LSC Use Only
Number:
Submission Date:
Action Date:

UWUCC USE ONLY 02-136
Number:
Submission Date: ~~01-43d~~
Action-Date: App UWUCC - 10/15/02
Senate App - 11/5/02

PART I. CURRICULUM PROPOSAL COVER SHEET

University-Wide Undergraduate Curriculum Committee

1. CONTACT

Contact Person Dr. N. Bharathan Phone 357-2584
Department Biology email: BHARATHN@GROVE.IUP.EDU

II. PROPOSAL TYPE (Check All Appropriate Lines)

XX COURSE — Molecular Biol. Topics
Suggested 20 character title

XX New Course* — BIOL 410 Molecular Biology Topics
Course Number and Full Title

___ Course Revision — _____
Course Number and Full Title

Rev.

___ Liberal Studies Approval for new or existing course — _____
Course Number and Full Title

___ Course Deletion — _____
Course Number and Full Title

___ Number and /or Title Change _____
Old Number and/or Full Old Title
New Number and/or Full New Title

___ Course or Catalog Description Change _____
Course Number and Full Title

_____ PROGRAM: ____ Major ____ Minor ____ Track

_____ New Program* _____

_____ Program Revision* _____

_____ Program Deletion * _____

_____ Title Change _____

III. Approvals (Signatures and date)

Department Curriculum Committee — Nov 30, 2001

Department Chair — W. B. Bo 11/30/01

College Curriculum Committee

College Dean — 11/30/01

Part II. Description of Curricular Change

1. **Catalog Description**

BIOL 410 Molecular Biology Topics	3 class hours 0 lab hours
Prerequisite : BIOL 263 or BIOC 301 or CHEM 351	3 semester hours (3c-0l-3sh)

Involves the study of biological phenomena in molecular terms. The course focus is on recombinant DNA principles as they relate to prokaryotes and eukaryotes. Course emphasis is placed on the modern methods used in recombinant DNA technology.

II. Course Objectives

Upon completion of this course the students will:

1. understand how genes function and regulate in simple and more complex organisms.

2. recognize the commonality of gene functions at molecular level and at the same time examine unique differences.

3. describe the theory, principles and essentials of gene manipulations, gene modifications and basics of intra-species gene transfer.

III. Detailed Course Outline

TOPIC OUTLINE: MOLECULAR BIOLOGY

The course is organized into three units. One of the important features of these units is the "layering" approach to knowledge construction. The first unit covers the molecular basis of a cell and is designed to provide the scientific background and vocabulary needed to understand principles of recombinant DNA technology covered in the remaining part of the course. The second unit builds on this background material to cover several relevant "models" to study gene structure and function. However, because the methods used in recombinant DNA technology are numerous and well publicized in agriculture, animal husbandry, and medicine, the entire third unit will be devoted to the discussion and application of DNA technology to "modern biology."

UNIT 1 (1-10 lectures)

Lecture 1 and 2
Advanced topics in nucleic acids

Physical and chemical nature of DNA and RNA. DNA topology, palindromes, proteins of chromatin (histones, non-histones). Organization of chromatin in eukaryotic nuclei; prokaryotic DNA.

Lectures 3 and 4
Advanced topics in DNA synthesis and repair

Principles of DNA replication, enzymology of DNA replication, DNA topoisomerases; repair of incorrect bases; repair by direct reversal; excision repair

Lecture 5
Molecular aspects of mutation

Biochemical basis of mutants; mutagenesis; alteration of DNA molecules, DNA damage and their role in carcinogenesis; mutagens and carcinogens

Lectures 6-7
Gene structure and transcription machinery in prokaryotes and eukaryotes

Molecular definition of a gene; chromosomal organizations of genes and non-coding DNA; functional rearrangements in chromosomal DNA; structure and organization of Class I, Class II, and Class III genes; chromatin structure and the nuclear matrix; promoters; enhancers and silencers.

Lecture 8
Recent advances in organelle DNA structure and function

DNA in mitochondria and chloroplasts;
multiple mtDNA molecules;
cytoplasmic inheritance; chloroplast DNA engineering.

