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DEC 04 1974

Preliminary Report to the Development Committee and the Faculty

FROM: Curriculum Synthesis Subcommittee

RE: The Job to Be Done

We are faced at this time with a strong interest in Biology inside and outside the University, which seems destined to continue for some time to come. Much of this stems from a growing interest in the environment and the wish to contribute to solutions of environmental problems. We feel that this Department can contribute to this both by training competent biologists and by giving non-biologists an interest and awareness of their environment from the standpoint of Biology. It is also clear that our major emphasis is in Environmental Biology an "umbrella" that covers the work of everyone in the group. The Committee strongly suggests that we use this umbrella as our guide.

At the moment we are trying to serve a large and diverse group of students with a curriculum based on a plan for much smaller numbers. It is obvious that we cannot give them perfection, but we must do more than run them through a mill. A knowledge of Biological principles in as many people as possible is exceedingly important. We are attempting to serve the following groups in and outside the Department.

Majors

1. Pre-Professional Biologists

- A. Those going into Teaching and into Basic Research,
- B. Applied Biology (We don't want a separation here, but a certain amount is necessary.)

Possibilities include: Applied Ecologists
Environmental Physiologists
Laboratory Technicians

2. Pre-Meds and the like

A large group some of whom will switch into #1 if they do not get into Medical School.

3. Non-Preprofessional Biologists

This is a large group who have found that a Biology major is a good Liberal Arts education. We feel that they are an important segment of our department and should not be ignored.

Non Majors

1. Pre-Professionals from other Departments taking 12-20 hours of Biology.
E.g. Pharmacy.
2. Science majors from other Departments taking 8-16 hours, E.g. Chemistry, Environmental Engineering.
3. Non-scientists wanting some background.

Graduate students fall into category, #1 under Majors, of course.

On the basis of GRE scores, on which our students do quite well, we seem to be doing an adequate job for those in 1A. Pre-Meds and such seem to be getting an adequate training for their curricula on the basis of acceptances and performance in Medical, Dental, and other such schools. We are not, however, able to do an adequate job for the other groups, those wanting Biology as a Liberal Arts Major and those wanting to work as applied Biologists.

This is the preliminary report of our attempt to synthesize present offerings and the needs that go beyond them.

The ways to begin the Biology program are as diverse as the number of faculty we have, but several plans have been presented to the Committee, all of which have the common feeling that the present system is not satisfactory. It may be cheap but it's not satisfactory.

1. The present system has a large course (101 and 102) taken by over 1,000 students now broken up into small(?) lecture sections of 150 to 250 and labs of 20 students each. This includes 35-40% non-science majors. The course starts with cellular organization and works upward to the Ecosystem and Biosphere. Specific courses in the disciplines are available at the 300 level.

2. Alternatives to the present plan include the following:

A. Purchase of a complete Audio-tutorial Program made up by people outside this Department. It would run very much as the present system and be much more expensive.

B. A plan combining those of several people.

101 - to start with the Environment and the organism and work down in levels of organization. There would be several choices for the second semester:

102A - Animal Biology

102B - Plant Biology

102C - Microbiology (to include Algae and Protozoa).

102D - A synthesis of A, B, and C as well as some of the present 101 material. A terminal course in Biology for Non-majors.

At the 300 level, there would be a series of large courses giving the basic "Principles" of each main discipline in EPOB: Ecology, Physiology, Genetics, Ethology, Systematics and Evolution, Structural Biology. Some of these would be with labs and some without.

From this basis would rise a series of small courses at the 400 and 500 level which would allow the students to have some faculty contact and some concentrated laboratory and field experience. Science is a way of approaching and solving problems, and students do not learn this in large, or small, lecture sections.

Courses will be arranged to provide routes of emphasis for interested students, especially the preprofessional Biologists. These would consist of:

Ecology - The Community and Ecosystem approach

Population Biology - Ecology with a strong genetics approach.

Systematics and Evolution

Physiological Ecology - Autecology from a physiological standpoint combining field and lab work.

Ethology - Autecology from a behavioral standpoint.

Comparative Physiology - Using the species as a variable as well as environmental factors. Emphasis on lab work and determination of basic mechanisms.

Quantitative Biology

Applied Biology - This will require some specific new courses to better train students for specific jobs, but they will have the basic courses as the foundation for applied work.

(There are also other areas which do not come under our "umbrella" of Environmental Biology which can be best shared with other departments such as MCD3 and Psychology.)
The scheme for this plan:

600	Seminars
500	Graduate courses, mostly with labs
400	Senior Research Program (for selected students)
	Small courses with labs and field work for concentrated study

Principles of :

300	Ecology, Physiology, Genetics, Ethology, Systematics and Evolution, Structural Biology, and Biometry
-----	--

100 level

101

102 A, B, C, D

- C. An alternative which would force greater specialization on the undergraduate level is given here:

General Biology

	Lecture	Lab
101	1. Framework: Man and his Environment	Environmental Problems
	2. Basic concepts of Biology	and their solutions.
	3. Investigative Methodology	a. Field studies (101)
	4. The formal disciplines	b. Lab studies (102)
	a. Microbial	
	b. Plant	
	c. Animal	
102	5. Introduction to the Programs	
	a. Environmental	
	b. Population	
	c. Organismic (Functional and Behavioral)	
	d. Biosystematics and Evolution	

A series of Team-taught Survey Courses in EPOB Programs

	Ecology	Populations Biology
	Physiology	Behavior
200	Genetics	Biosystematics
level	Evolution	

At the 300 level, specialization begins with advanced courses in Plant, Animal and Microbial aspects of the fields.

At the 400 level, courses should be specialized as to habitat (aquatic, terrestrial, etc.) and be oriented toward integrating the sub-disciplines.

Graduate Programs are extensions of the above courses with the emphasis on research, recent advances, etc.

D. Another alternative suggests that General Biology be required only for the disadvantaged students who can use an extra boost and that prospective majors move right into four 200 level courses in:

Introduction to Cell Biology

Introduction to Principles and Mechanisms of Evolution

Introduction to Principles and Methods of Systematics

Introduction to Principles of Ecology

In all the proposed plans it is emphasized that students at the junior and senior levels must be given more opportunity for personal contact with faculty and other students and to have the opportunity for intensive field and laboratory work. Eventually the student must learn to gather information for himself and to evaluate it himself rather than having the wide "background" of information we all want them to have. Biology is so large and diverse that no one can have all the knowledge that any two of us consider essential. Perhaps we are going to have to let the student find that it is to his disadvantage that he doesn't know a beetle from a mayfly, and then let him dig out the information. He'll remember it then.

In all the reports of the Discipline Sub-Committee it was obvious that students should have the opportunity to work through a reasonable specialty in one of the "Routes of Emphasis" noted above. Following are lists of the courses now on the books and proposed which it was felt would make an "ideal" curriculum,

Starred courses are those proposed and not now on the books.

Ecology

We are combining some of the suggestions of the Ecology and Populations Group where they overlap sufficiently.

Principles of Ecology (300)

large, team-taught, lecture course

It would cover the lecture side of Animal and Plant Physiology.

At the 400 level, a group of small courses (20-30 students) with intensive field and lab work in relatively restricted areas, e.g. Tundra Ecology, Avian Ecology, Ecology of Crop Plants, etc.

Present courses, some of which would fit into the above scheme, are all at the 500 level.

Recent Advances in Animal Ecology

Dynamics of Mountain Ecosystems

Biological Oceanography (Will lead a field trip, P.W.W.)

Animal Geography

Limnology

Stream Biology

Introduction to Arctic and Alpine Environments

Microbial Ecology

Population Biology and Genetics

This area is impossible to separate from Ecology, but with the strong emphasis on Genetics here and on Population Genetics in our genetics group it was felt that they could and should be combined. It is understood that there is a strong overlap here with Ecology.

<u>Principles of Genetics</u>	300 level
Genetics lab	}
Behavioral Genetics	
*Human Genetics	
*Statistical Genetics	}
Population Genetics	
Ecological Genetics	
Cytogenetics	
*Human Behavioral Genetics	}
*Advanced Organismic Genetics	
	600 level

Quantitative Biology

Part of the success for this program depends on our continuing to persuade the Math Department to give courses suitable for the needs of Biologists. The campaign has so far been partially successful. Courses in EPOB would start at the 400 level, unless we instituted a course comparable to Psych 210 (Research Methods).

400	{	*Biometry
		*Problems in Biomathematics
560	{	Survey of Quantitative Methods in Biology
		Taximetrics
		*Research Design
600	{	Quantitative Ecology
		*Simulation and Modeling

Structural Biology

Certain courses dealing primarily with the Morphology of plants and animals should come under this, plus most of those listed under the Systematics heading where structure is used heavily.

- Comparative Vertebrate Anatomy
- Invertebrate Zoology
- General Entomology
- Morphology of Nonvascular Plants
- Morphology of Vascular Plants
- Parasitology

New courses:

Strong suggestions have come from several points for the initiation of a course in Microtechnique, both plant and animal. This is expensive for large numbers, but if we give it, it should be for large numbers of students and not a few Graduates. It would be cheaper to have a lab with a full-time technician and only supervision by a faculty member, than to expect the latter to spend the necessary time in there.

Courses in MCDB (18), Geology (6), and Anthropology (5) are also considered suitable for this program, including Developmental Biology courses in MCDB.

Ethology

300	Principles of Animal Behavior (team-taught, no labs)
400	*Ecology and Behavior
	*Neuroethology all with Labs
	*Advanced Ethology
500	*Seminars in each of the above.

In view of the obvious and growing demand for an emphasis on Animal Behavior, this is a rather modest request.

Physiology

300	Plant Physiology } Animal Physiology } Combined into one Principles of Physiology Human Physiology - Primarily for service and for special majors.
400	Advanced Plant Physiology Cell Physiology *Comparative Invertebrate Physiology Comparative Vertebrate Physiology *Animal Ecophysiology *Techniques in Physiology and Anatomy (including histology)
500 (all with labs)	*Plant Nutrition Plant Growth and Development in Sterile Cultures (from 480) Microbial Physiology Immunobiology (from 437-8) Comparative Endocrinology Vertebrate Reproduction Mammalian Physiology Physiology of special groups (Algae, Insects, Birds, etc.)
600	Seminars of several kinds.

Systematics

There is a large group of courses which are concerned to a greater or less extent with the classification and systematics of different taxa. It is not clear, though, how much Systematics are (is) actually included in each of these; it all seems to depend on the inclinations of the instructor. The Systematics Subcommittee did not feel that we had courses and staff for an undergraduate emphasis in taxonomy with a few possible exceptions, though there is some disagreement with this view. The courses should be available for those students interested in special groups, of course, and should be titled as "The Biology of Special Groups." Most students should be exposed to the diversity of organisms and how they are categorized.

On the graduate level, however, there are several courses which would form a good basis for specialization:

Taximetrics

Principles and Practice of Biological Taxonomy

Plant Biosystematics

Plant Cytotaxonomy

Evolution and Speciation

*Numerical Taxonomy

Courses concerned with the classification of special groups - large or small - on the 200 to 500 level:

Plant Kingdom

Parasitology

Entomology

Field Botany and Field Zoology

Invertebrate Zoology

Mycology
 Classification of Flowering Plants
 Insect Taxonomy
 Herpetology
 Ornithology
 Advances In Classification of Flowering Plants
 Birds of the World
 Avian Communities of Colorado and New Mexico
 Mammalogy
 Ichthyology
 Algology
 Lichenology
 Plant Morphology
 Aquatic Botany
 Malacology

As can be seen, a curriculum in Biology cannot be set up in a logical sequence from General Biology upward to the Senior Year. There are so many different routes for a student to follow that it is hard to structure the curriculum as is done in Chemistry and Mathematics, for example. Because of this we are suggesting that there be no specific requirements beyond the elementary course and that it should be worked out between the student and his advisor. The Routes of emphasis can be strong guides for this and also the prerequisites for advanced courses. It is the general opinion of the Committee (with some wavering) that the student will learn and remember material once he has seen the need for it in his own field. Thus we are suggesting that Cell Studies and such be given in the courses as the

need for them is demonstrated, not beforehand. (It may well be that we can't be responsible for each student knowing all the basics of Biology. (What are they?) They'll have to realize the necessity for some of them the hard way, even up into Graduate School. P.W.W.).

So, if we don't have requirements as such, then it will be up to the advisors. This makes it more difficult for them and for the student, but it may be better in the long run.

D. Rogers

W. Segal

J. Windell

P. Winston

NOV 18 1974

EPOB 628 -020 - Sem - Adv Vert Ecology C. Bock

NOV 18 1974

Seminar on subjects related to the ecology of terrestrial vertebrates, with an emphasis upon the interrelationships between ecology, behavior, and evolution. Consent of Instructor.

