1987. Environmental physiology of plants. 2nd ed. Academic Press, NY
Gates, D.M. 1980. Biophysical ecology. Springer-Verlag, NY

1. soils, nutrients and plants
Ann. Rev. Ecol. Syst. 17:1-16
Ann. Rev. Ecol. Syst. 11:233-260

2. flow environments of aquatic benthos
Ann. Rev. Ecol. Syst. 15:303-328

3. ecological succession
Ann. Rev. Ecol. Syst. 11:287-310
Ann. Rev. Ecol. Syst. 10:351-372

4. adaptive significance of leaf life span
Ann. Rev. Ecol. Syst. 13:229-259 (e.g., Under what conditions would you expect a plant to be evergreen, deciduous?)

IV. Population ecology

Begon, M. and M. Mortimer. 1986. Population ecology. A unified study of animals and plants. Blackwell Scientific Publ., Oxford, England.

A. Dispersal
   1. of birds
      Ann. Rev. Ecol. Syst. 13:1-22
   2. of seeds and fruits
      Ann. Rev. Ecol. Syst. 13:201-228
      Ann. Rev. Ecol. Syst. 17:443-463
   3. of insects
      Ann. Rev. Ecol. Syst. 11:95-118
   4. of mammals
      Ann. Rev. Ecol. Syst. 11:163-196
      (e.g., What are the costs and benefits of leaving the natal area?)

B. Population dynamics and demography
   1. size-based demography in vertebrates
      Ann. Rev. Ecol. Syst. 18:71-90
   2. density-dependent regulation of population size in plants
      Ann. Rev. Ecol. Syst. 11:411-452
   3. intraspecific predation or cannabalism
      Ann. Rev. Ecol. Syst. 12:225-251
      Ann. Rev. Ecol. Syst. 6:87-106
   4. in plants
      Ann. Rev. Ecol. Syst. 10:109-146

C. Life history strategies
   1. life history variation & genetic variation in plants
      Ann. Rev. Ecol. Syst. 10:173-200
   2. seasonality in insects
      Ann. Rev. Ecol. Syst. 12:281-308
      Ann. Rev. Ecol. Syst. 19:1-18
   3. in marine invertebrates
      Ann. Rev. Ecol. Syst. 16:339-362
   4. evolution of complex life cycles
      Ann. Rev. Ecol. Syst. 11:67-94
   5. in social carnivores
      Ann. Rev. Ecol. Syst. 15:191-232
   6. evolution of phenotypic plasticity in plants
      Ann. Rev. Ecol. Syst. 17:667-693
   7. indeterminate growth in animals
      Ann. Rev. Ecol. Syst. 18:371-408
   8. in birds
      Ann. Rev. Ecol. Syst. 18:453-488
   9. r & K selection
      Ann. Rev. Ecol. Syst. 15:427-448
   10. reproductive strategies in bamboo
      Ann. Rev. Ecol. Syst. 7:347-392

D. Phenology
   1. in plants
      Ann. Rev. Ecol. Syst. 16:179-214

E. Interactions between species
   Ann. Rev. Ecol. Syst. 19:65-88
   Ann. Rev. Ecol. Syst. 13:291-314 (bacteria & algae)
   1. competition among species
      Ann. Rev. Ecol. Syst. 3:79-106 (rodents)
   2. herbivory
      Ann. Rev. Ecol. Syst. 19:111-146
      Ann. Rev. Ecol. Syst. 11:119-162
      (e.g., Do animals eat the most nutritious plants?)
      Ann. Rev. Ecol. Syst. 11:261-287
      (e.g., Do animals eat the least poisonous plants?)
      Ann. Rev. Ecol. Syst. 13:111-138
      Ann. Rev. Ecol. Syst. 12:405-438
   3. mutualism
      Ann. Rev. Ecol. Syst. 13:315-348
      Ann. Rev. Ecol. Syst. 8:407-428
   4. three-species interactions
      Ann. Rev. Ecol. Syst. 18:111-136 (plants, bugs, & ants)
      Ann. Rev. Ecol. Syst. 17:487-506 (parasite-mediated interactions)
      Ann. Rev. Ecol. Syst. 11:41-66 (plants, herbivores, predators)
   5. plants and pollinators
      Ann. Rev. Ecol. Syst. 18:343-370
      Ann. Rev. Ecol. Syst. 13:497-524
   6. effects of body size on interactions
      Ann. Rev. Ecol. Syst. 15:393-425
   7. birds and army ants
      Ann. Rev. Ecol. Syst. 9:243-263

V. Community ecology
   Strong, D.R., Jr., D. Simberloff, L.G. Abele, and A.B. Thistle (eds.). 1984. Ecological communities: Conceptual issues and the evidence. Princeton Univ. Press, Princeton, NJ.

