MAR 11 1994

LSC Use Only
Number: _____
Action: _____
Date: _____

UWUCC Use Only
Number: ~~93-80a~~ 94-26
Action: App 3/28/95
Date: Senate App 5/2/95

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. Title/Author of Change

Course/Program Title: BI 111 Principles of Biology I
Suggested 20 Character Course Title: Prin. of Biology I
Department: Biology
Contact Person: Dr. William Barkley Butler

II. If a course, is it being Proposed for:

X Course Revision/Approval Only
_____ Course Revision/Approval and Liberal Studies Approval
_____ Liberal Studies Approval Only (course previously has been approved by the University Senate)

III. Approvals

Robert P. Gendron
Department Curriculum Committee

Department Chairperson

College Curriculum Committee

W. J. Cale
College Dean*

Director of Liberal Studies (where applicable)

Provost (where applicable)

*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

re-submitted

IV. Timetable

Date Submitted to LSC: _____
to UWUCC: _____

Semester to be implemented: Fall, ~~1995~~ 1996

Date to be published in Catalog: ~~1995~~ 1996

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LIBERAL STUDIES

V. DESCRIPTION OF CURRICULUM CHANGE

1. Catalog Description

BI 111 Principles of Biology I — 4 credits, 3 lecture hours, 4 lab hours (3c-4l-4sh)

Prerequisites: must be taken after or concurrent with CH 111

Introduces the student to principles of biology, specifically in the topics of cell structure and function, genetics and physiology. Develops skills in the use of the scientific method. Designed for biology majors.

Explanatory Note:

Of the 4 lab hours, 1 hour per week will be used as a discussion/review session. The department proposed the Principles courses, in part, because of the difficulty students have with Cell Biology as an introductory course. The structure of these new courses will not fully solve this problem. The concepts of the cell biology and genetics units in particular are difficult for students to grasp, as all those who have taught Cell Biology or General Biology know. They are particularly difficult for first semester freshmen who have not yet had much, if any, chemistry. We believe, therefore, that one hour per week spent in discussion and review will help students master these concepts and may make a critical difference in their experience with the course. Far from adding to their burden, we hope it will lighten it. It is for this reason that we propose 4 lab hours intending 3 for lab and 1 for discussion/review.

Course Syllabus

1. CATALOG DESCRIPTION

BI 111 Principles of Biology I — 4 credits, 3 lecture hours, 3 lab hours (3c-3l-4sh)

Prerequisites: must be taken after or concurrent with Ch 111

Introduces the student to principles of biology, specifically in the topics of cell structure and function, genetics and physiology. Develops skills in the use of the scientific method. Designed for biology majors.

II. COURSE OBJECTIVES

1. Students will demonstrate an understanding of the general biological principles relating to cell structure and function, genetics and principles of physiology.

2. Students will know the basic terminology and the fundamental processes associated with cell structure and function, genetics and physiology.

3. Students will gain an understanding of the role that women and minorities have played in the discovery of knowledge related to the specific topics of the course.

4. Students will develop skills in using the scientific method, including formulating hypotheses, designing experiments to test hypotheses, collecting and analyzing data, and interpretation of results. Meeting this objective also requires the students to be able to think critically about scientific observations and problems.

5. Students will develop skills in communicating experimental methodology, results, and conclusions.

6. Students will gain an appreciation for the unity and beauty of biology as a science.

7. Students will gain an appreciation of the significance of biologists to the human endeavor.

III. COURSE OUTLINE

Statement of Basic Principle: Life is self-replicating information (order) maintained by a constant flow of energy.