EPOB 625-020 - Seminar on Ecology of Fungi - Sam Shushan

The interaction of fungi with other organisms and with their environment.

EPOB 626-020 - Seminar in Polar Ecology - J. Marr ~~Ofg.~~ Meeting: Wed-1:00 Hale 302

General survey of the characteristics of the ecology of the Polar Regions, including, Arctic sub-Arctic, Antarctica and sub-Antarctica regions, followed by intensive study of some one, or a combination of a few ecosystem processes especially important in these Regions.

EPOB 627-020 - Seminar in Advanced Insect Taxonomy - R. Gregg

Taxonomy of selected groups (families or genera) of insects. Collection required. Identifications using special monographs. Each student works on an individual project and carries out independent field work.

EPOB-633-020 - Dendrochronology - Paula Krebs

Photography as a Research Tool

Applications of Tree-ring Analysis

EPOB 693-020 - Sem-Population Biology - CANCELLED

EPOB 624 - Cancelled

EPOB 663 - 020 - Ecological Aspects of Animal Behavior Bernstein - Stacey

A seminar entitled Ecological Behavior
Foraging strategies: Communication and Signal systems: Spacing behavior;
Behavioral adaptations of prey to characteristics of their predators;
Functions of aggression; Reproductive behavior: Social behavior: Behavior
of human groups in relation to their ecology.

Consent of instructor only

November 8, 1974

To: Dr. David Rogers

From: Systematics Subcommittee, J. Bock, Chairman

Due to ineptitude of the subcommittee's chairman, we have not answered all questions proposed to us by the Development Committee. However, several ideas emerged from the Sub-committee meeting which was attended by Drs. Bonde, Burt, Shushan, Williams, Winston and Mssrs. Merritt and Vallo.

- 1) The systematics curriculum functions primarily as a service area to other areas in the Dept. such as ecology, physiology, behavior and population biology. It serves this function well and with certain modifications, especially faculty additions, will continue to fulfill this role.
- 2) A list of courses which contain substantial systematic material is appended.
- 3) We feel the following additions to our faculty are needed in the immediate future.
 - A. Entomologist complementary to Dr. Gregg (systematic orientation)
 - B. Paleobotanist
 - C. Perhaps an acarologist
- 4) It was felt that an undergraduate lecture-lab course in Principles and Techniques of Systematic Biology would be a useful course. It could be team taught, and would enable students to be better prepared for courses where a knowledge of organisms is important (e.g. behavior, ecology, physiology). Also, this course would provide students with intrinsically valuable skills in identification.
- 5) Dr. Armstrong, who was unable to attend the meeting, made a strong plea for a lower division course in numerical taxonomy. This was not objected to by the Sub-committee.
- 6) The Sub-committee did not identify and/or eliminate redundancies in existing course offerings. It is hoped that other sub-committees have done so.

Attention: Sub-committee members and others;

Please feel free to make constructive suggestions about systematics to Dr. Rogers. Thank you.

Jane Bock

Add Horace Quicks
Plant Geography Course

11/7/74

TO: DEVELOPMENT COMMITTEE

FROM: Sub-committee on Ideal physiology curriculum

(Jones (chm.), C. Norris, D. Norris, P. Winston, Segel, Shulls, Weiser, Bode)

Attached is the proposed Ideal physiology curriculum for our department. We have deleted three courses (543, 544 and 565), and have added the following new courses:

1. Human physiology (300); a service course, but majors could take it if they are medically oriented.
2. Invertebrate physiology (400); a survey of physiological regulation in invertebrates (to be taught by Winston).
3. Comparative vertebrate physiology (400); replaces 543 & 544; a survey of the evolution of organ system physiology in vertebrates.
4. Animal ecophysiology (400); Topics such as altitude physiology, thermoregulation, respiration, stress, photoperiod, water balance.
5. Techniques in physiology and anatomy (400); students will learn how to do microtechnique, fundamental physiological techniques.
6. Plant nutrition (500); including photosynthesis.
7. Several course in physiology of special groups (500); an example would be our present algology course. Possibilities include physiology of insects, parasites, birds, gymnosperms, etc. Depends on faculty expertise and interest.
8. Seminars (600) in animal ecophysiology and mammalian physiology.

To implement this plan, we would need:

Faculty

First choice: a mammalian physiologist to teach Human Physiology and mammalian courses.

Second choice: A plant physiologist specializing in photosynthesis and plant nutrition.

Third choice: a comparative animal physiologist

These faculty would of course each need about 1000 ft² of research and office space

Teaching facilities (new building):

1. Teaching Labs

2 elementary animal Physiology labs (to handle human Phys & 322; maximum of 20 students per lab).

- 1 cell physiology lab (max. 20 students/lab)
- 2 advanced physiology labs (max. 10 students/lab).
- 1 microbiology lab (20 students/lab)
- 1 immunobiology lab (20/lab)
- 1 elementary plant physiology lab (20/lab).
- 1 advanced plant physiology lab (10/lab)
- 1 laboratory for undergraduate problem-solving

11. Supporting facilities

- 1 walk-in incubator (micro.)
- 1 instrument room
- 1 isotope room
- 3 temperature-controlled rooms
- 4 animal rooms
- 2 darkrooms
- 2 rooms for growth chambers
- 2 teaching greenhouses
- 1 tissue culture room (Plants)

We feel that the proposed changes would make our physiology program outstanding.

Much interest was also expressed in practical training of students. Our proposed course in laboratory techniques would help in this regard. Also, some interest was expressed in relating our physiology program to others (e.g. ecology) to train students in methods of monitoring environmental parameters.

PROPOSED PHYSIOLOGY CURRICULUM (COURSES IN BOXES ARE NEW)

600 level	Seminar on ecophysiology of alpine and arctic plants (now 580, but may change to 600 level)	Seminar in animal ecophysiology	Endocrinology Seminar (643)	Comparative neurophysiology (641)	Seminar in vertebrate reproduction (652)	
		Seminar in mammalian physiology				
500 level	Plant nutrition	Plant growth and development in sterile culture (now 480, but may change to 500)	microbial physiology (561, 568)	Immunobiology (now 437, 438) but may change to 500 level	Physiology of special groups (e.g. insects, algae, birds, etc)	comparative endocrinology (545)
						Biology of Vertebrate reproduction (563)
						Mammalian physiology
400 level	advanced plant physiology (now 551, but will be 400 level)	cell physiology (423)	Invertebrate Physiology	comparative vertebrate physiology (old 422, but new approach)	Animal Ecophysiology	Techniques in physiology and anatomy
300 level	Essentials of Plant Physiology (321)	Essentials of Animal Physiology (322)	Human Physiology			

November 7, 1974

Dave:

These are suggestions from the Executive Committee concerning faculty and staff development in the next 4-5 years.

Please note especially the last 2 paragraphs at bottom of page 2. I personally believe we should act immediately. The timing is very critical. We have thought about all this stuff for years.

Wilson

Wilson Crumpacker

P.S. Charlie N. tells me of your plans to develop the "Biological Information" field as a major part of the Dept.'s efforts in the future. I think this is an excellent idea and is something we failed to consider in the Ex. Comm. plan. Why not at least consider that as position 12 on p. 2? Also, we geneticists think our own departmental biometrician is needed.

Reasons for need of additional faculty in EPO Biology

1. At present there are at least 1200 full-time majors in EPO Biology on campus and 24 full time teaching faculty. If the University's quality teaching goal of not more than 20 students per teacher were to be met in EPO Biology, we would need 60 faculty, or ~~20~~ more than we now have. *C. N. H. says 473 calculated faculty needed. ³⁶ ~~60~~ ^{little on basis of 50% enrollment, however faculty & TA's on this amount are 1/8 ratio, then 366 also for this average.}*
2. Our required courses (e.g., Intro. Biology, Ecology, Animal Physiology, and Genetics are greatly over-enrolled, considering the number of sections we can offer. Therefore, class sizes are much too large. These courses service ~~many~~ ^{several} other majors in addition to our own.

3. We do not have enough faculty to physically teach the wide range of undergraduate courses that should be offered in a fully developed non-molecular type of biology department, nor does our present faculty have the training, expertise, and interests needed to cover the desired range of courses.

4. The same problems cited in 3 occur with respect to our graduate course offerings, and we have been criticized by the Graduate School for not doing something about these problems.

We realize that the University can not provide us with ~~20~~ ³⁶ additional faculty. *(18 on basis of addendum to above)* Furthermore, the number of full-time majors might conceivably decrease in future years. It seems unlikely, though, that there will be much alleviation of this problem in the next 5 to 10 years, if at all. Fortunately, a consideration of teaching needs indicates that we could cover an important portion of the range of interests that should be included in a fully developed department by adding 12 new FTE's. This seems to be a modest and practical compromise that will meet many of our immediate requirements.

Since we will be housed together in one building, partly new and partly remodeled, in 1978, we suggest adding 3 new faculty positions per year for the next four years. Temporary crowding because of these additions would peak out in 1977, at which time 8 of the 12 FTE's would have been acquired, and some provisions would have to be made for this temporary overcrowding.

New Faculty

(Not listed in any order of priority)

1. Physiological Ecologist, Higher Plants - could teach EPOB 341, 441; research interests in productivity, ecosystem energetics.
2. Physiological Ecologist, Vertebrate Animals - could teach Animal Ecology, Physiological Ecology; research interests in productivity, energetics, physiological adaptation.
3. Field Entomologist - could teach field entomology, biology of insect populations; research interests could be physiology, behavior, genetic control, more general biological control, ecology, plant-insect interactions.
4. Plant Taxonomist and Geographer - could teach Plant Taxonomy, Plant Geography

5. Plant Cytogenetics and Systematics - could teach a general course in Cytogenetics of Higher Organisms, Systematics; research interests in evolutionary biology.
6. Plant Anatomist - could teach Plant Anatomy, Comparative Plant Anatomy, Plant Morphology; research interests in comparative anatomy, evol. biology.
7. Animal Vertebrate Embryologist - could teach Embryology, Histology, Microtechnique.
8. Developmental Geneticist of Non-Molecular Type - could teach??; research could be in genetics or physiology of development in plants or animals, could work on intermediate metabolism, reproductive biology, visual system, etc. *Charles Norris suggests this may be difficult to defend because of M.C.D.B. However, our dept. could really use someone like this to work with Jones, Norris, Weston, etc.*
9. Microbial Ecologist - could teach Microbial Ecology and other courses with non-molecular, microbiological content; research could be in pollution related problems.
10. Soil Biologist - could teach Soil Biology courses; research interests could be ecological, entomological, microbial, etc.
11. Physiological Ethologist - could teach general courses in Animal Behavior, Physiology of Behavior; research interests to complement those of Bekoff; could be an entomologist, ornithologist, etc.
12. ~~Suggestions???? Parasitology????~~

NOTE: Above group includes added teaching expertise in several areas, such as applied ecology and applied microbiology, which would increase the marketability of our B.A. and M.A. degree graduates.

New Supporting Staff

At present we have 5 secretaries for 25 faculty, or 1 for every 5 faculty. With 12 new faculty, we need a minimum of 2 new secretaries. *Charles Norris suggests adding 3rd new secretary skilled in preparing illustrations, photography, etc.*

Minimal needs for increased technical help are: 1 full-time animal caretaker, 1 programmer-data processor, 1 microtechnician, 1 soil technician. *Charles Norris suggests 1 more greenhouse man after new greenhouse/ lab facilities are provided.*

A considerable number of new TA positions will also be needed

There is an urgent need to coordinate these suggestions with the Development Committee and then with the Department as a whole as soon as possible. Hopefully, an Executive Committee-Development Committee Plan could be the topic of discussion at our next faculty meeting. There would be no need to assign priorities for new faculty at that time, unless the Department wanted to do so.

This development plan should be submitted to Dean Briggs, Vice President Nelson, and others before Thanksgiving. If we wait until after Christmas, we will be competing with all the typical Spring Semester problems of various departments. Also, we must formalize this plan as soon as possible for Vice Chancellor Andrews, with regard to our building needs.

November 6, 1974

To: Prof. David Rogers
EPO Biology Development Committee

From: A Gathering of Ecology Faculty, Graduate and Undergraduate Students.

Subject: Status of Ecology in EPO Biology Department. A Response

1. Background: This group managed a single meeting on 4 November. Consequently, achievements were limited. However, individuals of this group, and others, have discussed the subject several times in recent months and have produced some statements regarding the subject.
If there is time for further efforts along the subject lines, we will be glad to conduct whatever additional discussions participants can schedule.

Student body includes increasing number of individuals seeking means of understanding themselves.

Facilities:

Mobile

Fixed for multi-ecosystem simultaneous studies.