   A. Competition and community structure
      Ann. Rev. Ecol. Syst. 10:201-227 (seed-eaters in deserts)
      Ann. Rev. Ecol. Syst. 13:349-372 (phytoplankton)
      Ann. Rev. Ecol. Syst. 17:89-110 (plants)
      Ann. Rev. Ecol. Syst. 17:169-189 (frugivorous mammals)
      Ann. Rev. Ecol. Syst. 19:281-308 (desert rodents)

   B. Community structure
      1. in benthos
         Ann. Rev. Ecol. Syst. 12:331-354
         Ann. Rev. Ecol. Syst. 13:423-450
      2. in marine algae
         Ann. Rev. Ecol. Syst. 12:49-74

Ann. Rev. Ecol. Syst. 12:405-438
Ann. Rev. Ecol. Syst. 13:111-138

3. in lizards
Ann. Rev. Ecol. Syst. 4:53-74

C. Predation and community structure
Ann. Rev. Ecol. Syst. 16:269-312

D. Species diversity
Ann. Rev. Ecol. Syst. 18:91-110 (tropical frugivorous vertebrates)
Ann. Rev. Ecol. Syst. 16:149-178 (coral reefs)
Ann. Rev. Ecol. Syst. 5:285-308 (measurements)

E. Effects of disturbance on community structure
Ann. Rev. Ecol. Syst. 15:353-392
Ann. Rev. Ecol. Syst. 18:431-452 (tropical trees)
Pickett, S.T.A. and P.S. White (eds.). 1985. The ecology of natural disturbance and patch dynamics. Academic Press, Inc., Orlando, Fla.

F. Island Biogeography
Ann. Rev. Ecol. Syst. 5:161-182

G. Succession
1. and nutrient cycling
Ann. Rev. Ecol. Syst. 10:53-84
2. and physiological ecology (see above)

VI. Ecosystem ecology

A. Food webs
1. marine plankton
Ann. Rev. Ecol. Syst. 19:19-38

B. Productivity
1. in freshwater wetlands
Ann. Rev. Ecol. Syst. 12:123-162
Ann. Rev. Ecol. Syst. 11:359-386
Ann. Rev. Ecol. Syst. 18:159-184 (tropical)
2. in marine ecosystems
Ann. Rev. Ecol. Syst. 19:89-110

C. Nutrient cycling
Ann. Rev. Ecol. Syst. 171-190
1. in tropical forest
Ann. Rev. Ecol. Syst. 17:137-168
2. decomposition of plants in freshwater
Ann. Rev. Ecol. Syst. 17:567-594
3. stable isotope use
Ann. Rev. Ecol. Syst. 18:293-320
4. soils
Ann. Rev. Ecol. Syst. 2:85-110

D. Comparative studies

1. freshwater & salt marshes
   Ann. Rev. Ecol. Syst. 19:147-176
2. tropical savannas
   Ann. Rev. Ecol. Syst. 1:125-152
3. deserts
   Ann. Rev. Ecol. Syst. 4:25-52
   Ann. Rev. Ecol. Syst. 5:195-214
4. Arctic tundra
   Ann. Rev. Ecol. Syst. 4:359-400

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Walsh, J.M., and A.K. Walsh. 1966. Plain English handbook. McCormick-Mathers Publ. Co., Wichita, Kansas.

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Appendix A

BI 362 Ecology - Research Proposal Cover Sheet

	A	B	C	D	F
		Grade			
1.	The proposal fits the specifications exactly.		The proposal fits most of the specifications.		The proposal ignores the specifications.
2.	The research question or hypothesis is highly original, interesting, and clearly stated.		The research question is clearly stated but not particularly interesting or original.		The research question lacks originality, is impossible to answer, is not stated clearly.
3.	The literature review is complete, well-organized, and focuses on the theoretical context of the research questions.		The literature review is extensive but not well focused on the theoretical context of the research question.		The literature review is inadequate. The references are irrelevant; the references are too few and do not include the most important works done in this research area.
4.	The experimental design is clearly described and will adequately test the hypothesis.		The experimental design is clearly described, but needs some modification before it will adequately test the hypothesis (e.g., lacks appropriate controls, sample size is too small, results will not answer the question being asked).		The experimental design is wholly inadequate to test the hypothesis. The design is confusingly presented or presented in insufficient detail to be evaluated.
5.	Ideas are logically organized throughout the proposal.		There are some small defects in the logical order of ideas, but these defects do not interfer with understanding the proposal.		Ideas are not logically organized & are confusingly presented or presented in insufficient detail to be evaluated.
6.	Terms are clearly defined and the proposal is easy to read.		The writing is relatively clear. There may be one or two points of confusion, but it is generally possible to understand what you intend to communicate.		Terms and ideas are not explained; the writing is unclear. It's not possible to understand what you intend to communicate.
7.	No technical errors.		Less than five technical errors.		More than five technical errors; very sloppy.
8.	The literature cited section follows the approved format; the citations in the text correspond perfectly with the citations in the literature cited section. RECOMMEND FOR FUNDING		Only a few errors in format of literature citations and in correspondence between the text and the literature cited section.		Literature citations do not follow the appropriate format, no correspondence between the citations in the text and the literature cited section.

