San Bernardino Valley College
Curriculum Approved: May 9, 2005

I. COURSE DESCRIPTION

A. Division: Math & Science
Department: Biology
Course ID: BIOL 290
Course title: Biotechnology I
Units: 5 units
Lecture: 4 hours
Laboratory: 3 hours
Prerequisite: BIOL 201 or BIOL 102; and CHEM 101 or CHEM 150 or CHEM 150H

B. Catalog Description: This course will focus on basic principles of cellular and molecular biology and laboratory methods utilized in the biotechnology industry. Students will learn the foundations of lab safety and documentation, skills in the maintenance and calibration of basic lab equipment, calculation and preparation of laboratory solutions and principles of separation of cellular components and macromolecules.

C. Schedule Description: This course will focus on basic principles of cellular and molecular biology as it relates to biotechnology and laboratory methods utilized in the biotechnology industry.

II. NUMBER OF TIMES A COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES:

Upon successful completion of the course, the student should be able to:

A. Implement the scientific method to answer specific questions.
B. Demonstrate the flow of information in cells, gene expression from DNA to protein.
C. Compare and contrast prokaryotic and eukaryotic cell structure and composition.
D. Properly use, calibrate and maintain a variety of laboratory equipment to include pH meters, spectrophotometer, documentation systems, micropipettes, centrifuges, and electrophoresis equipment.
E. Calculate and prepare solutions in various concentrations (molarity, normality, percentage).
F. Handle, store and dispose of commonly used chemicals and biohazardous materials to include MSDS documentation.
G. Maintain bacterial cultures utilizing sterile technique.
H. Maintain a lab notebook documenting lab protocols, data collection and standard operating procedures.
I. List the parameters of the different levels of biosafety and apply practices of general laboratory safety.
J. Construct a standard growth curve for bacteria and standard plate counts for enumeration utilizing spectrophotometry.
K. Identify the parameters used in vertical and horizontal electrophoresis methodology and apply to a given problem.
L. Identify solution parameters and their application to a given problem.
M. Perform DNA extractions, DNA amplification and gel documentation.
N. Illustrate a DNA molecule
O. Explain the differences and uses of plasmids, phage, and transposans.
P. Explain the methods of recombination in bacteria.

IV. CONTENT:

A. Lecture:
1. History of the biotechnology industry
   a) The beginning
   b) The future

i. careers in biotechnology
ii. science, technology and society
iii. application – medicine, agriculture, diagnostics, forensics

2. Cell Biology
   a) Morphological and molecular comparisons of prokaryotic and eukaryotic cells
   b) DNA structure
   c) Gene expression - DNA to protein
      i. the genetic code, condons, anticodons
      ii. tRNA, mRNA, rRNA
3. Basic Eukaryotic genetics
   a) chromosomes
   b) mitochondria genes
   c) human genome project
4. Bacteriophage, Plasmids, Transposons
   a) phage genetics
   b) plasmids - types and use
   c) Transposable elements - discovery and use
5. Bacterial Genetics
   a) chromosome replication
   b) the operon and regulation
   c) recombination
      i. transformation
      ii. conjugation
      iii. transduction
6. Tools of the trade
   a) enzymes - restriction endonucleases, polymerases reverse transcriptase, ligase
   b) gene vectors
7. DNA extractions
   a) bacterial
   b) plant
   c) animal
8. Bioethics
   a) gene therapy
   b) genetic testing

B. Lab:
1. Lab Safety
   a) safety levels
   b) protective wear
   c) hoods
   d) MSDS
2. Nucleic Acid Chemistry: constructing a model helix
3. Protein chemistry - modeling
4. Documentation
   a) SOP
   b) notebooks
   c) chain of custody
   d) production facilities
5. Preparations of Solutions
   a) micropipettors
   b) proportional relationships
   c) buffers and their preparation
   d) pH meters
   e) dye preparation

6. Bacteriology
   a) microscopy
   b) media preparation
   c) growth and maintenance of phage & bacteria
   d) population counts
7. Spectrophotometry
   a) quantification - standard curve
   b) growth curve - doubling time determination
   c) molecular quantifications – DNA, protein
8. Bioseparations
   a) electrophoresis
   b) chromatography
9. DNA assays
   a) extractions
   b) amplification - PCR
   c) size determinations

V. METHODS OF INSTRUCTION:

A. Lecture format with and without various media support
B. Media support materials in the learning center
C. Open discussions
D. Problem solving groups
E. Written assignments and presentations
F. Field trips - application in action
G. Laboratory exercises on application of procedure and protocol
H. development

VI. TYPICAL OUT-OF-CLASS ASSIGNMENTS:

A. Reading Assignment:
   1. Read and prepare to discuss the various applications of "DNA scissors"
B. Writing Assignments:
   1. Compare and write a report on horizontal vs. vertical gel electrophoresis procedures.
   2. Maintain a laboratory journal
   3. Research and write a report on the laboratory safety guidelines for the proper disposal of gels stained with ethydium bromide. Include the MSDS information and a history of procedures. Prepare to discuss the pros and cons of each procedure.
C. Critical Thinking Assignments:
   1. Paper PCR - assimilation of the wet lab procedure using paper models of DNA sequences and enzyme models
   2. View and self test on the CD-ROM "DNA: the master molecule" in the learning center.
   3. Select either a pro or con stand on the use of genetically engineered crops to feed the growing population of the earth. Research your stand and prepare to debate with a group taking the opposite stand.

VII. METHODS OF EVALUATION:

A. Methods of evaluation
   1. Objective and subjective examinations on lecture material and laboratory materials presented in class. Examples:
      a) What is the relationship between the base sequence of the coding strand and the base sequence of mRNA?

b) All the following are possible applications of DNA fingerprinting except
   i. identifying human remains
   ii. replacing defective genes with normal copies
   iii. linking crime scene specimens to suspects
   iv. paternity testing
   v. identifying pathogens

2. Laboratory practical exams. Example tasks:
   a) prepare a 0.5M TBE buffer
   b) interpret the size of DNA band on this gel
   c) calibrate a spectrophotometer
3. Written lab reports and periodic checks on laboratory journals.
4. Discussion participation and classroom presentations. Clarity of presentations and supporting evidence of view will be evaluated.

B. Frequency of evaluation
   1. Lecture examination every 3 to 4 weeks.
   2. Laboratory practical and written exams 2 to 3 times each semester.

VIII. TYPICAL TEXT(S):

A. Kreuzer, Helen and Adrianne Massey, Recombinant DNA and Biotechnology; a guide for students, Second Edition, Washington, DC, ASM Press, 2001
B. Scheppler, Judith A., Patricia E. Cassin, and Rosa M. Gambier, Biotechnology Explorations, Applying the fundamentals, Washington, DC, ASM Press, 2000
C. Seidman, Lisa A., and Cynthia J. Moore, Basic Laboratory Methods for Biotechnology; Textbook and laboratory reference, New Jersey, Prentice Hall, 2000
D. Thieman, William J. and Michael A. Palladino, Introduction to Biotechnology, San Francisco, Pearson/Benjamin Cummings, 2004

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

A. Lab coat
B. Protective eye wear
C. Box of disposable gloves
D. NCR numbered page lab journal
E. Colored pencils and a black Sharpee