Lectures 9 -10
Recent advances in post-transcriptional events in eukaryotes

Splicing; capping and polyadenylation;
RNA editing, mechanism, and evolution;
control in gene expression; codon degeneracy;

translation initiation in prokaryotes and eukaryotes; control of initiation; mechanism of translation; elongation and termination.

Selected topics on gene expression and development in eukaryotes

Levels of control of gene expression in eukaryotes DNA methylation, steroid hormone regulation of gene expression, hormone control of gene expression in plants, gene regulation in development and differentiation, genetics of embryogenesis, lethal mutants in *Arabidopsis* and Maize.

Class Meeting 11: **Exam One**

UNIT II (lectures 12-20)
Lecture 12-15
Modern understanding on molecular aspects of oncogenes:

Agrobacterium mediated transformation in plants; Characterization of *vir* and *onc* genes associated with Ti plasmid, transformation and oncogenesis by damaging the chromosome. Retroviruses and cancer; identification of *src* and *sis* gene products; DNA tumor viruses; products of oncogene.Tumor supressor genes, aging process, and molecular aspects of senescence.

Lectures 16-20
Transposable genetic elements

Bacterial transposons; Corn, Drosophila and yeast transposable elements; Retroposons; transposon tagging; Recombination and transposition.

Class Meeting 21: **Exam Two**

UNIT III (lectures 22-31)
Lecture 22-26
Principles of recombinant DNA methodology and genetic engineering: Molecular tailoring of genes

Cloning methods; isolation of DNA; biology of restriction enzymes; joining DNA fragments; plasmid vectors; phage vector for bacteria; transformation; chromosome walking to clone a gene; cloning from RNA; establishing gene libraries (Genomic and cDNA library)

Lectures 27-28
Polymerase Chain Reaction (PCR) technology and applications

PCR : an alternative to cloning; reverse transcription PCR; PCR amplification of mutant alleles permits their detection in small samples; PCR technology applications in medicine and human genetics testing.

Lectures 29-31
Nucleic acid Hybridization

Plaque or colony hybridization; Southern blot, Northern blot DNA sequencing; DNA fingerprinting and DNA typing; protein engineering with cloned genes: site directed mutagenesis

Class Meeting 32: **Exam Three**

Unit III contd. 33 to 42
Lectures 33-37
Modern methods in gene mapping and quantifying transcripts

S1 mapping; primer extension; run-off transcription, measuring transcription rates *in vivo;* nuclear-run-on transcription; reporter gene transcription; assaying DNA-protein interaction

Lectures 38-42
Selected topics on the application of molecular biology and recombinant DNA technology

In Agriculture: Systemic acquired resistance gene; genetically modified food;
In Medicine; tissue engineering; tissue culture; in plant and animal transgenics; forensic science; In Vaccine production
In gene therapy; detection of genetic abnormalities
In Environment;Genome Projects (example: Human Genome and *Arabidopsis*); Federal Regulations and Recombinant DNA Technology.

Class Meeting 43 : Final Exam Week: Comprehensive Final: Exam Four

IV. Evaluations:

A. Examinations (Total = 80%)

There will be **THREE** quizzes and **FOUR** major exams for a total of 400 possible points and a term paper worth 100 points.

3 quizzes x 20 points each	=	60 points
3 major exams x 80 points each	=	240 points
1 Comprehensive Final x 100 points	=	100 points
One term paper	=	100 points

Exams will be composed of objective multiple-choice questions, and short answer essay questions. These exams are designed to stimulate critical thinking about the living world and gauge the student understanding of the factual material of the course.

B. **One Term Paper** (20%)

Students will be required to write a (10-12 standard double-spaced typed pages) term paper on ONE aspect of **"modern methods in molecular biology"**. In order to maximize student interest, students will be allowed to select topics on related themes. The term paper will be worth 20% of the final grade. There will be a rigid format to which the students must strictly adhere. The instructor will meet with the individual students and together define a term paper topic within the area of special interest. A term paper topic will be due four weeks after the semester begins. The early deadline requires students to survey the text, literature, internet links, and web sites on related topics soon after the semester begins.
The term paper is expected to demonstrate the author's ability to synthesize material from various sources and to think critically about scientific data.
Students will write a rough draft of the term paper and submit it to the instructor about 9 weeks after the semester begins. The instructor will hold an individual conference with each student to discuss the rough draft and make suggestions for revision. Students will revise the rough draft and turn in the final copy of the term paper 12 weeks after the semester begins. In its final form, the term paper is to resemble a scientific review article with correct grammar usage, punctuation and spelling as well as scientific terminology.