Limnology

or

2. The following details were recorded by Marr. They have not been cleared with the other members of the group. I am distributing them so that individuals can report errors or make additions directly to you. Perhaps a copy of any such communication should come to me to provide a central record.
3. The major innovation possibilities presented were:
 - a. Study the feasibility of combining several courses into a 2 semester, team-taught, basic ecology course required of all, biology majors.

or

Use large lecture sessions (several hundred) and small field-trip units and group project units. These will be field and lab teaching units, not just demonstration groups. This scheme would presumably reduce faculty-time in lecture and increase faculty-time in field and lab contact with students.

[Perhaps we need "traineeships" for advanced graduate students to teach in this course. Marr]

It might be wise to have field-lab courses separate from the lecture course; there should be many of these field-lab units covering a variety of concepts and methods.

For example, units could include:

Aquatic ecology measurement techniques.

Tree-ring analysis.

Study of soils in the field, lab, and greenhouse.

Methods of vegetation sampling and manipulations of vegetation data.

Techniques of collecting and preserving plants and animals.

"Peer-teaching" possibilities should be explored.

- b. Develop a series of "field stations" and/or "ecology research sites" to support concentrations of "teaching-ecosystems" and "research areas" where a variety of components of each of one or more types of ecosystems could be studied. Such areas could include National Parks, research stations, natural areas, National Forests, etc.

[I wonder if arrangements could be made to use the ski-area facilities of the State in the fall-winter-spring "off" season. Perhaps students could get jobs as care-takers. Also, what summer use is made of the field facilities of Public School Districts such as Denver's "Balarat" near Jamestown and the now famous Jefferson County field station. Marr]

- c. Develop a series of "Ecosystem Analysis Laboratories available to all classes for sign-up during a 16 hours per day basis.

Sample types:

1. Browsing lab. Books, Reports (student), Maps, slides, comfortable chairs and tables, self-teaching modules, etc.
2. Plant and animal specimen processing lab. Teaching herbarium, animal skin collections, binocular scopes, taxonomy books, etc.
3. Soils laboratory. Sieves, hydrometers, scales, etc.
4. Data Processing Lab. Adding machines, calculators, computer consoles, drawing boards, light table, etc.
5. Field equipment design, construction, and maintenance lab.
6. Teaching greenhouse for eco-physiology exercises.
7. Research greenhouse for eco-physiology studies.
8. Transplant gardens in several mountain regional ecosystems.

- d. Provide for greater emphasis on Homo sapiens in courses. One technique would be to require all EPO Biology Majors to take 435, Ecology FOR Man. Another would be to urge that Man be given greater attention in all ecology (or all Biology!) courses.

4. Course Changes.

No specific or generally agreed to changes. Several possibilities such as reducing the number for limnology and avian communities were mentioned.

5. Additional Faculty.

This topic was not discussed but it has been agreed in several similar analyses in recent months that the top priority in the ecology field is a physiological ecologist of the type who do physiological measurements in the field.

6. It has been agreed in previous discussions that we should establish a program for a Masters Degree in Applied Ecology. It was not discussed this week.

7. The curriculum for the old "Environmental Biology" B.A. degree appears to still be a reasonable program but it was not discussed. Perhaps anyone who has ideas for changes there-in will send them directly to Dave, with a copy to Marr.

8. Could the University establish a program of "Planning Semester" to give faculty members time to develop some of these brilliant ideas? With our current teaching loads, it is hard to keep up using only our old designs and materials. There is little time for innovation.

Subject: Ecology Courses
To: Ecologists and Associated Types
EPO Biology Faculty
From: John Marr

It occurs to me that EPO Biology should have mechanisms which assure that any student in the University who becomes interested in ecology can find a course in ecology open to one with his or her particular background.

If we fail to so provide, it is likely that some other department will take on the job (and none of them can do as well as we can).

In this connection, I suggest that we agree in general that the following courses be continued and that admission to them be as indicated:

- A. Ecology FOR Man (435) For any non-science major. No prerequisite other than Interest.
- B. Principles of Ecology (341) For science majors other than in Biology OR For science majors other than in Environmental Biology.
(I prefer that all biology majors get more ecology than 341 can provide but other faculty members disagree).
- C. Animal ecology (443) and Plant ecology (441): For Biology Majors. (341 is not a prerequisite any longer).
- D. These courses are not designed for building one on top of the other; It is expected that most students taking "A" or "B" will not take additional courses in ecology. However, some students will experience changes in their objectives. Therefore, any student would be acceptable in any of these courses if he has taken the preceding course in the list regardless of other characteristics he may possess.

If you will give me your reactions to the above and if they show a high degree of unanimity of opinion, I will pass this information on to the Departmental Committee on Courses.

If some overall agreement is arrived at, the details should be presented to each class by the instructor at the beginning of each semester in order to reduce current heterogeneity in the background of the members of some classes.

Offerings and Undergraduate Requirements for Majors In

ENVIRONMENTAL BIOLOGY

1. Required Lower Division science and mathematics courses outside the life sciences include the following:
 - Mathematics (one year), or through beginning calculus
 - Chemistry (one year; lab course)
 - Physics (one year; lab course) - 201-202 recommended
 - Geology or Geography (1 semester of either Physical Geology or Physical Geography).

Appropriate courses: Geology 101-4 (Physical Geological Science); Geol. 207- (Physical Geology); Geol. 341-4 (Introductory Paleontology); Geol. 425-3 (Groundwater); Geol. 436-4 (Glacial Geology); Geol. 463-3 (see Geog. 463); or Geography 100-4 or 101-4 (Physical Geography); Geog. 300-3 (Environmental Quality & Human Choice); Geog. 400-3 (Climatology); Geog. 301-3 (Biogeography Geog. (also Geol. 463) 463-4 (Principles of Geomorphology).
2. General Biology (101-4 and 102-4 or 105-4 and 106-4)
3. Required core courses:

A. Genetics	(EPOB 383)	3 hours
B. Physiology (one of the following)		
(1) Essentials of Animal Physiology	(EPOB 322)	4 hours
(2) Essentials of Plant Physiology	(EPOB 321)	4 hours
C. Morphology (one of the following)		
(1) Morphology of Non-Vascular Plants	(EPOB 311)	4 hours
(2) Morphology of Vascular Plants	(EPOB 312)	4 hours
(3) Principles of Comparative Vertebrate Anatomy	(EPOB 408)	3 hours
Lab Studies In Comparative Vertebrate Anatomy	(EPOB 409)	2 hours
(4) Invertebrate Zoology	(EPOB 411)	5 hours
4. General Ecology courses:

Plant Ecology	(EPOB 441)	4 hours
Animal Ecology	(EPOB 443)	4 hours

and one of the following

(1) Recent Advances in Animal Ecology	(EPOB 515)	3 hours
(2) Dynamics of Mountain Ecosystems	(EPOB 521)	3 hours
(3) Biological Oceanogeography	(EPOB 517)	2 hours
(4) Animal Geography	(EPOB 512)	3 hours
5. One taxonomy course:

(1) Field Botany	(EPOB 331)	3 hours
(2) Animal Kingdom	(EPOB 332)	3 hours
(3) Mycology	(EPOB 414)	3 hours
(4) Classification of Flowering Plants	(EPOB 430)	4 hours
(5) Insect Taxonomy	(EPOB 431)	4 hours
(6) Biology of Amphibian & Reptiles	(EPOB 432)	3 hours
Herpetology Lab	(EPOB 433)	2 hours
(7) Mammalogy	(EPOB 533)	4 hours
(8) Ornithology	(EPOB 422)	3 hours
(9) Plant Taxonomy	(EPOB 554)	3 hours
(10) Lichenology	(EPOB 525)	3 hours
(11) Plants of Colorado	(EPOB 446)	3 hours

GOALS

J. Beck
1 Nov. 1974

- 1) Optimum curriculum
- 2) Identify present courses
- 3) Identify new courses
- 4) Identify new FTE's
- 5) Identify service courses
- 6) Identify applied courses

Systematic Courses

210-3 The Plant Kingdom	571-3 Plant Biosystematics
301-4 Biology of Microorganisms	584-3 Plant Cytotaxonomy
302-3 Parasitology	692-3 Evolution and Speciation
303-4 Intro. to Entomology	
331-3 Field Botany	1. 408-9 Comparative Anatomy
332-3 Field Zoology	2. 311-2 Comparative Morphology
411-5 Invertebrate Zoology	3. Aquatic Botany
414-3 Mycology	4. X hist vertebrate & invertebrate paleontology
430-4 Classification of Flowering Plants	5. Malacology
431-4 Insect Taxonomy	6. Plants of Colorado
432-3 Herpetology	
434-3 Ornithology	
446 Biological Field Studies	
460-2 Adv. Classification of Flowering Plants	
510-3 Avian Communities of Colo. and New Mexico	
511-3 Birds of the World	
533-3 Mammalogy	
547-3 Ichthyology	
554-3 Algology	
555 Lichenology	
564-3 History of Biology	
573-3 Taximetrics	
575-3 Principles and Practices of Biological Taxonomy	

October 31, 1974

TO: E.P.O.B. Faculty
FROM: Dr. Richardson
RE: Proposals for the E.P.O.B. Honors Program

After discussing the situation pertaining to honors biology with Dr. Williams, I am most impressed that something needs to be done to or for this program. In the past the program has been "kept under wraps" due to time and space limitations on the part of the E.P.O.B. faculty. Yet, students are persistent and continuously wish to become involved in some special work qualifying them for an honors degree in biology which is separate from the University Honors Program.

As the departmental program has functioned for the past few years, a student wishing to qualify for graduation with honors in biology must

- 1) complete a senior thesis or research project under the direction of an E.P.O.B. faculty member
- 2) take the GRE general and biological sciences area exams
- 3) achieve satisfactory performance in the two above efforts to recommend the person for graduation with honors to the CU Honors Council.

On talking casually with several faculty members in the department, I find that most do not feel that they have the time, money or space for providing large numbers of students with a laboratory experience equivalent to a honors project and are not utilizing the existing program.

- 1) does the department wish to continue its participation in the honors program?
- 2) if so, which of the following proposals might best serve the needs of our faculty and students:

Plan A: Continue the program as it is presently functioning (?)

Plan B: An honors student will take a total of four semester seminars in E.P.O.B. (taught by the faculty, of course) and on completion of this requirement (department) will be considered by the Honors Committee for departmental honors. Enough departmental area seminars exist to accommodate the number of students wishing to attempt graduation with departmental honors.

Plan C: A student must elect to begin the honors program at the beginning of his or her junior year at which time that person would be assigned to a three person tutorial committee. The student's goals and interests would be examined and self-direction in their development would be encouraged by a written or oral tutorial examination both at the end of the junior and senior years.

Plan D: A senior library thesis would be the focus of the departmental honors program and would be directed and reviewed by an individual faculty member.

Plan E: You name it!

In view of our new Teaching and Learning Committee whose goal is the improvement of the teaching-learning experience, it would seem germane to do something about the existing honors program.

Please give these ideas consideration and add those of your own. We will discuss this issue at our next faculty meeting.

Thanks,

Norm Richardson

neurobiology seminar

Dani Rogers

The committee charged with developing an optimal program in BEHAVIORAL BIOLOGY met on October 31, 1974 from 1:00-2:15PM and again on November 4 from 12:00-1:15PM. In attendance were:

Faculty: Marc Bekoff (Chmn.), Richard Jones, and Olwen Williams
Graduate students: Judy Diamond, Peter Stacey, and Louis Vincent
Undergraduates: Gordon Rodda and Debby Star

We first discussed the obvious need for more behaviorally oriented faculty members on the EPOB staff. There is a strong current interest in behavioral biology and this interest appears to be growing rapidly and becoming more intense. A poll taken by Bekoff in EPOB 424 this semester has indicated that at least 125 students are interested in pursuing advanced courses (seminars, laboratories) in behavior. Dr. Williams noted that in the past 5 years in her mammalogy course, there has been a steady increase in the number of students choosing to work on behaviorally oriented projects. Therefore, with the current growing interest in this aspect of biology, our requests for additional FTE's and space appear to quite realistic and overdue. The current load could be more adequately handled by the addition of at least one more behavioral biologist.

A list of courses that are (were) relevant to behavioral biologists was presented by R. Jones, based on an analysis that he did a few years ago with D. Chizar of the Psychology department. It was felt that the best way to advise undergraduates interested in behavioral biology would be to allow maximum flexibility in their programs, depending on their respective interests -- e.g., those interested in birds would probably enroll in ornithology instead of ichthyology or mammalogy.

Two major points of interest were discussed. These included: (1) The long-term goals of this committee and (2) what to do until they are realized.

