Bakersfield College

Course Number & Title:	Biol 31 Applied Biotechnology
Units & Course Hours:	5 units, 162 hours
Weekly Hours:	3 lecture, 6 laboratory
Number of Weeks:	18
Repeatability:	0
Credit/Applicability:	Baccalaureate Degree Applicable AA/AS Degree Applicable Certificate Applicable
Disciplines:	Biological Sciences, Agriculture, Chemistry
TOPS No.:	0430.00
Comments:	This course is part of an approved program Biotechnology & Biomedical Technology

Course Description

An intermediate course in biotechnology; topics include aseptic technique, media production, bacterial culture, nucleic acid isolation and manipulation, DNA cloning, and tissue culturing. Laboratory activities involve GLPs and safety, quality control, use of molecular biology techniques and equipment. Field trips will be required. Prerequisites: Biol 30 **and** Chem 11, Chem 16 or Chem 8/9. Hours: (162) 3 lecture/6 lab. Offered: F. CCS: Occupational Education. Transferable: CSU and private colleges.

Text & Supplemental Education Materials

Biotechnology and Recombinant DNA by Kreuzer, 1996, or any comparable biotechnology text and lab manual. *Note:* It is essential that the text be current as this field is rapidly advancing. It is equally important that the text be introductory due to the nature of this course as an undergraduate level course.

Course Goals and Objectives

When the student has successfully completed this course he/she will be able to:

1. Assess personal compliance with safety regulations, GLPs and federal regulations relating to biotechnology.
   - **Objective A:** Read and follow OSHA and FDA regulations.
   - **Objective B:** Follow and assess personal compliance under work simulated situations.
   - **Objective C:** Appropriately use, store and dispose of wastes and biohazards.
2. Appropriately use, calibrate, maintain and troubleshoot biotech lab equipment.
   - **Objective A:** Successfully use centrifuges, incubators, automatic pipettors, spectrophotometers, electrophoretic equipment.
   - **Objective B:** Observe and describe the method of action of HPLC, cell counters, and other selected biotechnical equipment at field trip sites.
3. Complete a lab experiment according to a Standard Operating Procedure (SOP), collect, interpret and present data.
   - **Objective A:** Maintain a lab notebook documenting lab procedures, problem solving episodes, data collection, graphing analysis and future recommendations.

4. Culture and maintain bacteria using aseptic technique.
   Objective A: Isolate and grow prokaryotic organisms.
   Objective B: Perform CFU counts.
   Objective C: Prepare, choose and use correct culture media.
5. Prepare biological solutions to precise concentrations and analyze them.
6. Review DNA mechanics and gene expression
7. Perform nucleic acid manipulations.
   Objective A: Extract and purify nucleic acid from various sources.
   Objective B: Using restriction enzymes make appropriate DNA preparations.
   Objective C: Transform cells and verify transformation.
   Objective D: Discuss and perform, if available, probe testing for identification.
   Objective E: Observe and describe PCR.
8. Perform tissue culture using sterile technique.
   Objective A: Prepare tissue culture media, feed and maintain eukaryotic cultures.
9. Perform protein separation and analysis.
   Objective A: Perform chromatography and spectrophotometry.
   Objective B: Discuss protein shape and function.
   Objective C: Perform electrophoresis for protein identification.
10. Perform and interpret immunological methods of testing.
    Objective A: Perform various antibody mediated lab tests (HCG, LH) using monoclonal technology.
    Objective B: Perform ELISA lab tests and discuss the theory behind identification.
    Objective C: Observe and evaluate FTA-ABS identification tests.

Course Content

• Biotechnology Methods	3 weeks
• Laboratory Practices and Safety	1 week
• DNA Structure and Function	2 weeks
• DNA Manipulation and Analysis	3 weeks
• Introduction to Gel Electrophoresis	1 week
• Bacterial Cell Culture and Quantitation	1 week
• Bacterial Transformation	2 weeks
• Tissue Culturing	2 weeks
• Protein Analysis and Identification	1 week
• Immunological Tests and Procedures	2 weeks

Attachments

1. Critical thinking example.
2. Reading example.
3. Instructor evaluation of necessary elements of biotechnology (BIOL 30) as prerequisites.
4. Transfer equivalents for lower division courses:
   - Pepperdine — Biol 211—Biology of Cells
   - UCLA — Biol 70—Genetic Engineering and Society
   - UCSD — BILD 20—Human Genetics in Modern Society
   - Cal Tech — Biol 10—Cell Biology

Biol 30 Applied Biotechnology
Critical Thinking Example

1. Previously vaccines were developed from attenuated or killed organisms. (1^{st} generation). With the advent of Biotechnology, 3^{rd} generation vaccines are produced through bioengineering. Compare and contrast these two types of vaccines. Include an analysis of cost, availability, safety and liability.