A. Basic Chemistry (10%)
Living systems are unique in their chemical composition but obey the same laws of chemistry and physics as do inanimate objects.
   1. Cells are composed of a hierarchy of chemical substances from small ions to large complexes of macromolecules each with a specific function and held together by covalent and weak bonds.
      a. atoms
      b. weak and strong bonds
      c. structure of micromolecules (ions, water, amino acids, sugars nucleotides, lipids)

d. structure of macromolecules (proteins, poly-nucleotides, and polysaccharides)
e. structure of large complexes (membrane, chromatin, and cytoskeletal elements)

2. Cellular reactions can be understood by considering the second law of thermodynamics including the law of mass action in which equilibria can be disturbed by coupling exergonic reactions to endergonic ones.
   a. reaction equilibria
   b. Keq, G^o, G
   c. use of specific coupling reactions to disturb equilibria
      phosporyl transfer reactions
      redox reactions
   d. energy storage in covalent bonds
   e. steady states

B. Basic Biochemistry (15%)
Reactions within the cell are specific due to recognition processes among molecules and are speeded up by the lowering of energy barriers to reaction.
1. Enzymes are specific protein catalysts which allow regulation of reaction states.
   a. catalysis and equilibrium
   b. enzyme structure
      protein
      cofactors
      prosthetic groups
      apo- & holoenzymes
   c. enzyme specificity
   d. properties of enzyme reactions
   e. inhibitors
   f. regulation of enzyme reactions
   g. isoenzymes
   h. multi-enzyme complexes
   i. ribozymes
2. Cellular communication depends on the recognition of certain signal molecules.
   a. enzyme and substrate
   b. receptors and ligands
   c. how a cell responds to the change in the concentration of a ligand

C. Basic Cell Biology (25%)
The cell is a compartmentalized structure capable of directing and regulating its own synthesis, and receiving and responding to information from other cells from the environment
1. Cell structure is studied by microscopy and cell function is studied by cell fractionation.
   a. basics of microscopy
      light
      electron
      specific staining
   b. cell fractionation
      cell breakage
      centrifugation
      marker enzyme activities

2. There are two cellular architectures encompassing the five kingdoms of living things
   a. prokaryotic cell structure
   b. eukaryotic cell structure
3. Membranes separate the cell from its environment and compartmentalize the cell into functional compartments providing a chemical environment appropriate for each compartment's function.
   a. passive transport
      permeability
      lipid sieve model
      facilitated diffusion
   b. active transport
      primary
      cotransport
   c. transport of bulk materials
      endocytosis
      exocytosis
   d. electrochemical potentials as sources of
      stored energy
4. Organisms obtain metabolically available energy either from the oxidation of organic and inorganic nutrients or through the utilization of sunlight energy.
   a. metabolic classificationof organisms
   b. depolymerization of macromolecular nutrients
   c. active transport
   d. glycolysis
   e. fermentation
   f. respiration
      Krebs cycle
      respiratory electron transport
      oxidative phosphorylation
   g. photosynthesis
      capture of quantum energy
      photosynthetic redox processes
      photophosphorylation
      CO_2 fixation
5. Utilization of available energy for other cellular function (motion, etc.).

D. Genetics (25%)

The traits of an organism are largely due to its protein complement as inherited from its ancestors as base sequences of the genetics material.

1. Base sequences of the genetic material constitute the information necessary to be translated into specific proteins each of which carries out specific functions in specific cellular locations
   a. what is a gene?
   b. base pairing
   c. intracellular information flow
   d. transcription
   e. translation
   f. mutations
   g. regulation of gene expression
   h. routing of translation products to cellular compartments

2. Asexual reproduction begins with replication of an organism's genetic material followed by its distribution ito the products of reproduction.
   a. cell cycle
   b. DNA replication
   c. prokaryotic cell division
   d. mitosis
3. Sexual reproduction involves the replication, segregation, and recombination of base sequences from two parents resulting in progeny that possess novel gene combinations.
   a. meiosis, gametogenesis & sporogenesis
   b. importance of crossing-over
   c. Mendelian genetics
      interaction of alleles
      genotypic and phenotypic ratios
      sex-linked
   d. non-Mendelian inheritance