I. Long-Term Goals

A careful analysis of R. Jones' outdated list of courses indicated that there are 2 obvious omissions for those students interested in behavioral biology. These are:

- (1) The lack of a program concerned with the interaction of behavior and ecology -- that is, there is no one on the EPOB staff whose prime interests are in behavior but who also looks at environmental effects on the expression of behavior. This applies to both vertebrates and invertebrates. Neither A. Cruz nor C. Bock fit into this category. Since the area surrounding CU is a good one in which to conduct field work, we feel convinced that an ecological behaviorist would fit in nicely in this community.
- (2) The absence of anything resembling neuroethology. Neuroethology (or neurobiology and behavior) is one of the fastest growing and well-supported fields of biology, some major institutions having full departments bearing this name. Classical ethology (a la Lorenz and Tinbergen) was founded with the strong belief that ultimate explanations of behavior would come from those scientists interested in the neural bases of adaptive behaviors.

We decided that our first choice would be a person fitting into category 1 -- an ecological behaviorist. However, we would like to request that our bid for 2 new FTE positions be considered carefully in order to round out the program in behavioral biology.

Needs of new FTE's and of Bekoff:

(1) In new addition: A general teaching laboratory for each FTE would be required. These would be best designed as 3 adjoining rooms of approximately 900 square feet each. In addition, 2 preparation and storage rooms of approximately 144 square feet each would be needed. These rooms would be used for teaching essential 400-level laboratory courses (see below) to be offered in conjunction with 400-level lecture/seminar courses offered in the fields of expertise of each of the new FTE's and of Bekoff.

In addition to specific needs, we think that there is a pressing need for an animal care facility for use by the whole department. This should consist of (1) a rodent room, (2) a room for other mammals, (3) an aquarium room for fish and other non-mammals including invertebrates, (4) a cold room, and (5) a teaching aviary.

(2) New faculty needs in Ramaley: Each FTE would need an office and a laboratory. We would like to request that these be designed as adjoining rooms with a total of approximately 1000 square feet for both office and laboratory for each FTE. We also wish to stress that the use of the roof on both building be considered. For example, Bekoff would be happy to have his office overlooking areas on the roof where animals may be kept. This would entail taking precautions ensuring that the roof is constructed properly and supported from below. This design should definitely be used for the new addition. Use of the roof would remove some of the pressing space demands and, in fact, a roof is a good place for keeping animals from being disturbed by undesirable events.

Teaching responsibilities of new FTE's in conjunction with Bekoff: (Fig. 1)

(1) There would be a 3 credit, 200 level course team-taught by the behavioral biologists. The course would be called "Introduction to behavioral biology". There would be 3 lectures per week and the course would go for 2 semesters. This introductory course would serve as a prerequisite for the following courses.

(2) Three 400-(or 500) level 3 credit courses (lectures or seminars) in the fields of expertise of the behavioral biologists to be offered in conjunction (but not as mandatory co-requisites) with

(3) Three 400-level 2 credit laboratories.

Therefore, the teaching load of each of the behavioral biologists would revolve around developing strong undergraduate and graduate programs in the areas of their expertise.

TA requirements:

Along with the acquisition of new FTE's would be the requirement for additional TA's. Currently, the animal behavior course (EPOB 424) is allowed $\frac{1}{2}$ TA for the more than 200 students enrolled in the course (Fall 1974). This is insufficient. We feel that 2 TA's would be needed for each semester in the introductory 2 semester course in behavioral biology. In addition, 1 TA would be required for each of the 400-level courses, this TA serving for both the lecture (seminar) and laboratory.

II. Current situation in behavioral biology

As mentioned above, the current curriculum for behavioral biology in EPOB is not at all compatible with the mounting interest in the field. There is too much (!) interest in behavioral biology and there is an expressed need for advanced courses and laboratories. The following proposal was discussed.

(1) Bekoff will continue to teach animal behavior (EPOB 424) as it is currently being taught in the Fall except that the course will be for 4 credits (3 lectures and 1 recitation per week) with at least 1, and hopefully 2, TA's being assigned to this class, which is bound to grow in size. $\frac{1}{2}$ TA is not sufficient to handle a class of this size with or without recitation.

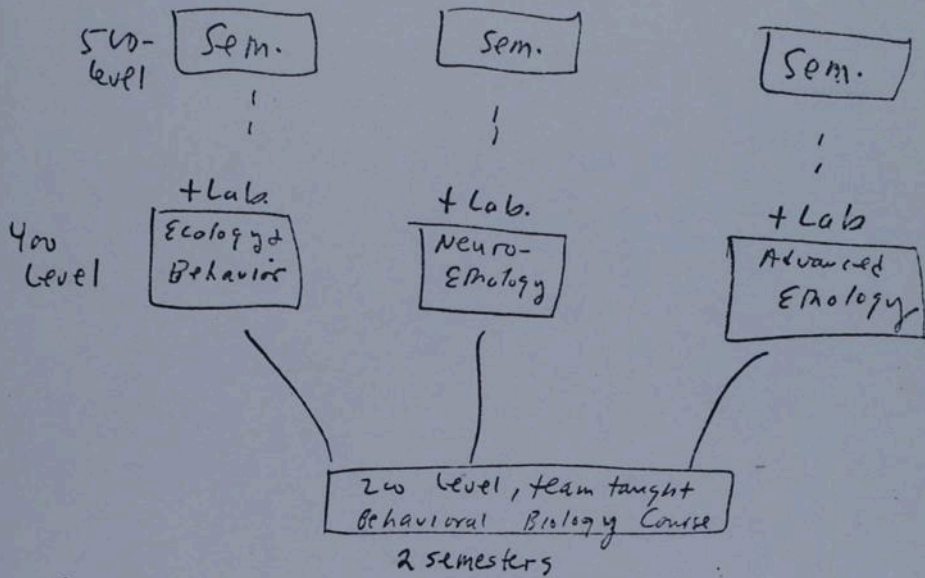
(2) There is also a pressing need for an advanced course and a laboratory. Currently, students are signing up for independent research credit and doing work that would normally be done in an animal behavior lab. This is fine except for the following facts:

- (1) Bekoff can handle only a limited number of students,
- (2) NO TA is allowed for independent students, and
- (3) by doing it this way, the obvious need for an animal laboratory is undermined.

We concluded unanimously that the current interest in behavioral biology is continuing and will continue to grow, and presently is beyond our ability to handle adequately the needs of the students. We feel therefore that our requests are not at all out of line with what we perceive to be the future interests and demands of students interested in behavioral biology. Accordingly, we hope that our requests will be given serious consideration by the development committee. It is hoped also that the proposed changes in the current animal behavior course (e.g., making it a 4 credit course with more TA's) will be permitted by the curriculum committee.

Respectfully submitted by Marc Bekoff for the Behavioral Biology Committee.

Figure 1



From S. Shushan

REPORT OF THE STRUCTURAL BIOLOGY COMMITTEE (see two-page ditto, undated, of ca. 21 October 1974)

Meeting was held on 31 October 1974 (12:05 - 1:30 p.m.)

Present at the meeting: Drs. John Bushnell, Dave Rogers, Sam Shushan, Patrick Webber

The following courses are basically "structural biology" courses or contain "structural biology" overtones:

- EPOB 101-4 (General Biology)
- EPOB 102-4 (General Biology)
- EPOB 210-3 (The Plant Kingdom)
- EPOB 302-3 (Parasitology)
- EPOB 303-4 (Introduction to Entomology)
- EPOB 311-4 (Morphology of Nonvascular Plants)
- EPOB 312-4 (Morphology of Vascular Plants)
- EPOB 313-4 (see EPOB 408-3, 409-2)
- EPOB 315-3 (Plants and Man)
- EPOB 408-3 (Principles of Comparative Vertebrate Anatomy)
- EPOB 409-2 (Laboratory Studies in Comparative Vertebrate Anatomy)
- EPOB 411-5 (Invertebrate Zoology)
- EPOB 414-3 (Mycology)
- EPOB 431-4 (Insect Taxonomy)
- EPOB 432-3 (Herpetology)
- EPOB 434-3 (Ornithology)
- EPOB 461-4 (Vertebrate Embryology) MCDB 461
- EPOB 476-3 (Palynology and Environmental History) GEOG 476 GEOL 476
- EPOB 523-2 (Aquatic Botany)
- EPOB 531-2 (Peripatetic Biology)
- EPOB 533-3 (Mammalogy)
- EPOB 547-3 (Ichthyology)
- EPOB 553-3 (Developmental Plant Anatomy)
- EPOB 554-3 (Algology)
- EPOB 555-3 (Lichenology)
- EPOB 564-3 (History of Biology)
- EPOB 573-3 (Taximetrics)
- EPOB 575-3 (Principles and Practices of Biological Taxonomy)
- EPOB 591-3 (Advanced Palynology) ANTHRO 591 GEOG 591 GEOL 591
- EPOB 598-3 (Cenozoic Paleobotany and Palynology)
- ANTHRO 411-3 (Human Paleontology)
- ANTHRO 412-3 (Advanced Physical Anthropology)
- ANTHRO 414-3 (Primateology)
- ANTHRO 512-3 (Gross Anatomy)
- ANTHRO 513-3 (Advanced Osteology)
- GEOL 341-4 (Introductory Paleontology)
- GEOL 342-4 (Introductory Stratigraphy)
- GEOL 447-4 (Paleontology of the Lower Vertebrates)
- GEOL 448-4 (Paleontology of the Higher Vertebrates)
- GEOL 545-3 (Micropaleontology)
- GEOL 551-3 (Advanced Invertebrate Paleontology)

structural biology courses (continued)

- MCDB 105-4 (Introduction to Molecular, Cellular, and Developmental Biology)
 MCDB 106-4 (Introduction to Molecular, Cellular, and Developmental Biology)
 MCDB 312-4 (Cell and Tissue Biology)
 MCDB 313-3 (Structure and Function of Vertebrate Organ Systems)
 MCDB 411-3 (Introduction to Electron Microscopy for Biologists)
 MCDB 412-3 (Biological Membranes)
 MCDB 420-2 (Topics in Plant Cell Biology, Ultrastructure and Morphogenesis)
 MCDB 422-3 (The Plant Cell - Diversity of Form and Function)
 MCDB 444-3 (Cell Growth and Reproduction)
 MCDB 461-4 (Vertebrate Embryology) EPOB 461
 MCDB 501-1 (Techniques of Electron Microscopy)
 MCDB 502-1 (Techniques of Light Microscopy)
 MCDB 503-1 (Techniques of Cell Culture)
 MCDB 515-3 (Biology of Cancer Cells)
 MCDB 525-2 (Biology of Sensory Phenomena)
 MCDB 546-4 (Experimental Embryology)
 MCDB 562-2 (Cellular Differentiation)
 MCDB 564-2 (Cell and Tissue Interactions in Development)

SUGGESTIONS:

- I. Students in the "MORPHOLOGICAL BIOLOGY" pathway should be required to take the following courses:

IN ZOOLOGY: General Biology (one semester)
 General Zoology (course to be developed) (The Animal Kingdom)
 Comparative Anatomy
 Invertebrate Zoology
 Bacteriology
 Animal Physiology

(also genetics and a course in ecology or taxonomy)

IN BOTANY: General Biology (one semester)
 The Plant Kingdom
 Morphology of Nonvascular Plants
 Morphology of Vascular Plants
 Bacteriology
 Plant Physiology

(also genetics and a course in ecology or taxonomy)

- II. A three credit course in Microtechnique should be instituted. (Plant and Animal or individual courses in zoology or botany)

October 21, 1974

MEMO

TO: Dr. John Williamson
Math Department

From: David J. Rogers

Dear John:

Sorry I've taken a month to respond to your requested statement on Math 181, 182. Let me say at the outset that I am very appreciative of your efforts to institute courses in math for biology majors. We have needed someone to become involved from the math department, and your efforts represent a breath of fresh air to us.

Your sequence, 181-182 would be much more appropriate than the present 3 semester calculus sequence, a real advantage for our students. But I would definitely recommend that your sequence be followed by another semester of applications of "relational" or abstract math. Whether you would be willing to introduce that, or someone else in math, I cannot say, but it has a logic we find extremely powerful in ecological and taxonomic thinking, and I recommend it highly.

Not that you should start in with another course proposal now. I still highly favor your approach. I am also appreciative that you want to start with a small group of 35 students as a test case. This is reasonable, but may I suggest you more or less hand-pick this test group? You may have a more high powered approach than our typical freshmen can handle.

Our curriculum and executive committee has already indicated its favorable reaction to your course requests. I think this is more powerful than that which I could do alone in recommendation, but if you find it useful, I can categorically state that the courses are definite contributions to our program.

Thanks for consultation with us. We hope you succeed, and if I can help anyway, please do not hesitate to ask.

September 16, 1974

TO: *Prof. D. Rogers*

Enclosed are copies of the proposals for the new courses Math 181 and Math 182. The course outlines found in item 12 are taken directly from the table of contents of the book by Grossman and Turner, the book listed in item 13 as the course text.