2. A gene is found that produces a hormone which induces white blood cell production. Evaluate the feasibility of this biotech product. Describe the industrial process that would be required. Determine whether this product is one that warrants development.

Discovering Genes for New Medicines

by William A. Haseltine

Scientific American, March 1997

By identifying human genes involved in disease, researchers can create potentially therapeutic proteins and speed the development of powerful drugs.

Most readers of this magazine are probably familiar with the idea of a gene as something that transmits inherited traits from one generation to the next. Less well appreciated is that malfunctioning genes are deeply involved in most diseases, not only inherited ones. Cancer, atherosclerosis, osteoporosis, arthritis and Alzheimer's disease, for example, are all characterized by specific changes in the activities of genes. Even infectious disease usually provokes the activation of identifiable genes in a patient's immune system. Moreover, accumulated damage to genes from a lifetime of exposure to ionizing radiation and injurious chemical probably underlies some of the changes associated with aging.

A few years ago I and some like-minded colleagues decided that knowing where and when different genes are switched on in the human body would lead to far-reaching advances in our ability to predict, prevent, treat and cure disease. When a gene is active, or as a geneticist would say, "expressed," the sequence of the chemical units, or bases, in its DNA is used as a blueprint to produce a specific protein. Proteins direct, in various ways, all of a cell's functions. They serve as structural components, as catalysts that carry out the multiple chemical processes of life and as control elements that regulate cell reproduction, cell specialization and physiological activity at all levels. The development of a human from a fertilized egg to mature adult is, in fact, the consequence of a …

Content Review Worksheet

Department: Life Science Date: 5/11/97
Target Course: BIOL 31 Applied Biotechnology
Prerequisite: Organic Chemistry--CHEM 11, CHEM 16 or CHEM 8/9

The student should possess the following skills or knowledge:

1. An understanding of the importance of carbon's ability to form strong bonds with itself and other commonly found elements, thus forming the backbone for the large, chemically complex molecules required for the existence of life.
2. An understanding of basic valence bond theory, its application to the bonding of atoms to one another, and the consequences that such bonding confers on local and overall molecular structure and reactivity.
3. An understanding of oxidation/reduction processes as well as some primary types of reactions (hydrolyses, dehydrations, condensations, etc.) found in organic substances.
4. An understanding of the structure of functional groups, the reactivity/characteristics they confer upon a molecule, and their role in the chemical manipulation of organic substances.
5. An understanding of the type of inter- and intramolecular interactions which exist in organic substances, their dependence on external factors (e.g., pH and ionic strength), and the consequences all of these have on various physical and chemical characteristics of biochemicals (e.g., protein and DNA structure, and enzymes functioning as chemical catalysts).
6. Knowledge of the major classes of biochemicals (lipids, carbohydrates, proteins, nucleic acids) and descriptive examples of each (SARs).

Ratings of Relevance

Rating scale: 5=critically relevant; 4=very relevant; 3=moderately relevant; 2= slightly relevant; 1=not relevant.

Skill	Rater #1	Rater #2	Rater #3	Rater #4	Rater #5	Total	Mean
1	5	5	5	5	5	25	5.00
2	5	5	5	5	5	25	5.00
3	5	5	5	5	5	25	5.00
4	5	5	5	5	5	26	5.00
5	5	5	5	5	5	25	5.00
6	5	5	5	5	5	25	5.00

Number of items with a mean rating of 3 or greater is 6. Percentage of items with a mean rating of 3 or greater is 100%.

Department Recommendation: X Prerequisite

Completed by: Janet Fulks, Janice Toyoshima, Kenward Vaughan, Wendell Wall, Tom Yale

Content Review Worksheet

Department: Life Science Date: 5/11/97
Target Course: BIOL 31—Applied Biotechnology
Prerequisite: BIOL 30—Introductory Biotechnology and Cell Physiology