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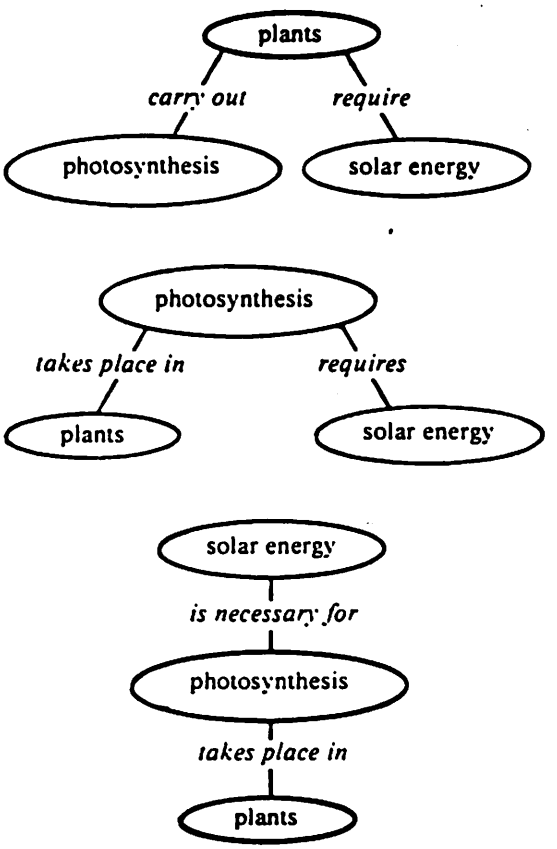
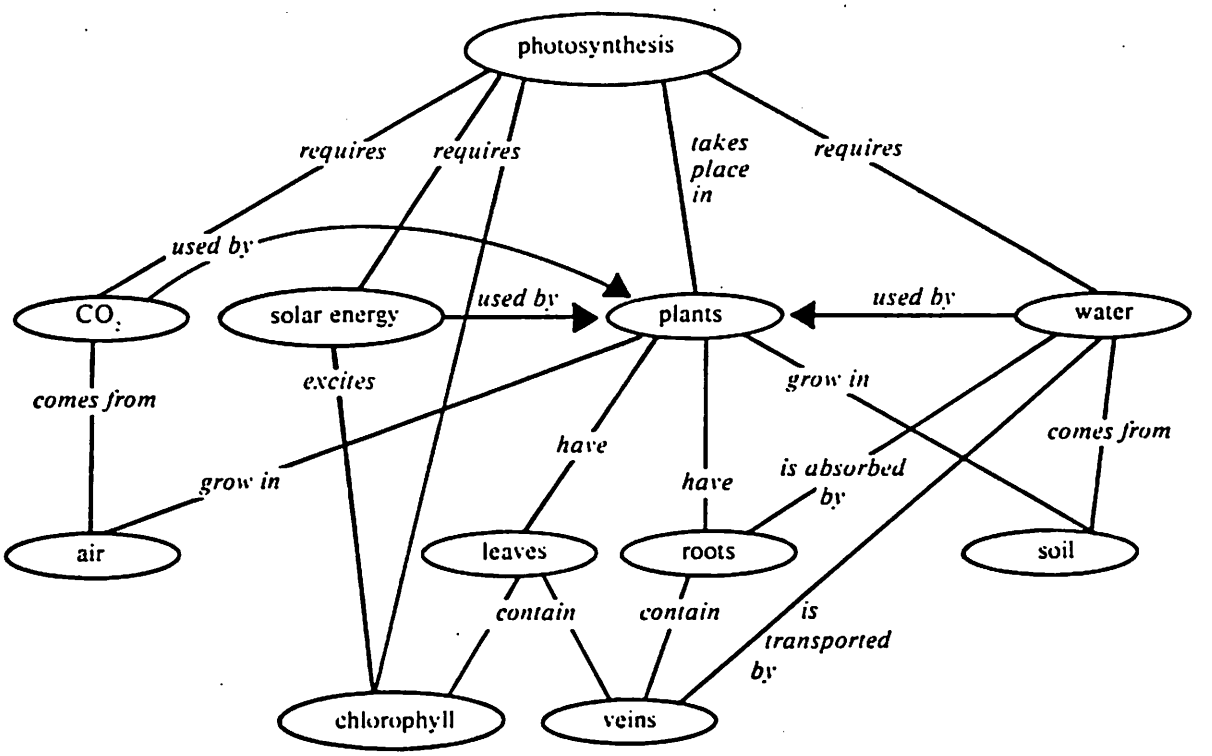
Corresponding Editor: T. R. Meagher