I would appreciate two kinds of comments from you. I would like a paragraph over your signature that could be copied and attached to the proposal. In this paragraph statements like "If this course is approved, it will be made a requirement for _____" or "If Math 181 is approved it will be listed as a prerequisite for _____" would be helpful. The second type of response that I am looking for would be a personal note to me with comments like "Requiring both semesters for our majors would be out of the question. We could only strongly recommend," or "We would like to see the course set up to handle large numbers of students next fall rather than having just 35 students taking it on a trial basis," or "It is too much to try to cover in one year," or the negative of any of these statements, or anything else that comes to your mind.

Thank you.

John A. Willimson

John A. Willimson
Department of Mathematics

Oct. 6, 1974

Date -

My general reaction to this is that it would provide the basis of the calculus of probability with good applications in biology. A "module" dealing with relational (abstract) math. and the application of its logic to biology would have to be developed as a 2nd course. A third module in computer applications could be offered also. (= 1 yr.)

I would say 181, 182 would be minimal requirements for EPOB major - the calculus sequence (3 semesters) + Math. 481 (= 2 yrs.) would be an alternative.

Wellman's is, I think, quite demanding. Therefore any pilot program next year should be restricted to "proven" students and not offered to freshmen. (Indeed, I doubt it should even be considered freshman level.)

L.A.A.

COURSE OUTLINE

This form is to be completed for each proposed new or revised course, whether graduate or undergraduate. The phrase "new or revised course" applies to the following — a course not listed in the current University catalog and/or an existing course for which the number of credit hours and/or the number of class or laboratory contact hours is being changed, or a major revision is being made, or a change in catalog description is being made.

1. College or School ARTS AND SCIENCES 2. Department MATHEMATICS

3. Title of Course MATHEMATICS FOR THE LIFE SCIENCES

4. Catalog Description of Course PROBABILITY, LINEAR PROGRAMMING, GAME THEORY, AND DIFFERENCE EQUATIONS WITH MOTIVATION AND APPLICATIONS FROM THE LIFE SCIENCES

Prerequisites 2 YEARS HIGH SCHOOL ALGEBRA OR CONCURRENT REGISTRATION IN MATH 101 Probable Instructor(s) JOHN A. WILLIAMSON

5. To be offered: Sem. I X Sem. II _____ Summer Only _____ Alternate Years _____

6. Credit 4 Clock Hours 4 Expected Enrollment I *35 II S

7. Curricular Purposes of Course (Please answer all questions.)

- a. Required in BIOLOGY (SEE REMARKS AT END OF FORM) curriculum (or major) _____ Yes _____ No X
- b. Elective for departmental major or specialization: _____ Yes _____ No X
- c. Elective contributing to a general (liberal) education: _____ Yes X No _____
- d. Designed as an elective for student in ANY OF THE LIFE SCIENCES curriculum, department, etc. _____

8. General Educational Purposes of Course (Please answer all questions.)

- a. General education _____ Yes _____ No X
- b. Departmental specialization _____ Yes _____ No X
- c. Opportunity for student research _____ Yes _____ No X
- d. Professional or preprofessional training _____ Yes X No _____
- e. Could the educational purposes of this course be achieved by the modification of another course now being given? Yes _____ No X. If yes, please explain _____

*** 35 STUDENTS ON A LIMITED ENROLLMENT BASIS DURING THE FIRST YEAR. IF THE BIOLOGY DEPARTMENT FINDS THE COURSE SATISFACTORY, THEN IN SUBSEQUENT YEARS THERE SHOULD BE HUNDREDS OF STUDENTS.**

Sequence of action

- a. Request prepared by _____ Date _____
(Instructor(s))
- b. Approved by Department _____ Date _____
(Head of Department)
- c. Approved by appropriate College Committee _____ Date _____
(Responsible Officer)
- d. Approved by Dean of College _____ Date _____
- e. Approved by Graduate School* _____ Date _____
(Dean of the Graduate School)

9. Relation to Other Courses (Please answer all questions.)

a. Prerequisite(s), if any, 2 YEARS OF HIGH SCHOOL ALGEBRA OR CONCURRENT
Name course(s)
REGISTRATION IN MATH 101

b. This course is to be a formal prerequisite for SEE REMARKS AT END OF FORM
Name course(s)

c. An introductory survey of the field of knowledge represented by your department..... Yes No

d. An introductory survey of a special area of knowledge within the total field represented by your department..... Yes No

e. A further development of:
 (i) A course described under "c"..... Yes No

(ii) A course described under "d"..... Yes No

f. An application to the departmental field of an area of knowledge represented by some other department NO
Name department and course(s)

g. A summarizing and/or integrating course Yes No

h. In your judgment, does this course overlap to any considerable extent with any other course, either in your department or in another department?..... Yes No

If so, please name the common topics and the courses.

<i>Topics</i>	<i>Courses</i>
1. <u>LINEAR PROGRAMMING, MATRICES, PROBABILITY</u>	<u>MATH 107</u>
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____

Please indicate the reasons why overlapping is justified PLEASE SEE ATTACHED PAGE 1

i. If there is substantial overlapping with another course, has this been discussed with the key representative of that department? Yes No

j. If the course is a revision of an existing course

(i) Have the changes which are based on a prerequisite course been discussed with the appropriate individuals? Yes No

With whom? _____

(ii) Have the changes been discussed with appropriate individuals involved with courses that use this course as a prerequisite? Yes No

With whom? _____

10. What are the reasons why this course should be offered at the present time and how does it fit in the development of the educational program of your department?

PLEASE SEE ATTACHED PAGE 1

11. If this course is intended to replace an existing course or courses, please specify.

12. Topical Outline of Course (Give under major and minor headings the principal topics covered in this course together with the approximate number of class hours to be devoted to each topic. *Please be specific and inclusive* and avoid technical terms where possible.) Note: If this proposed course is a reorganization of, or an important change in, an existing course, prepare the outline so as to show the exact nature of the change or reorganization. (Insert extra page if needed)

PLEASE SEE ATTACHED PAGE 2

13. Basic Text for Proposed Course MATHEMATICS FOR THE BIOLOGICAL SCIENCES by GROSSMAN & TURNER

(Give author and title)

14. Special Syllabi _____

(Give author and title)

15. Required Readings (Indicate appropriate journals or texts)

ONLY THE TEXT

16. Classroom, laboratory or other needed space (specify full needs)

CLASSROOM SPACE WITH GOOD

BLACKBOARDS

17. Impact of this course on departmental staffing needs (Additional faculty, graduate assistants, secretarial and clerical help. Please specify.)

SHOULD BE ABLE TO HANDLE COURSE WITH PRESENT PERSONNEL

18. Impact of this course on library facilities (Are current holdings adequate for this course? New books or periodicals needed? Please specify.)

CURRENT HOLDINGS ARE ADEQUATE

Remarks: Add any explanations or additional information that you believe would be helpful in the appraisal of this course.

9. THERE IS VERY LITTLE PROBABILITY INTRODUCED IN MATH 107 AND IT IS INTRODUCED IN THE LAST THREE WEEKS OF THE COURSE WHILE IN MATH 181 THE PROBABILITY IS INTRODUCED EARLY AND THEN USED AND BUILT ON THROUGHOUT THE SEMESTER. THE LINEAR PROGRAMMING AND MATRIX MATERIAL IS USED IN MATH 181 IN UNITS SEBESEQUENT TO THOSE WHERE THE IDEAS ARE FIRST INTRODUCED WHILE THIS IS NOT THE CASE IN MATH 107. IN GENERAL, MATH 181 ASSUMES THAT STUDENTS ARE BETTER PREPARED AT THE TIME THEY ENTER THE COURSE AND THEN EXPECTS MORE FROM THE STUDENT DURING THE SEMESTER THAN DOES MATH 107.

10. UNTIL RECENTLY, SCIENTISTS IN BIOLOGY, MEDICINE, AND RELATED AREAS FELT LITTLE NEED FOR MATHEMATICS OTHER THAN A STANDARD COURSE IN STATISTICS. THE PAST DECADE, HOWEVER, HAS SEEN A RAPID RISE IN APPLICATIONS OF VARIED MATHEMATICAL TOOLS TO THE STUDY OF MANY DIFFERENT KINDS OF BIOLOGICAL PHENOMENA. THIS HAS OCCURRED TO SUCH AN EXTENT THAT IT IS NO LONGER NECESSARY TO CONVINCe STUDENTS OF THE LIFE SCIENCES THAT MATHEMATICS PLAYS AN IMPORTANT ROLE. WHAT IS NECESSARY IS TO MAKE THE RELEVANT MATHEMATICS ACCESSIBLE IN A REASONABLE TIME AND TO DEVELOP THE STUDENT'S ABILITY TO RELATE MATHEMATICS TO PROBLEMS IN BIOLOGY AND MEDICINE. THESE ARE THE TWO AIMS OF THIS COURSE AND THE TWO REASONS WHY THIS COURSE SHOULD BE OFFERED AT THE PRESENT TIME.

12.

- A. PRELIMINARIES 2 WEEKS
1. The Language of Sets
 2. Set Operations
 3. Relations and Functions
 4. The Mathematics of Counting: Permutations
 5. The Mathematics of Counting: Combinations
 6. The Binomial and Multinomial Theorems
- B. DISCRETE PROBABILITY 2 1/2 WEEKS
1. Introduction
 2. Sample Spaces and Equiprobable Spaces
 3. Finite Probability Spaces
 4. Conditional Probability
 5. Bayes' Theorem
 6. Repeated Trials: The Binomial and Multinomial Distributions
 7. Random Variables
 8. Expected Value and Variance
 9. The Poisson Distribution
- C. VECTORS AND MATRICES 2 1/2 WEEKS
1. Vectors
 2. Matrices
 3. Systems of Linear Equations
 4. The Inverse of a Matrix
 5. Determinants and Cramer's Rule
 6. Eigenvalues and Eigenvectors
- D. LINEAR PROGRAMMING 2 1/2 WEEKS
1. Introduction
 2. Convex Sets and Linear Inequalities
 3. Linear Programming: The Corner Point Method
 4. The Dual Problem
 5. The Simplex Method
 6. The Simplex Method (Continued)
- E. MARKOV CHAINS AND GAME THEORY 2 1/2 WEEKS
1. The Transition Matrix
 2. Regular Markov Chains
 3. Absorbing Markov Chains
 4. The Theory of Games
 5. Strategies for Matrix Games
 6. Matrix Games and Linear Programming

F. DIFFERENCE EQUATIONS

2 WEEKS

1. Introduction
2. First Order Linear Difference Equations
3. Second Order Linear Difference Equations
4. The Variation of Constants Method for Second Order Difference Equations
5. Systems of First Order Difference Equations

SUBCOMMITTEE ON BIOLOGY TEACHING AND PHILOSOPHY

Members

Faculty: Ruth Bernstein
Norman Richardson
Olwen Williams, Chairperson

Graduate Students: Chris Kodadek
Tom Swain
Ruth Williams

Undergraduate students: Lynn Al
Tom Hart

Due to unavoidable difficulties in scheduling, this committee was never able to meet as a whole; however, about six hours of dialogue among various segments of the committee revealed a high degree of agreement regarding the changes in curriculum structure needed to enhance the teaching-learning experience in which EPO Biology faculty and students are involved. Discussions were candid and constructive. The chairperson was impressed by the concern and the thoughtfulness with which each committee member approached the task and wishes to thank the members for their contribution of time and effort.

The major ideas and suggestions brought out in these meetings are summarized below.

General Comments

Undergraduate viewpoint (from students in environmental biology)

1. Emphasized the value of laboratory and/or field courses in the educational experience since they provide the opportunity for students to become personally involved and make biology more meaningful. Regret was expressed that field trip groups had to be so large that numbers of individuals missed much that was pointed out and discussed.
2. Emphasized the need for classes in which students have the opportunity to talk about ideas and to interact with each other and with a professor. Again, it was suggested that this made the educational experience more interesting, stimulating, and meaningful.
3. The need for an integrated curriculum in which carefully structured courses provide a means whereby a student can progress steadily and logically toward his terminal objectives was suggested by student comments. Courses in a program such as environmental biology are heavily overlapping and redundant and insufficiently sequential.
4. A need was voiced for an occasional respite from the task of learning a massive body of fact in order to devote time and energy to the assessment of these facts, integrating them, and developing perspectives in the subdisciplines of biology.
5. Need for an opportunity to learn how to apply ecological principle and theories, "academic ecology," to the practical task of decision-making and similar activities taking place in consulting agencies, in governmental agencies, and in similar groups.
6. A need for finding a way to make ancillary requirements for the major (courses taken outside the department such as chemistry) more relevant to the needs of the biology student.