LIST OF SKILLS OR KNOWLEDGE NEEDED

1. Knowledge of basic biotechnical terminology.
2. Knowledge of application of the metric system to volume, mass and linear measurements and prepare solutions of various concentrations.
3. Knowledge of the proper use of Eppendorf pipettes, volumetric flasks, graduated cylinders, beakers, metric scales, etc.
4. Knowledge of the preparation of solutions of varying concentrations and dilutions.
5. Knowledge of lab safety procedures, GLPs (Good Lab Practices), waste treatment and biohazard considerations.
6. Knowledge of a typical MSDS and waste streams in the lab.
7. Knowledge of scientific documentation of lab experiments.
8. Knowledge of the structure and function of biologically active molecules: proteins, nucleic acids, carbohydrates, lipids.
9. Knowledge of methods of separation and isolation of proteins and nucleic acids.
10. Knowledge of chemical assays.
11. Knowledge of modern concepts of cell structure and function (plant and animal cells).
12. Knowledge of the cell membrane.
13. Knowledge of aseptic technique.
14. Knowledge of use of an autoclave and incinerator as methods of controlling cell reproduction.
15. Knowledge of the historical perspectives of DNA and applications in genetic engineering.
16. Knowledge of bioengineering tools and their application.
17. Knowledge of gene expression, manipulation and DNA cloning.

Ratings of Relevance

Rating scale: 5=critically relevant; 4=very relevant; 3=moderately relevant; 2= slightly relevant; 1=not relevant.

Skill	Rater #1	Rater #2	Rater #3	Rater #4	Rater #5	Total	Mean
1	5	5	5	5	4	24	4.80
2	5	5	5	5	5	25	5.00
3	5	5	5	5	4	24	4.80
4	5	5	5	5	5	25	5.00
5	5	5	5	5	5	25	5.00
6	5	5	5	5	4	24	4.80
7	5	5	5	5	4	24	4.80
8	5	5	4	4	4	22	4.40
9	5	5	5	5	3	23	4.60
10	5	5	5	5	4	24	4.80
11	5	5	5	5	4	24	4.80
12	5	5	5	5	4	24	4.80
13	5	5	5	5	5	25	5.00
14	5	5	5	5	5	25	5.00
15	5	5	5	3	4	22	4.40
16	5	5	5	5	3	23	4.60
17	5	5	5	5	4	24	4.80

Number of items with a mean rating of 3 or greater is 17. Percentage of items with a mean rating of 3 or greater is 100%.

Department Recommendation: X Prerequisite

Completed by: Janet Fulks, Janice Toyoshima, Tom Yale, Wendall Wall, Kenward Vaughan

Transfer Equivalents for Lower Division Courses

Pepperdine University (1995-96 Academic Catalog)

Biol 211. Biology of cells (4)

A study of the basic processes which are common to all living organisms. The study of these principles, which emphasizes such cellular processes as transport mechanisms, metabolism, and the genetic control of cellular functions, is designed to be an introductory course for students who plan to major in biology. Three lectures and one three-hour laboratory per week. Prerequisite: CHEM 120 or consent of the instructor.

University of California, Los Angeles

Biol 70. Genetic Engineering and Society

Lecture, three hours; discussion, two hours. Designed for non-majors. Not open to students with credit for course 9 or 108. Basic principles of genetic engineering. Overview of genetic engineering techniques and relationship of genetic engineering to medicine, agriculture, and society. Emphasis on specific genetic engineering applications to generate discussion on its use in society.

Mr. Goldberg

University of California, San Diego

BILD 20. Human Genetics in Modern Society (4)

Fundamentals of human genetics and introduction to modern genetic technology such as gene cloning and DNA fingerprinting. Applications of these techniques, such as forensic genetics, genetic screening, and genetic engineering. Social impacts and ethical implications of these applications. Prerequisite: BILD 1, 10, or equivalent. (S)

Cal Tech

Bi 10. Cell Biology Laboratory. *6 units (1-3-2); third term.*

Prerequisite: Bi 8; designed to be taken concurrently with Bi 9. Introduction to basic methods in cell and molecular biological research, including polymerase chain reaction, molecular cloning, expression and purification of recombinant fusion proteins in bacteria, enzymology, and gel electrophoresis of proteins and nucleic acids. Instructor: Deshaies.

SCANS COMPETENCIES AND FOUNDATION SKILLS
ALL ASPECTS OF THE INDUSTRY

The SCANS five competencies and three-part foundation skills are incorporated into an integrated (vocational and academic), sequenced program that includes school and work-based learning. To what extent are these competencies being met in this course:

Directions: Circle the number that best describes the degree to which each component is taught. 1 = 0-25% 2 = 26-50% 3 = 51-75% 4 = 76-100%