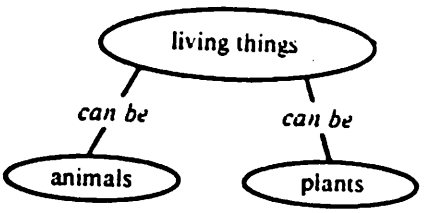
APPENDIX C

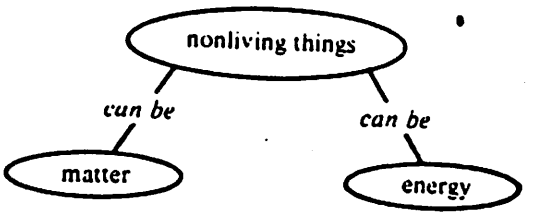
Concept maps

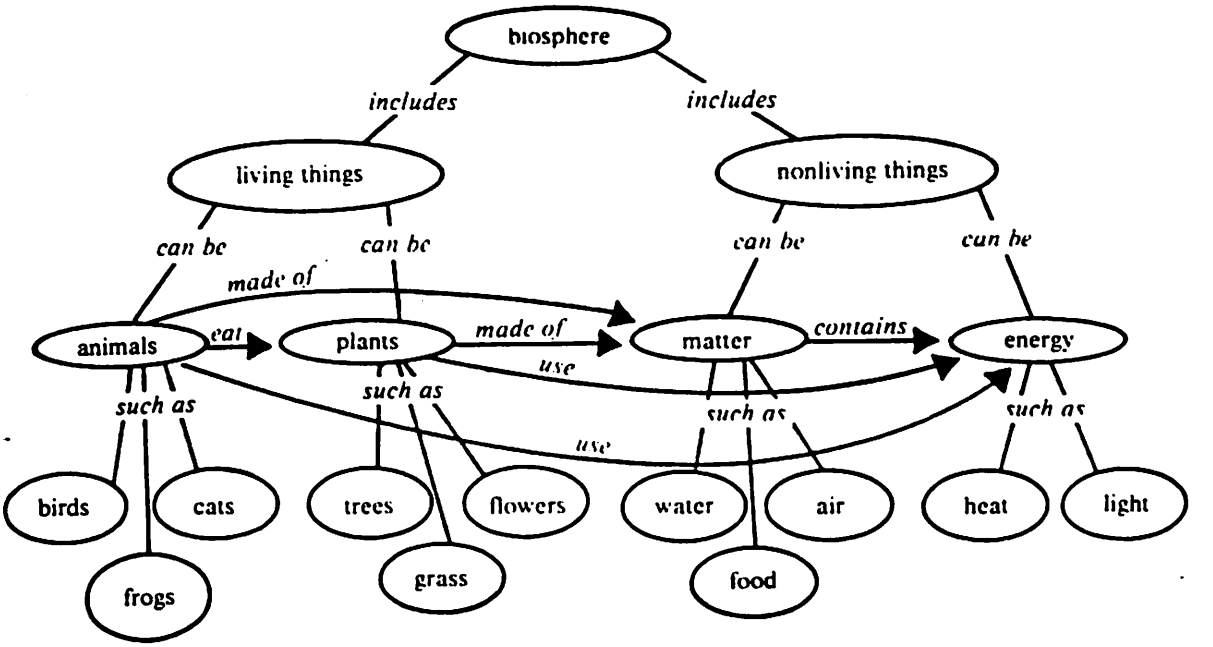
A concept map is a mechanism for visualizing how ideas are connected to each other. The three examples below show how the concepts "plant", "photosynthesis", and "solar energy" might be connected. The concepts are illustrated inside the oval, while the relationships between the concepts are written on the connecting lines. Additional examples of concept maps are shown on the next page. You may wish to use a concept map to organize the ideas you discover in your review of the literature.