Graduate student viewpoint

1. Students seem to recognize a need for substantial improvement in opportunities to develop practical skills relating to their fields of concentration. In a number of laboratory and/or field courses, where the need has been most obvious, work has not been structured to provide adequate training in the use of up-to-date, sophisticated equipment. Students think this is important if they are to acquire the research and teaching skills they will need in the "real world" and if they are to compete in the job market.
2. Although it was agreed that most departmental courses provide a reasonably good academic background in the programs for which they are designed, in too few of them are students sufficiently encouraged to use the current literature and become truly cognizant of the newest developments. Courses seem to become "out-of-date" because of the failure to emphasize current work.
3. There was some feeling that students are not sufficiently encouraged to be explorative, innovative, and creative but are sometimes held back by teachers and advisers who seem to feel less than completely secure and competent in newer and rapidly changing subdisciplines. Means must be found to enable students to progress beyond the point to which their teachers have been able to become academically competent.
4. Because the students discussing teaching were T.A.'s, the problems of General Biology were brought up. Some ambivalence was revealed as the apparent conflict in goals of the course was considered, namely, the need to give students a solid factual background in the major areas of biology, on one hand, and to stimulate student interest in biology through freedom of inquiry and exploration on the other. Because of the difficulty of resolving these problems in the face of large numbers and heterogeneity of student background, the usefulness of the course for most of the students enrolled was questioned. It was generally agreed that disadvantaged but strongly motivated students get a great deal out of the course offered through section 6. The possibility of providing means whereby an even greater number of students with good high school backgrounds might go directly into more specialized courses of more immediate interest and challenge was discussed.

Faculty viewpoint

1. Need to find ways to enable faculty to use their time and energy more efficiently and effectively and to reduce the increasing sense of frustration that the newer faculty members are experiencing as they try to reach the students enrolling in their courses.
2. Need to make some fundamental decisions regarding what should constitute the common body of knowledge that all BPO Biology students should acquire as undergraduates, develop courses for this purpose (core curriculum), and produce a well integrated, logically sequenced curriculum eliminating the redundancy and disorder that reduces the effectiveness of our present program.
3. Need to introduce greater variety in the way courses are taught in the department. Need to consider ways to decrease student anxiety and increase student interest and motivation.

RECOMMENDATIONS

1. Maintain a general biology course, similar to the present Section 6, for disadvantaged students who come into the biology department strongly motivated but with woefully inadequate academic backgrounds.
2. For the majority of students, replace the present general biology course with a number of lower-division, introductory courses dealing with the subdisciplines of biology now treated in the general course, with the exception of the genetics material. This is adequately covered by the present introductory genetics course. These courses should be carefully structured to start at a sufficiently elementary level to meet the needs of beginning students but they should provide a much more "in-depth" treatment of the subdiscipline than the student presently gets in General Biology. Decisions will have to be made as to which of these courses would be part of the required core curriculum. These courses should be dynamic, well taught, stimulating, and challenging. The exact character of the courses was not considered except to suggest that they incorporate new instructional approaches maximizing instructor-student contact where it counts, namely, in discussions, in laboratory and/or field. It is suggested that Graduate Student Teaching Assistants could be used much more effectively than they have been in the past and that ways can be found to minimize the disparities in grading etc. that have worried course coordinators when multisectioned courses are contemplated. The following courses are recommended for development at the lower-division level

Introduction to Cell Biology
Introduction to the Principles and Mechanisms of Evolution
Introduction to the Principles and Methods of Systematics
Introduction to the Principles of Ecology

Present courses could be adapted, namely, EPOB 251 and EPOB 341 (reduced to the 100 or 200 level). New courses (in Cell Biology and Systematics) would have to be developed, but the personnel capable of the task are already members of the department.

3. Accompanying the major change recommended in 2 above, all of the other courses in the department, building on this foundation, should be carefully scrutinized for content and presentation in order to provide a highly integrated and ordered program allowing sufficient flexibility to meet student needs and interests (a number of different tracks).
4. Take some positive steps to introduce greater variety in the way courses are taught in the department. Consider ways to decrease student anxiety and increase student interest and involvement. Capitalize on the potential of new instructional approaches most of which have been well tested and have proved valuable if used intelligently and creatively. These techniques have and are being used successfully in certain courses in the department. They need not be prohibitively costly in equipment, space, and materials. They do cost more than some forms of traditional teaching in time and energy, but they are worth the cost. Specifically, the department should make a substantial investment in:
 - a. Modular instruction - self-paced, individualized work allowing students to start where they are, progress at their own pace and become responsible for their own learning.
 - b. Use of closed-circuit television, audio-tapes and slides, computer aided instruction, etc. as devices for making learning more efficient, providing variety, and improving the quality of instruction.
 - c. Use of new and better means of evaluating student progress.
 - d. Developing a student-centered rather than an instructor-centered approach to learning.

Facilities

1. Facilities that would otherwise be designated for a large multisectioned general course would be adequate for these courses. Utilization of new instructional approaches should serve to maximize the use of space and equipment and hence substantially improve the cost-benefit relation of facility and function.

To the Curriculum Synthesis Committee - Rogers, Windell, Segal, Winston

The first part of the meeting on Monday afternoon was spent in verbal jockeying that allowed us to get things off our chests, to clear our minds of our own plans and axes to grind, etc. It was suggested that we were to be mere instruments to put the desires of the subcommittees into a meaningful whole. However, Jay Windell had not had a subcommittee for General Biology and when he finished expounding his latest dreams and desires, we had all worked out what looks like a good redoing of the General Biology Program. This would take care of the needs for Gen. Bot. and Gen. Zool., for example, without piling them on top of 2 semesters of Gen. Biol. A suggested beginning looks like this:

	102A	-	Animal Biology
	102B	-	Plant Biology
	102C	-	Microbiology
	102D	-	Cell Biology, Genetics and some of 102A,B,C. THIS would be a terminal course.
Biol. 101			
Principles of Ecology			
Environmental Problems			
Investigative Techniques			
An Holistic approach to Biology			

(These leaves us without the nice introduction to genetics - or could it still go into 101 - yes.)

102D would be terminal for the Non-Biology major.

102A&B would be more than the straight conventional Botany and Zoology courses but would also include some functional aspects in them (and others, presumably). Only a bit of cell stuff here - but some.

102C Microbiology would have the heaviest input of cellular studies of the 3, naturally, but here is where they would also be introduced to biochemistry and cell structure and function.

It was suggested that students would be required to take 101 and one of these others if not more. (We should keep the overlap to a minimum among A,C,B.)

Also, in 101 we would be able to demonstrate the need for Cell Biology taxonomy, and other studies that they are apt to shy away from. There they will be shown how important plants really are and they will flock into 102B. (Presumably the 102 courses would be prerequisites for respective advanced courses).

Would you please set up what you think are the good routes for majors emphasizing different things - try to identify those within the framework of the scheme I gave you Monday.

Further, somewhat unrelated points dredged from the poor memory.

We must try to get it across to the rest of the Department that we need this framework right now for planning the new building. The more concrete this is, the better our chances of convincing others that we really need it. There is no need to panic however, there is plenty of time to ignore it for the next 4 years when the building might be ready - at the earliest. Parts of a new plan can go in before then of course.

We tried to list courses that were required by other Departments or Schools (Pharmacy, etc.) and the only one that is almost wholly a service course is Human Anatomy. A list of courses for the general student - not requiring General Biology was very small. They mostly seem to be one-shot deals that we can't keep up with.

Agreement was unanimous that the number of requirements should be kept to a minimum - no more than General Biology? Pathways must be very clear from there on, though.

One of our problems is to be sure to try to set up the curriculum so that more of our graduates can get jobs other than teaching. Dave suggested that we might profitably bring someone in Government or Industry to give an idea of the things people need. (Charlie Norris has already gotten a start on this).

It was suggested that more examples from the "real world" be used, that Man is an environmental factor, and that Agriculture is worthy of study. The world Food Problem was suggested as a good thing for the kids to look at as a central theme.

The equal split between Ecology and Populations Biology is not necessary, but the latter is good to bring all the geneticists under the umbrella.

We all agreed that Environmental Biology should be the umbrella for the Department. Don't change the name again, however.

We did not come to grips with the small class vs. large class problem, but it was discussed.

Curriculum Sub - Committee on Quantitative Biology

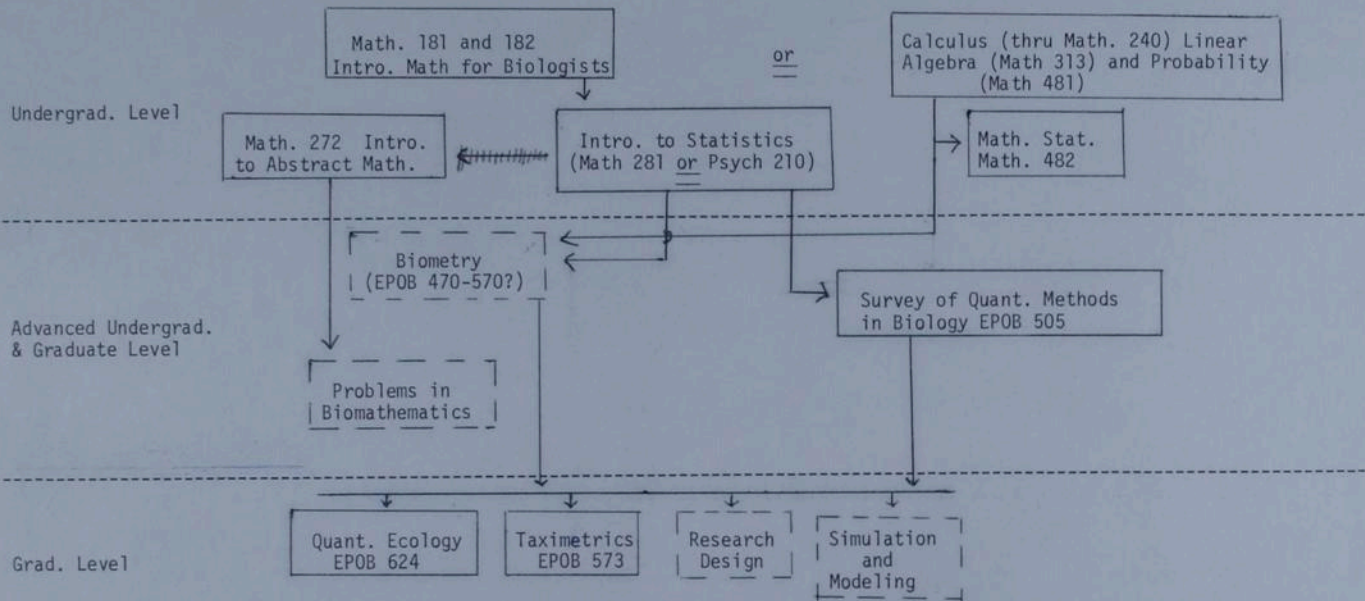
Recommendations -

The curriculum in quantitative biology is perceived as essentially a set of service functions for biologists in the department rather than as a specialty in itself (though training in the field per se on the graduate level is not ruled out). The committee notes that the applications of mathematics to biological problems is of increasing importance and further, that many of the most powerful mathematical techniques are not confined to the traditional math courses recommended for biologists. The result is that the biology student needs a less time-consuming route and more guidance in acquiring the necessary quantitative background.

We are encouraged that one member of the mathematics faculty has realized the need for mathematics course tailored "to the needs of biologists at the lower division undergraduate level and has proposed that a year sequence, Math. 181 and 182, be offered beginning Fall, 1975, on a pilot basis. The course would include set theory, discrete probability, matrix algebra along with their applications to linear programming and game theory and enough calculus to understand elementary difference and differential equations. The course appears to serve the function of combining the most essential elements from the calculus sequence, linear algebra, and probability theory into a space of one year and presenting them with particular references to biological problems.

Based on this the committee would like to propose the alternative ^{courses} ~~courses~~ and ^{approaches} ~~approaches~~ shown in the attached flow chart. Some of the courses are already available, either in this department or elsewhere (solid-line boxes in the diagram); others would have to be added (dotted line boxes) In addition to the curriculum flow chart we would like to recommend the following graduation requirements for EPOB majors.

1. All majors be required to take a basic computer programming course - *Computer Science 201, 202, or 203*
2. All majors be required to an introductory statistics course: Math. 281 Psych. 210, or Math 482, or a biometry course (proposed EPOB 470 or 570).



To the Curriculum Synthesis subCommittee.

For a starter, let's assume that Environmental Biology is the major thrust of this Department. This requires a broader definition than was heretofore used, as can be seen for undergraduates (and graduates) below. You will undoubtedly want to expand or modify these, so let's do that today. Most other routes would require a considerable input from other Dept., e.g. NCDB, Med School, etc., for necessary Biology offerings. These routes must be considered, of course, and we must not neglect them. But even with the proposed faculty additions we would not be able to give or to justify giving the whole Biology curriculum for people following them. Another point is that all these suggested routes overlap to a greater or less extent and that students should be encouraged to not be too narrow as undergraduates.