Copies of <u>All</u> Internet articles and other resources must be submitted with the paper. <u>No</u> resources with the paper will result in 0 for the paper.

Grading Scale: Grades will be determined from the total points obtained divided by the total possible points, and expressed on a percentage scale.

A = 90-100% B = 80 – 89% C= 70 - 79% D = 60-69% F= <60%

V. Required Textbooks, Supplemental Books and Readings

A. Textbook:

MOLECULAR BIOLOGY by Robert F. Weaver, 1999, WCB/McGraw-Hill.
ISBN # 0-697-14750-9.

B. Non-Textbook Readings (Required):

GENES VII by Benjamin Lewin 2000, Oxford University Press.
ISBN # 0-19-879276-X

C. Supplemental Readings (Optional):

Biotechnology: Proteins to PCR by David W. Burden and Donald B. Whitney 1995, Birkhauser, Boston.
ISBN # 3-7643-3843-1

RNA Methodologies by Robert E. Farrell, Jr. 1998, Academic Press, New York.
ISBN # 0-12-249695-7

VI. Special Resource Requirements

There are no specific resource requirements for the course other than textbook and non-textbook readings. Students are however, required to use Computers in the Instructional Technology Room in Weyandt Hall or the library for articles related to the course. There is no laboratory fee associated with the course.

VII. Bibliography

Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, D.J. 1994. Molecular Biology of the Cell. Garland Publishing, Inc. USA.

August, J.T., Anders, M.W., Murad, F., and Coyle, T. J., 1997. Gene Therapy Vol. 40 of Advances in Pharmacology. Academic Press, New York.

Brown, T.A. 1990. Gene cloning. Chapman and Hall, London

Browne, M., and Thurlby, P. 1996. Genomes, Molecular Biology, and Drug Discovery. Academic Press, New York.

Calladine C., and Drew, H. 1997. Understanding DNA. Academic Press, New York.

Chrispeels, M.J., and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett, Boston, London.

Glick, B.R., and Pasternak, J.J. 1994. Molecular Biotechnology. Principles of Recombinant DNA. ASM Press, Washington, DC.

Hans-Walter Heldt 1997. Plant Biochemistry and Molecular Biology. Oxford University Press, New York.

Hawley, S.R., and Mori, A.C. 1998. The Human Genome. Academic Press, New York.

Hehl, R. 1994 . Transposon tagging in Heterologous Host Plants. Trends in Genetics, 10: 385-386.

Howell, H.S. 1998. Molecular Genetics of Plant Development. Cambridge University Press.

Innis, A. M., Gelfand, H. D., Sninsky, J.J., and White, J. T. 1990. PCR Protocols: A guide to Methods and Applications. Academic Press, New York.

Jefferson, R.A. 1987. Assaying chimeric genes in plants: the GUS gene fusion system. Plant Molecular Biology Reporter 5: 387-405

Karp, G. 1999. Cell and Molecular Biology Concepts and Experiments. John Wiley and Sons, Inc.

Kenyon, C. 1994. If birds can fly, why can't we? Homeotic genes and evolution. Cell 78: 175-180.

Kier, B., L and Hall H. L., 1999. Molecular Structure Description. Academic Press, New York.

Kriegler, M. 1990. Gene Transfer and Expression. W.H. Freeman and Company, New York.

Laux,T. and Jurgens, G. 1997. Embryogenesis: A New start into life. Plant Cell 9:989-1000.

Lodish, H., Berk, K., Zipursky, L.S., Matsudaria, P., Baltimore, D., and Darnell, J., 2000. Molecular and Cell Biology. W.H. Freeman and Company, USA.

Long, D. and Coupland,G. 1998. Transposon tagging with Ac/Ds in arabidopsis. Methods in Molecular Biology, Vol. 82: Arabidopsis Protocols, edited by J.M. Zapater and J. Salinas, Humana Press inc. Totowa, NJ.