E. Physiology (25%)
1. Multicellular organisms are constructed of tissues and organs representing a division of labor within the organism.
   a. cells > tissues > organs > organism
   b. functions of tissues
      1) plant
      2) animal
2. Multicellularity requires strategies to allow for the exchange of nutrients, wastes, metabolic gases, heat and water and to provide for coordination among its tissues.
   a. circulatory systems are designed to reduce
      diffusional distances
      1) diffusion
         Fick's Laws and the continuity equation
         limits to size based on diffusion
         solubilities and physical
            properties of exchanging
            substances
         circulatory systems
            when needed?
            basic designs
   b. Exchange of nutrients
      special carriers
   c. Exchange of metabolic waste
      special problem of nitrogenous wastes in animals
   d. Exchange of metabolic gases
      water to cell
      air to water to cell
   e. Osmoregulation
      osmosis
      cells cannot pump water
      components of water potential
      osmoregulation
         microbe
         plant
         animal

f. Thermoregulation
    size and heat loss
    control of temperature
        insulation
        size
        thermoregulation
            mechanisms
            integration with circulatory system

3. Coordination of activities among the tissues of an individual organism requires the production of informational molecules, the distribution to target tissues and specific responses.
    a. hormonal systems
        1) endocrine
        2) non-endocrine
        3) distribution in circulation
        4) specificity of response
        5) plant growth factors
    b. Cell-to-cell information transfer
        1) local coordination
            gap junctions and plasmodesmata
            examples
        2) long distance cell-to-cell coordination
            neuron function
            nervous systems

The laboratory portion of the course has three aims:
1. To nurture in students a curiosity about the natural world and provide them an opportunity to experience the excitement of observing it and asking questions about it.
2. To illustrate some of the major concepts of the lecture portion of the course.
3. To begin to acquaint them with the scientific method.

In the laboratory portion of this course, students will usually work in groups. They will be guided in formulating specific hypotheses and experiments to test them within a framework which will ensure that all students are exposed to the same general concepts and techniques and use methods, etc. which are proven and will give them useful results.

Tentative sequence:
1. Cell types, cell structure and microscopy
2. Growth curves and data presentation
3. Measuring and studying enzymatic reactions
4. Molecular composition of cells and tissues
5. Simple Mendelian genetics
6. Exchange of materials between organisms and the environment
7. Effects of size and shape of organisms
8. Control of physiological processes
9. Communication of scientific results

IV. EVALUATION METHODS

The final grade for the course will be determined as follows:

75% Tests and quizzes on lecture material, including four major examinations consisting of multiple choice, completion, true-false, matching, and essay questions.

25% Laboratory Reports, Proposals, and Quizzes. Most laboratory experiments will require a written report in the format of a scientific journal article: introduction, methods, results, conclusions

Each report will be approximately 3-5 pages long. Proposals will typically be much shorter. There will be approximately 5-6 lab reports and a small number of proposals. Revision of proposals or reports receiving a grade lower then "B" may be considered as a way to increase the emphasis on gaining skills and decrease the grade pressure in this portion of the course. Quizzes to test specific skills (calculations, graphing, etc.) may also be given.

V. REQUIRED TEXTBOOKS, SUPPLEMENTAL BOOKS AND READINGS

Textbook: Campbell, N.A. 1990. Biology, 2nd ed.
Benjamin/Cummins Publishing Co., Inc. Redwood City, CA
Textbook: Laboratory Manual for Principles of Biology I,
prepared by the Biology Department, available at Kinkos.
Supplemental readings may be required from the scientific literature.

VI. SPECIAL RESOURCE REQUIREMENTS

None.

VII. BIBLIOGRAPHY

Alberts, et. al., Molecular Biology of the Cell, 2nd edition, Garland, NY & London, 1989
Darnell et. al., Molecular Cell Biology, 2nd edition, W.H. Freeman and Co., Salt Lake City, 1990.
Lewin, Benjamin, Genes IV, 4th edition, Oxford University Press, NY, 1990.
Schmidt-Nielsen, Animal Physiology, 3rd edition, Cambridge, NY, 1990.

Course Analysis Questionnaire

A: DETAILS OF THE COURSE

A1. The course will be the first semester of a two-semester sequence designed to introduce students to the principles of biology. The sequence is primarily for majors in biology and will form the foundation for advanced courses in biology. The biology student is expected to take the sequence in the freshman year. We do not expect a large enrollment of non-biology students. This course is not being proposed for inclusion in the Liberal Studies course list.

A2. The development of this course is part of a revision in the B.S. and B.A. programs in biology. These changes are described in the proposal for program revision.