photosynthesis
requires
requires
takes place in
requires
used by
used by
used by
CO2
solar energy
plants
water
comes from
excites
grow in
have
have
is absorbed by
comes from
grow in
air
leaves
roots
soil
contain
contain
is transported by
chlorophyll
veins


living things
can be
can be
animals
plants


nonliving things
can be
can be
matter
energy


biosphere
includes
includes
living things
nonliving things
can be
can be
can be
can be
made of
animals
eat
plants
made of
matter
contains
energy
use
such as
such as
such as
such as
use
birds
cats
trees
flowers
water
air
heat
light
frogs
grass
food

Ecology - Exam 3
Newell & Gendron

Name_____

Part I. Matching (2 pts each)

_____1. Z_{eu}
_____2. Simberloff
_____3. Primary consumers
_____4. Elton
_____5. Standing crop
_____6. oldfield succession
_____7. Rhizobium
_____8. phenology
_____9. high dispersal ability
_____10. allelopathy

A. mutualism
B. horseweed, aster, broomsedge, pine
C. mangrove islands
D. biomass
E. euphotic zone
F. pyramid of numbers
G. herbivores
H. seasonal patterns
I. chemical inhibition of one plant by another
K. producers
L. early successional species
M. late successional species

Part II. Definitions / Short Answers. Choose eight (8) of the following. (5 pts each)

1. keystone species concept

2. symbiosis

3. intermediate disturbance hypothesis

4. lottery-competition hypothesis

5. ecological succession

6. multidimensional niche space

7. IBP

8. upwelling zone

9. net primary productivity

10. Lindeman's efficiency

11. second law of thermodynamics

12. solar constant

13. What factor(s) limit production in the Sargasso Sea?

Part III. Essay Questions. (10 pts each) On each of the following pages there are two questions. Choose one question on each page to answer. Indicate which question (A or B) you are answering.

A. Based on your readings, discuss the roles of competition, predation, and disturbance in the structure of the rocky subtidal community.

B. Define "null model" and discuss the role of null models in the study of competition and community structure.

Choose one of following two questions.

A. Based on your readings, describe the mutualistic relationships between insects and fungi. Speculate in as much detail as possible how such a mutualism could evolve.

B. Contrast Clements' view of discrete communities and Gleason's individualistic concept of community structure. In 1987 Shipley and Keddy analyzed the distribution of plant species along a gradient from an upper to a lower marsh. They found that the upper boundaries of species distributions were clustered at certain points along the gradient. However, species whose upper boundaries coincided did not necessarily have lower boundaries which coincided. How would you interpret these results? Do they support or conflict with Clements' view, with Gleason's view?

Answer one (1) of the following two essay questions.

A. Speaking of forest ecosystems, Krebs states "most of the species we as humans tend to think of as important turn out to have little role in energy transfers." What does he mean by this? Would this statement be equally true for grasslands? The open ocean?

B. Why does deforestation of tropical rain forests disrupt the normal nutrient cycles so badly? How do the results of the Hubbard Brook deforestation experiment support your argument?

Answer one (1) of the following two essay questions.

A. One hypothesis for the latitudinal gradient of species diversity is that tropical communities are older. Why do some ecologists believe that tropical communities are older? In the context of niche theory, explain why species diversity might increase with time.

B. Figure 24.12 shows the hypothetical change in species richness for a newly formed volcanic island. Explain what is happening in each of the four phases.

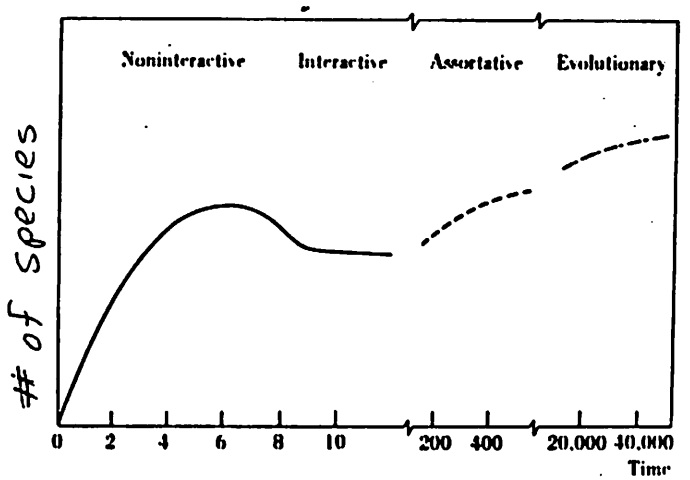


Figure 24.12 Postulated sequence of equilibria in a community of species through time. The time scale is imaginary, supplied here only to convey the notion of the vastly greater time periods required for shifts to states beyond the initial interactive equilibrium. (After Wilson 1969.)