After the possible routes for majors have been set up, we need to see how our present offerings fit into the scheme, how much overlap and redundancy there is, and how much the newly proposed courses fit in and overlap, //if they do. Could we say that our goal should be that, as a minimum there will be enough courses for a student to get a reasonable background for any of these routes without having to put in 40-50 hours on specified courses?

Then we should determine what facilities have been requested (some of these are pretty thin requests) and try to show how some of them can be grouped for use by more than one discipline, e.g., Physiology and Microbiology can use some things together.

Hardest of all will be to guess as to the demands for the different courses and pathways.

SUGGESTED ROUTES AND PATHWAYS in Environmental Biology

Ecology Defined Synecology, minus Populations Biology. The Community and Ecosystem approaches.

Populations Biology Synecology with an evolutionary and genetics slant?

Systematics and Evolution The goal for all Biological research??

Physiological Ecology Autecology from a physiological standpoint, combining field and lab work.

Ethology Autecology from the behavioral standpoint.

Comparative Physiology Using the species as a variable as well as environmental considerations. Emphasis is on lab work and working into mechanisms.

Applied Environmental Biology This can include Environmental Physiol.,
" Micro.
Ecologists

Other possible routes Most of these would have to include much work outside EPOB

Physiology

Mammalian

Cellular

The courses should be considered as background for the other routes, probably

Genetics

Morphology

Animal Behavior

Quantitative Biology

Orphan courses

Microbiology (Introd.)

Courses now available or requested
 now on the books

101, 102

Requested
 Heredity + Society

- 201 - Microorganism Evol
 210 - Plant Kingdom
 219 - Human Anatomy
 251 - Evolution

- Intro to Cell Biol
 " " Evolution
 " " Systematics
 " " Ecology

Behavioural Biology (2 semesters)

- 300 appl. Med Technol.
 301 Microbiol.
 302 Parasitology
 303 Entomology

- Human Physiology

- 311 } Plant Morphol.
 312 }

Ecology 4
 Pop. Biology 4

- 315 Plants + man
 321 Plant Physiol
 322 Animal Physiol

- 331 Field Botany
 332 Field Zoology (Animal Kingdom)
 341 Pine Ecol
 345 Insect. Anst. affini ev. (naiste ev?)
 376 Hist. Bot. Com.

Suggested 500 courses.

- Plant Nutrition
 - Plant Growth & Development (+ tissue culture) (Ch. 460 to 500?)
 - Physiology of special groups (insects, algae, etc).
 - Mammalian Physiology
 - Seminars in Ecology & Behavior, Ethology (adv.) + Neuroethology
 - Statistical Genetics
 - Cytogenetics
 - Population Genetics (Ch. 451 to 500 level?)
 - Ecological Genetics
 - Evolution
 - Problems in Biomathematics
-

Suggested 600 courses

- Research Design
- Simulation + Modeling
- Human Behavioral Genetics
- Adv. Organismic Genetics
- Animal Eco-physiology - Seminar
- Mammalian Physiology - Sem.

Suggested courses 400 + ~~50~~

400-limit

Human Genetics

Ecology + Behavior

Neuroethology

Advanced Ethology

Adv. Plant Physiology (change fr. 500)

Invertebrate Physiology

Animal Ecophysiology

Techniques Physiology + anatomy

Biometry

Advanced Ecology - Population Biology

(at least 8 courses (2 hrs) in special interest areas)

(from Populations group)

500 courses on the books

- 505 (the catch-all #) —
 Protistology
 Survey - Quant. Methods
 Envir. Measurements + Control
- 507 Teaching Adv. Biol. Labs.
 510 Avian Communities of Colo + N. Mex
 511 Birds of the World
 512 Animal Geography
 513 Techniques in Geocology
 515 Recent Advances Anim. Ecol.
 517 Biological Oceanography
 514 Population Dynamics *
 Mountain Ecosystems
- ~~520~~ 520 Biology of Social Insects
 523 Aquatic Botany
 531 Peripatetic Biology
 533 Mammalogy
 536 Field Problems in Mt. Plant Ecology
 545 Comp. Endocrinology
 546 Experimental Embryology
 547 Ichthyology
 553 Evol. Plant Anatomy *
 554 Algology
 555 Lichenology
 561 ^{150%} Microbial Physiology + Lab.
 562 Topics in Animal Behavior *
 563 Vertebrate Reproduction
 564 History of Biology
 565 Instrumentation *
 571 Plant Biostatistics
 572 Plant Cytology *
 573 Taxinetics
- 575 - Princ. + Pract. Biol. Taxonomy
 580 - Ecophysiol. Act. + Alpine Plants -
 (Ch. to Cas. and?)
 584 Plant Cytotaxonomy
 590 Plant Evol. + Biogeog *
 591 Adv. Palynology *
 597 Histor. Geobotany *
 598 Anagenic Paleobotany + Palynology *
- Missed a few —
- 522 - Tundra Ecology
 543-544 Comp. An. Physiol.
 546 Experimental Embryology
 548 Biol. Fish Population
 549-550 Immuno Biol + Lab.
 551 Adv. Plant Physiol
 552 Adv. Topics Pop. Genetics
 553 Ecological Genetics

on the books

Requested

- 400 Teaching Med Biol
401+403 Microbiology
405+406 Teaching Lab Biol
408+409 Comp Vert. Anat. (+ Lab)
410 Behavioral Genetics
411 Invertebrate Zoology
414 Mycology
422 Cell Physiology
423 Comp Vert Physiol. (new approach)
424 Animal Behavior
425 Microbial approaches to Env. Problems.
430 Classes of Flowering Plants
431 Insect Taxonomy
432+433 Herpetology
434 Ornithology
435 Ecology for Man
436 Pathogenic Biology
437+438 Immunobiology (maybe see)
441 Plant Ecology
443 Animal Ecology
446 Biol. Field Studies (on Plants of Colorado)
451 Population Genetics
460 Adv. Classif. Flowering Plants
461 Vertebrate Embryology
480 Plant Tissue Culture

see next
page.

600 Courses

- 611 Stream Biology
 612 Limnology
 613 Benthic + Aquatic Insect Biol
 624 Quantitative Ecology
 625 Ecology of Fungi
 626 Polar Ecology
 627 Adv. ~~Forest~~ Insect Taxonomy
 628 Adv. Vert. Eco.
 630+631 The Arctic & alpine Environments *
 632 Analysis + Prep. of Papers
 635 Adv. Env. Biol. - Dendrochronology
 641 Comp. Neurophysiol. Sem.
 643 Endocrinology Sem
 646 Adv. Exp. Embryology *
 651 Reprod. Biol. Flowering Plants *
 654 Vistas in Botany
 655 Ecoenzymes
 657 Special Topics in Microbiology
 7652 Vertebrate Reproduction
 662 Applied Microbiology *
 664 Ergonomics *

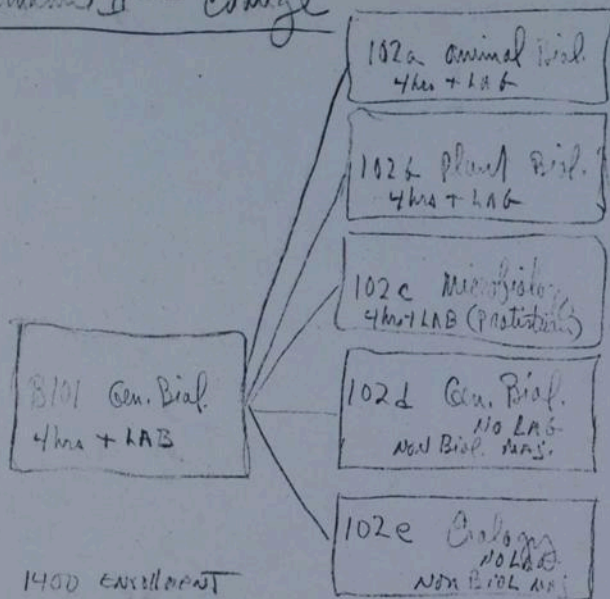
~~664~~

10A - Wed - Paul Winston.

Pathways for underproducts

Alternative I - No change

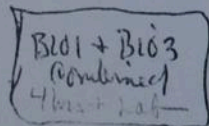
Alternative II - change



1400 ENROLLMENT

6 Lecture Sections
70 LAB SECTIONS

Alternative III



4 Basic Programs with Subprogs

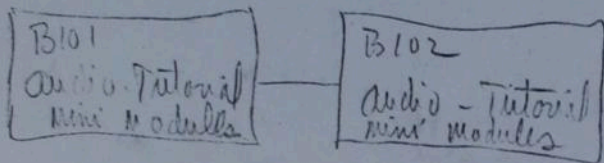
I Curricular Prof.

II Functional Prof.

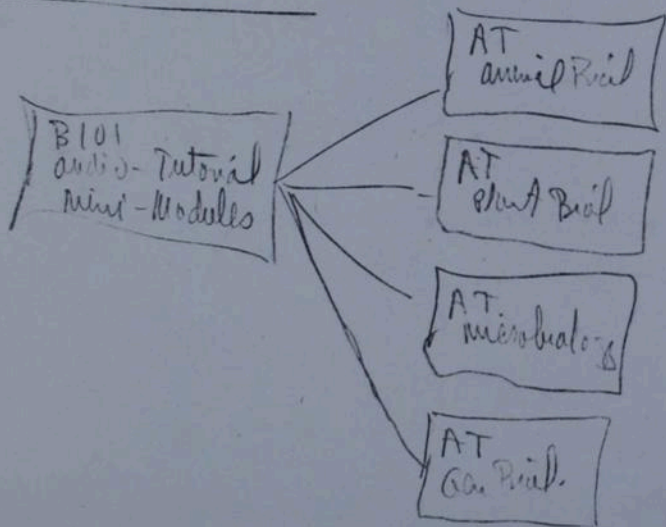
III Population Prof.
(includes genetics
& quantitative)

IV Behavioral Prof.

Alternative III



Alternative IV



General Facility

(Required Physical Facilities)

Lecture Hall - Max 200/sec to accommodate min of 7-8 lecture sections
(Expected enrollment 1400-1600 students)

Laboratories^{*} - Max 20 students/sec. = 70 sections
Require minimum of 12 laboratories

Sectional Office with adjacent work & storage area + 2 adjoining faculty offices for course coordinators

Laboratory Supervisor Office adjacent to a laboratory preparation office with adjacent preparation and storage area. Requires gas, air, hood, inc. machine, autoclave, distilled water, analytical balances, centrifuge etc.

Teaching Assistant preparation and lounge area

Recitation Rooms To accommodate 15-25 students - #?

Each of the additional laboratories requires the following:

1. Student benches and chairs with electricity
2. A bench with sink and electricity
3. Refrigerator
4. Oven
5. Spectrophotometer and pH meter
6. Aquarium rack
7. Blinds for windows
8. Overhead light projector
9. Teacher's desk and rostrum
10. Chalk-board
11. Bulletin boards
12. Clock
13. 2x2 projector
14. 6'x8' screen
15. Waste baskets
16. Etc.

All areas require air-conditioning.

Total plan requires a functional greenhouse.

Telephone and intercom system.

4/

Undergraduate Program.

How many majors do we have?

How many can we service?

Should a limit be set?

Can we set an upper limit?

See Physiology list of
Needs.

Faculty

1. Assume 30 FTE ?
2. Assume 5% growth or reduction ?

Office
Research
secretarial
staffs

3. Assume

1. Visiting Professors
2. Sabbaticals
3. Retirements
4. Career Development grants
5. Encourage, discourage, or status quo on persons like Dr. Burt. in Museum.

5. Assume Realistic needs for each Faculty

1. office space
2. Research space
3. Graduate Student space
- * - 4. Teaching Space Needs — share or no share

Graduate Program

1. Should graduate program be limited? assume 30 per.
No limit = ?
2 per Joe = 60
3 " " = 90
4 " " = 120
5 " " = 150
2. Office + Research Space for Grad's?
In office
In Research areas (Main plan)
In Separate Bldg.
3. Office Space for TA's
4. Office Space for non TA's
5. Shouldn't Joe. Office (~~Research areas~~) be designed for privacy from Grad's.
Do you want Grad's to have access to your office space — I don't.

17

Optional Senior Thesis Program.