Moffat, A.S. 1995. Exploring transgenic plants as a new vaccine source. Science, 268:658-660.

Nicholl, D.S.T. 1994. An Introduction into Genetic Engineering. Cambridge University Press, Cambridge.

Plant Cell and Environment 1994. Special issue on Transgenic Plants. Plant Cell and Environment, 17: 465-680.

Ream, W. and Field, G.K. 1999. Molecular Biology Techniques. Academic Press, New York.

Watson, D.J., Hopkins, H.N., Roberts, W.J., Steitz, A.J., and Weiner, M.A., 1987. Molecular Biology of the Gene Volumes I and II. The Benjamin/Cummings Publishing Company, Inc. USA.

Watson, D. J., Gilman, M., Witkowski, J., and Zoller, M. 1992. Recombinant DNA. W.H. Freeman, New York.

Willmitzer, L. 1993. Transgenic Plants. In Biotechnology, a multi-volume comprehensive treatise, edited by H.J. Rehm, G. Reed, A. Puhler, and P. Stadler, Vol. 2, pp 627-659. Verlag Chemie, Weinheim.

Wolfe, L.S. 1997. Introduction to Cell and Molecular Biology. Wadsworth Publishing Company, USA.

2. Course Analysis Questionnaire

Section A: Details of the Course

A1. The course is designed to be a 3-credit non-laboratory science course that students majoring in Biology can count as a controlled elective.

A2. This course does not require a change in any existing course or program.

A3. This course has never been offered at IUP.

A4. This course is not a dual-listed course.

A5. This course will not be offered for variable credit.

A6. Several Institutions offer similar courses, including those in the following list

(1) BI-457 (4 credits) Molecular Biology, Ball State University-a senior level course that emphasizes on the structure and function of macromolecules in living things.

(2) PCB4524 (3 credits) Molecular Biology, Florida International University. The course deals with advanced nucleic acid and plant biochemistry biosynthesis of macromolecules and molecular genetics.

(3) BIOL 446 (3 credits) Topics in Molecular Biology, College of William and Mary. The course deals with molecular mechanisms of gene regulation in eukaryotes.

(4) BI 470 (3 credits) Molecular Biology, Mansfield University of Pennsylvania. The course examines the principles and techniques underlying the chemical and physical aspects of living systems.

(5) MBI 365 (3 credits) Molecular Biology, Miami University of Ohio. The course deals with enzyme models, DNA replication, Protein Synthesis, membrane function and applications in Biotechnology.

A7. No accredited agency recommends or requires the skills or content of the proposed course.

Section B: Interdisciplinary Implications

B1. The proposed course will be offered by a single instructor

B2. IUP Biology and Chemistry Departments currently offer courses in Genetics (BIOL 263) and Biochemistry (CHEM 351), respectively. These courses represent only a small part of the content. The proposed course Topics in Molecular Biology does not significantly overlap these existing courses. It is an in-depth, advanced exploration of the methods in recombinant DNA technology, its applications, molecular mechanisms of gene regulation, based on readings from the current primary literature.

B3. Seats in this course will be made available for students in the School of Continuing Education.

Section C: Implementation

C1. Three complement hours per offering. Faculty resources are currently adequate.

C2. a. Space: One-average-size classroom per offering, to be used three times a week. Current resources are adequate.

b. Equipment: Standard audio-visual equipment such as an overhead projector and screen. Current resources are adequate.

c. Laboratory Supplies: None needed, since this is a lecture course.

d. Library Materials: Current holdings are adequate for term papers. If need be students will be expected to use inter-library loan, and faculty collections to make up any deficiency at IUP library.

e. Travel Funds: No travel funds are necessary.

C3. Not applicable. The course is not being funded by a grant.

C4. It is expected that the course will be offered initially every other year. Depending on future demand the course will be offered every year.

C5. It is anticipated that a single section of the course will be offered during any semester.

C6. The class size will determined by the number of students that could be conveniently accommodated in a standard classroom.

C7. No professional society recommends enrollment limits for a course of this nature.