A3. The course follows the traditional type of offering by the department.

A4. The course has never been offered at IUP on a trial basis.

A5. The course is not a dual-level course.

A6. The course will not be taken for variable credit.

A7. Most universities in the United States offer a one-year introductory biology sequence for biology majors. See the Appendix.

A8. No professional society, accrediting authority, law, or other external agency mandates the contents of the course.

B. INTERDISCIPLINARY IMPLICATIONS

B1. The course will be taught by one or two instructors. One instructor could teach the course in a given semester; but because of the diversity of topics and the time commitment necessary to prepare laboratory exercises, two instructors would be able to provide a higher quality experience for the students. When two instructors are involved in the course, the teaching load will be equally split between them.

B2. This is the first course of a two course sequence. The proposal for the second course is included in the proposal for program revision.

B3. There are no overlaps between this course and courses taught in other departments. Some of the topics covered in this course overlap with BI 103-104. However, BI 103-104 is designed specifically for non-majors and does not cover the topics in the depth required for biology majors. In addition, the laboratory exercises in the proposed course focus more specifically on skills necessary for biologists-in-training. BI 111 Principles of Biology I is a much more rigorous course designed to introduce students to biology as a profession.

B4. Seats in this course can be made available to students in the School of Continuing Education.

C. IMPLEMENTATION

C1: Resources

a. Faculty currently in the Biology Department can teach this course.

b. Laboratory rooms and lecture facilities are available in Weyandt Hall.

c. The equipment necessary to implement this course is already available in the biology department. Future equipment needs will be met through the standard departmental procedures for procuring equipment.

d. Laboratory supplies will be obtained through standard departmental procedures for budgeting funds for supplies.

e. Library materials are currently adequate.

f. No travel funds are required for the course.
Laboratory exercises involving field trips will use university-owned vans.

C2. None of the resources for this course are from a grant.

C3. This course will be offered every Fall semester and, when feasible, in Summer Session I. The second course in the sequence will be offered every Spring semester and, when feasible, in Summer Session II.

C4-5. In recent years 80-120 students enter the biology program each year. The space available in the laboratory room limits the size of the laboratory sections to 24 students. Size of the lecture section will be a compromise between the need for small classes to improve interactions between the instructor and the students and the need to distribute faculty load among all courses in the department.

C6. No professional society mandates any component of the course.

C7. This will be a required course for biology majors. The program revision describes the number of free electives and total credits in the program.

BI 111

Appendix

Universities offering similar courses:

1. Boston College: BI 200 and 201, 202 and 203

BI 200 Introductory Biology I (F: 3)
An introduction to living systems at the molecular, cellular, organismal and population levels of organization. Three lectures per week. Required for biology majors.

BI 201 Introductory Biology Laboratory I* (F: 1)
One three-hour laboratory period per week. Required of all students taking BI 200.

BI 202 Introductory Biology II (S: 3)
A continuation of BI 200. Required for biology majors. *The Department*

BI 203 Introductory Biology Laboratory II* (S: 1)
One three-hour laboratory period per week. Required of all students taking BI 202.
Mary Albert

2. Bowling Green State University: BIOL 204, 205

¶◆BIOL 204. Concepts in Biology I (5) I, II, III (on demand). Introduction to ecological and evolutionary biology, Mendelian and population genetics, and the major groups of plants, animals and microbes. Three one-hour lectures, one three-hour lab and one two-hour recitation. Field trips required. Lab fee.

¶◆BIOL 205. Concepts in Biology II (5) I, II, III (on demand). Introduction to molecular and cellular biology, physiology and organ systems. Three one-hour lectures, one three-hour lab and one one-hour recitation. Lab fee.

3. Duquesne University: 111, 112

111, 112. General Biology. 4 cr. each
Introduction to the scientific study of life at the molecular, cellular and organismal level. It involves consideration of relevant structure, function, development, reproduction, inheritance, evolution and ecology. This course provides the basic information and concept necessary for understanding living systems, their activity and interrelationships. 111 is prerequisite to 112. Lecture and laboratory.