1. Space?

In research labs
In Special labs
In field labs

2. Limited # of students
Laboratory Projects
Field Projects
Computer Projects

3. Cost — student pays fee depending
on project?

4. Responsibility
~~Who~~ Whose?

Indiv. Fac.
Dean Fac.
adv. Grad. Students
Teaching Associates

Proposed Curriculum for Population Biology (PB)

C. Bock

I. General Requirements

- A. Mathematics: very critical. Should include calculus, statistics, and computer science. We strongly urge development of an in-house course in statistics and computer science for our graduate students.
- B. Chemistry: one year, hopefully to include some sort of biological chemistry.
- C. Physics: should not be required of PB majors.
- D. General Biology: PB majors will get much of Biol. 102 in advanced courses, but we still recommend the whole 101-102 sequence.
- E. Genetics: one semester, as presently taught.
- F. Physiology: one semester of general plant or animal physiology. For PB majors, the more comparative the course(s) the better.
- G. Evolution: one semester course - 300 level

II. Courses which should be Available

- A. Animal Behavior: 1 semester; very important for PB majors with a zoological interest. Course should emphasize comparative as well as general theoretical approach.
- B. Survey Courses: Each student should take at least one survey course in his or her area of special interest (e.g., entomology, ornithology, plant taxonomy, etc.). The more of these available, the better.
- C. Laboratory Genetics

III. Ecology and Population Biology Courses

- A. General Statement: We feel that offerings in ecology at C.U. suffer from 1) lack of small classes where a student can participate in the field, in the lab, or in discussions with faculty members, and 2) a great redundancy in material covered in large lecture courses in ecology. Accordingly, we propose the development of one 1-semester lecture course called "Ecology" and one 1-semester course called "Population Biology." These would serve in place of 1) Ecology for Man, 2) Principles of Ecology, 3) Animal Ecology, 4) Plant Ecology, 5) Recent Advances in Animal Ecology, 6) Dynamics of Mt. Ecosystems, 7) Ecological Genetics and 8) Population Genetics, insofar as lecture material is concerned. We would imagine each of these courses being taught by a team of, say, three faculty, who would work very closely to integrate the material.

In addition we propose that each faculty member propose and develop at least one environmentally-oriented course in his or her "favorite" field. These courses would be limited in enrollment (20 students?) and emphasize lab, field, and discussion. We would call these, collectively, Advanced Ecology - Population Biology courses (2 hours credit each)

- B. Ecology: 4 hrs credit
4 lectures/week, 1 semester
taught each semester

Topics: descriptive ecology
biogeography
physiological ecology
ecosystem ecology
human ecology

- C. Population Biology: 4 hrs credit
4 lectures/week
taught once/year

Topics: population ecology
population genetics
ecological genetics
theoretical and mathematical ecology

- D. Advanced Ecology - PB Courses

Examples: tundra ecology (Marr)
avian ecology (Bock-Cruz)
mammalian eco-energetics (Williams)
ecology of crop plants (Rogers)
limnology (Lewis-Bushnell)
desert ecology (Bernstein)
pollination biology (J. Bock-Linhart)
insect ecology (Gregg)

IV. Proposed PB Biology Curriculum

Math - one year, with statistics and computer science	
Chemistry - one year	
General Biology	8 hrs
Genetics	3
Physiology	4
Evolution	3
Ecology (see above)	4
Population Biology (see above)	4
Survey Courses, 1 or 2 (see above)	3-6
Laboratory Genetics (optional)	3
Animal Behavior (optional)	3
Advanced Ecology - PB Courses, 2 or 3	4-6

TOTAL HOURS 39 to 44

PREFACE

The information explosion in science has doubled in the last 25 years and is likely to double again in the next because ninety percent of all scientists are alive today as against less than one percent of all people. Truly, "an age of science" has begun with the zenith yet to be reached. More than 60,000 scientific periodicals are now being published as weeklies, monthlies, quarterlies, etc., and few libraries handle more than a small percentage of these. A teacher who thought that his training was completed in 1945 is faced with the problem of mastering as much new material produced since that time, as was available to him, accumulated since science began.

This flood of scientific knowledge is forcing a long overdue reassessment of the status of biological education. Relatively little attention has been given to the actual "practice" of biology early in career training. Similarly, a basic premise of traditional biological instruction, which seems to have arisen spontaneously and without any rational defense is that the scientific process of investigation is reserved for those few who attempt to pursue an advanced degree. This premise is rejected and replaced with the idea that the process of biology is what makes it dynamic, forever changing, and responsible for the generation of all biological knowledge. Therefore, all other considerations are inconsequential to the process and practice of investigation.

Traditionally, general biology courses have been designed to provide a conservative approach by the lecture method of instruction whereby a simple transfer of knowledge takes place. Although ideally suited for the practice or process approach the role of laboratory has been to present material in the form of exercises for the sole purpose of re-inforcing information covered in lecture. Unfortunately, this leads to a thoroughly distorted view of biological science from which there is little recourse. This is not meant to imply that biological science is not both conservative and static --- progressive and dynamic. It is.

I believe that true biological education can only be communicated through an experience with reality and this book offers one possible approach. It emphasizes first hand experience with "practices" used during the work-a-day world of biologists. However, before anyone practice can be brought to fruition, it must be reduced to a series of explicit steps that form the "practice of biology." Therefore, the approach used here only emphasizes the importance of biological information insofar as it relates to how information is generated and what follows after generation.

J.T.W.

The word science has been defined in as many ways as there are sciences. Consider the following definitions:

"Science is that human endeavor that seeks to describe, with ever increasing accuracy the events and circumstances that occur or exist within our natural environment."

"A branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws."

"Systematic knowledge of the physical or natural world."

"Science is the interpretation of nature and man is the interpreter."

"Science is the process which makes knowledge."

No two definitions are alike, but when these and many more are compared one finds they can be separated into two major groups --- namely those that define science as organized knowledge, and those that define science as a practice or process that leads to organized knowledge. The latter implies that science is a dynamic, changing and progressive activity whereas the former implies that science is static, involved in the conservation of knowledge already obtained and therefore conservative. Both implications are reasonable and necessary since science and especially biology has both progressive and conservative aspects.

For example, consider human anatomy, the study by dissection of gross structures such as the bones and muscles. No one expects still unknown bones and muscles to be discovered so anatomists do not search for them. Because of this, anatomy is considered a conservative and static science. Teachers of anatomy are concerned primarily with the transmission of knowledge. However, no justification is required because what would happen in one generation if anatomy was omitted from medical school training? The answer is obvious.

Moreover, even in the youngest and most dynamic field of biology, continued progress is made possible only by the conservation and transmission of knowledge to each new generation.

In contrast to anatomy consider the science of ethology --- the study of behavior. In this field what remains to be discovered exceeds many times that which has thus far been recorded. It is logical and reasonable to say that ethologists, as a group, are more involved in progressive and investigative activities than they are in conservative ones. Current ethological literature reflects its dynamic and youthful character. Workers in this field constantly define, characterize and emphasize the dynamic aspects of behavioral investigation.

Anatomy and ethology were selected merely to illustrate the extremes in the nature of biology; other areas of specialization are more of a mixture. That is, they have both a conservative and progressive aspect. Differences between them reflect their differences in age and maturity and most will no doubt, sooner or later, mature as anatomy has.

THE SCIENTIFIC METHOD AS IT RELATES TO BIOLOGY

Everything that is biology ultimately had its basis in the scientific method just as everything that will be biology in the future will have its basis in the scientific method. Both the power and the limitations of biology are defined by the method. But what is the scientific method? Actually there is no single method. A practice followed by one biologist may not be suitable for another and different methods are required for different branches of biology. Taken individually, most of the practices that can be considered within the realm of the scientific method involve common place procedures used by most everyone daily. Taken together, these practices amount to the most powerful tool man has devised to know and to control nature. Biologically there are some basic principles, practices, and mental techniques that are commonly

PROGRESSIVE BIOLOGY SKILLS

B101

The B101 Laboratory Program has been designed to place emphasis on acquiring major biological skills directly related to progressive or investigative biology. Practice, proficiency, experience and knowledge of these skills can lead to substantial expertness and have valuable carryover value for all areas of scholarly endeavor. The general educational objectives as stated on pages 26 and 27 of the Study Guide served as guidelines for program development and a number of the skills are listed below.

LIBRARY SKILLS

(Completed Assignments
Checked)

- 1. Card Catalog _____
 - Subject Index _____
 - Author Index _____
 - LC List of Subject Headings _____
- 2. Serials Book Catalog _____
- 3. Biological Abstracts _____
 - Author Index _____
 - Subject Index _____
 - Biosystematic Index _____
 - Cross Index _____
 - Biosis _____
- 4. Zoological Record _____
- 5. Index Medicus _____
- 6. Science Citation Index _____

SCIENTIFIC METHOD SKILLS

- 1. Formulated Numerous Hypotheses _____
- 2. Made Numerous Critical Scientific Observations _____
- 3. Conducted 2 Scientific Experiments _____
- 4. Designed Extensions of 2 Scientific Experiments _____
- 5. Gathered and Recorded Scientific Data _____
- 6. Graphed Scientific Data _____
- 7. Tabulated Scientific Data _____
- 8. Drew Logical Conclusions from Collected Data _____
- 9. Developed All Lists to Work on a Number of a Small Research Team _____

COMMUNICATION SKILLS

- 1. Wrote 2 Scientific Abstracts _____
- 2. Wrote 2 Scientific Papers _____
- 3. Revised 1 Edited Paper _____
- 4. Presented brief Oral Report _____
- 5. Critically Analyzed 2 Published Scientific Papers _____
- 6. Critically Analyzed 7 Published Scientific Abstracts _____
- 7. Reviewed 20 Scientific Reprints _____
- 8. Reviewed 1 Galley Proof _____

MISCELLANEOUS SKILLS

- 1. Paper Chromatography Determination Skills _____
 - a. dimensional _____
 - b. dimensional _____
- 2. Oxygen Consumption Determination Skills _____
 - a. Invertebrates _____
 - b. Vertebrates _____
- 3. Behavioral Observation and Analysis Skills _____
 - a. Oligochates _____
 - b. Fish _____
 - c. Prairie Dogs _____
- 4. Experimental Investigation of Seed Germination Skills _____
- 5. Experimental Investigation of Plant Hormones Skills _____

GENERAL EDUCATIONAL OBJECTIVES - LABORATORY

B101

SCIENTIFIC METHOD OBJECTIVES

1. Given a number of scientific observations the learner will be able to formulate and write valid hypothesis.
2. Given a well formulated hypothesis the learner will be able to design a controlled experiment.
3. Given appropriate raw data the learner will be able to analyze, interpret and draw appropriate conclusions.
4. Given appropriate raw data the learner will be able to construct a logical summary in the form of a publishable table.
5. Given appropriate raw data the learner will be able to construct a logical summary in the form of a publishable figure.
6. Given sufficient and appropriate methods and materials the learner will be able to independently conduct a scientific investigation.
7. Given a published scientific abstract the learner will be able to critically analyze it for content, format and style.
8. Given a published scientific paper the learner will be able to critically analyze each major and minor section for content, format and style.
9. Given opportunity to observe an oral presentation of a scientific paper the learner will be able to critically analyze it for delivery, content and visual aids.
10. Given a reprint of a published scientific paper the learner will be able to list and describe the major scientific steps which gave rise to it.
11. Given opportunity the learner will gain experience and practice working as one member of a small research team.

COMMUNICATION OBJECTIVES

1. Given opportunity to conduct an openended scientific investigation the learner will be able to formulate a valid hypothesis, design a controlled experiment, gather and record data, analyze and interpret data, tabulate and graph data in acceptable written style and format.
2. Given all of the preliminary requisits the learner will be able to write a scientific paper in acceptable format and style for journal publication.
3. Given all of the preliminary requisits the learner will be able to write a scientific abstract in acceptable format and style for journal publication.

BIOLOGICAL LIBRARY AND LITERATURE SEARCH OBJECTIVES

1. Given an assignment the learner will be able to conduct a biological literature search utilizing the: (a) Card Catalog (b) Library List of Subject Headings and (c) Serials Book Catalog (SBC)
2. Given an assignment the learner will be able to utilize the card catalog to locate a library holding that is classified according to the Dewey Decimal Classification and the Library of Congress Classification System when the author and title are known.
3. Given an assignment the learner will be able to utilize the Serials Book Catalog to locate a specific reference paper when the Journal (Serial), author, title and volume are known.
4. Given an assignment the learner will be able to utilize the Library List of Subject Headings to locate specific information classified under alternative subject headings.
5. Given an assignment the learner will be able to conduct a biological literature search and construct a bibliography in a specialized area by utilizing the Biological Abstracts.
6. Given a complete set of Biological Abstracts the learner will be able to utilize the: (a) Author Index (b) Subject Index (c) Biosystematic Index (d) Cross Index (e) Biosis (List of Serials)
7. Given an assignment (optional) the learner will be able to utilize and locate specific biological information using the: (a) Zoological Record (b) Science Citation Index (c) Index Medicus

400 - Specialization - The Senior Research Program

Seminars (or symposia) by combined (teams) faculty
for ecology, population, systematics, physiologic, etc.

Allied courses, depending on specialization in Chem, Physics, Geography,
Geology, Geology, Ecologists, Taxonomists - math - modern (combinatoric, finite) for
Physiologists, geneticists - math - analytic,
infinite, statistics.

Some types of additional
outside requirements.