SCANS Competencies

Competency 1		Resources: Identifies, Organizes, Plans and Allocates Resources
1 2 3 4		TIME—selects goal relevant activities, ranks them, allocates time, and prepares and follows schedules
1 2 3 4		MONEY—uses or prepares budgets, makes forecasts, keeps records, and makes objectives to meet objectives
1 2 3 4		MATERIAL AND FACILTIES—acquires, stores, allocates and uses materials or space efficiently
1 2 3 4		HUMAN RESOURCES—assesses skills and distributes work accordingly, evaluates performance and provides feedback
Competency 2		Interpersonal: Works with Others
1 2 3 4		PARTICIPATES AS A MEMBER OF A TEAM—contributes to group efforts
1 2 3 4		TEACHES OTHERS NEW SKILLS
1 2 3 4		SERVES CLIENTS/CUSTOMERS—works to satisfy customers' expectations.
1 2 3 4		EXERCISE LEADERSHIP—communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies
1 2 3 4		NEGOTIATES—works towards agreements involving exchange of resources, resolves divergent interests
1 2 3 4		WORKS WITH DIVERSITY—works well with men and women from diverse backgrounds
Competency 3		Information: Acquires And Uses Information
1 2 3 4		ACQUIRES AND EVALUATES INFORMATION
1 2 3 4		ORGANIZES AND MAINTAINS INFORMATION
1 2 3 4		INTERPRETS AND COMMUNICATES INFORMATION

Competency 4 Systems: Understands Complex Inter-Relationships

1 2 3 4 UNDERSTANDS SYSTEMS—knows how social, organizational, and technological systems work and operates efficiently with them

1 2 3 4 MONITORS AND CORRECTS PERFORMANCE—distinguishes trends, predicts impacts on system operations, diagnoses deviations in systems performance and corrects malfunctions

1 2 3 4 IMPROVES OR DESIGNS SYSTEMS—suggests modifications to existing systems and develops new or alternative systems to improve performance

Competency 5 Technologies: Works With A Variety of Technologies

1 2 3 4 SELECTS TECHNOLOGY—chooses procedures, tools or equipment including computers and related technology

1 2 3 4 MAINTAINS AND TROUBLESHOOTS EQUIPMENT—prevents, identifies, or solves problems with equipment, including computers and other technologies

Foundation Skills

Skill 1 Basic Skills: Reads, Writes, Performs Arithmetic and Mathematical Operations, Listens and Speaks

1 2 3 4 READING—locates, understands and interprets written information in prose and in documents such as manuals, graphs and schedules

1 2 3 4 WRITING—communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs and flow charts

1 2 3 4 ARITHMETIC/MATHEMATICS—performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques

1 2 3 4 LISTENING—receives, attends to, interprets, and responds to verbal messages and other cues

1 2 3 4 SPEAKING—organizes ideas and communicates orally

Skill 2 Thinking Skills: Thinks Creatively, Makes Decisions, Solves Problems, Visualizes, Knows How to Learn And Reason

1 2 3 4 CREATIVE THINKING—generates new ideas

1 2 3 4 DECISION MAKING—specifies goals and constraints, generates alternatives, considers risks, evaluates and chooses best alternative

1 2 3 4 PROBLEM SOLVING—recognizes problems and devises and implements plan of action

1 2 3 4 SEEING THINGS IN THE MIND'S EYE—organizes and processes symbols, pictures, graphs, objects and other information

1 2 3 4 KNOWING HOW TO LEARN—uses efficient learning techniques to acquire and apply new knowledge and skills

1 2 3 4 REASONING—discovers a rule or principle underlying the relationship between two or more objects and applies it in solving a problem

Skill 3 Personal Qualities: Displays Responsibility, Self-Esteem, Sociability, Self Management, and Integrity and Honesty

1 2 3 4 RESPONSIBILITY—exerts a high level of effort and perseveres toward goal attainment

1 2 3 4 SELF ESTEEM—believes in own self-worth and maintains a positive view of self

1 2 3 4 SOCIABILITY—assesses self accurately, sets personal goals, monitors progress and exhibits self control

1 2 3 4 INTEGRITY/HONESTY—chooses ethical courses of action

Knowledge of "All Aspects of the Industry"

Means strong experience in, and understanding of, all aspects of the industry the students are preparing to enter.

1 2 3 4 Employers and school personnel jointly design learning outcomes and participate in curriculum development and approval

The instructional program (vocational and academic, school and work-based) include strong experience in, and knowledge, of the following aspects of the industry on which the instructional program is based:

1 2 3 4 Planning

1 2 3 4 Management

1 2 3 4 Finances

1 2 3 4 Technical and Production Skills

1 2 3 4 Underlying Principles of Technology

1 2 3 4 Health and Safety

1 2 3 4 Staff development efforts enhance necessary skills and appropriate attitudes for faculty, counselors, administrators, workplace instructors and supervisors

1 2 3 4 Work-based activity explicitly reinforces academic and technical lessons

1 2 3 4 Students are engaged in real, productive work

1 2 3 4 Other _____

1 2 3 4 Other _____

1 2 3 4 Other _____