4. University of Notre Dame: 103, 104

103-104. Biological Sciences I and II
(3-3-4) (3-3-4) Hunt
Prerequisite: CHEM 117-118 are to be taken concurrently.
Introduction to living organisms, with emphasis on biological processes and principles. Restricted to biological science majors.

5. University of Toledo: 211 and 212, 213 and 214, 215 and 216

211—FUNDAMENTALS OF LIFE SCIENCE I. 4 hours. *A general introduction to cell structure and function, energy processing in plants and animals, basic genetics, and molecular biology. Four hours lecture.* (Fall, D/N, Winter, D/N, Summer,D) 155:211

212—FUNDAMENTALS OF LIFE SCIENCE LABORATORY I. 1 hour. Corequisites: Biol. 211 and Chem. 110. Intended for science majors only. *A series of laboratory experiments which supplement the material discussed in 211. Three hours laboratory.* Fall, D/N; Winter, D/N; Summer, D) 155:212

213—FUNDAMENTALS OF LIFE SCIENCE II. 4 hours. *A general introduction to the anatomy, physiology, and development of plants and animals. Four hours lecture.* (Winter, D/N; Spring, D/N Summer, D) 155:213

214—FUNDAMENTAL OF LIFE SCIENCE LABORATORY II. 1 hour. Corequisites: Biol. 213 and Chem. 111, 121. Intended for science majors only. *A series of laboratory experiments which*

215—FUNDAMENTALS OF LIFE SCIENCE III. 4 hours. *A general introduction to basic principles of ecology, behavior, population biology, and systematics. Four hours lecture.* (Fall, D/N; Spring, D/N; Summer, D) 155:215

216—FUNDAMENTALS OF LIFE SCIENCE LABORATORY III. 1 hour. Corequisites: Biol. 215 and Chem. 112 and 122. Intended for science majors only. *A series of laboratory experiments which supplement the material discussed in 215.* (Fall, D/N; Spring, D/N; selected Summers, D) 155:216

MAIL> extract tt:
From: GROVE::RGENDRON "Rob Gendron" 24-MAR-1995 12:29:36.62
To: DRCHRDSN
CC: RGENDRON
Subj: Bio Curriculum

To UWUCC:
Re: Biology Proposals 4/25/26
Responses to our Questions

Darlene,

I have made the corrections in the BI111 and Program proposals and sent the pages to you via campus mail. (yes, received + placed in proposals)

I have asked Bob Prezant and Bill Dietrich to comment on the question the committee had regarding BI105, BI210 and BI220. What follows are their slightly edited e-mail messages to me. As you can see, the library holdings are not so weak as to preclude the teaching of BI210 and BI220, which are both introductory courses. In their proposals Drs. Prezant and Dietrich have simply reiterated the plea for more support for the library. In this they probably reflect the feelings of the Biology Department, and probably many other faculty.

As Dr. Prezant's reply indicates, we forsee no problem in meeting the need for Cell Biology, even with the reduced class size.

Rob Gendron

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From Bob Prezant:

"Weak library holdings" signifies the current state of the University library for all Biology materials. Having said that: There is sufficient material in our zoology holdings in the IUP library to run the BI220 course as an introductory level majors course. The "weakness" stems from a lack of depth in those holdings. Students wishing to pursue deeper aspects of zoology, as introduced in BI220, will be challenged by our holdings.

BI105: The total number of seats for BI105 has not been reduced. With enrollment management taking effect for Nursing and with our Biology majors and Medical Technology students no longer taking BI105 (but instead taking Principles), the 2-3 sections of 48 students each should suffice. Teaching this course outside of Weyandt Hall is not a requirement; merely a suggestion to keep those students taking the course on their "home base". The course will be scheduled where appropriate rooms are available.

From Bill Dietrich:

Regarding BI210, Botany:

The library holding are weak but not enough so that we are unable to teach the course as described in the proposal. We pressntly supplement the holdings with our personal books and jopurnals.

The reply of the UWCC implies that the Biology department can do something about the woeful state of funding of the IUP library. As near as I know, we can only complain. The real question is: What will the university do to alleviate the problem. The library has been a low priority for funding for quite a while and the Biology department did not make or enforce that decision.