San Bernardino Valley College
Curriculum Approved: November 8, 2004

I. Course Description:

A. Division: Science
Department: Biology
Course ID: BIOL 201
Course Title: Cell and Molecular Biology
Units: 4
Lecture: 3 hours
Laboratory: 3 hours
Prerequisite/Corequisite: CHEM 150 or 150**H**.

B. Catalog Description:

An introduction to cellular and molecular aspects of biology emphasizing principles of prokaryotic and eukaryotic cell structure and function, classic and modern genetics, and concepts that integrate cellular with organismal activities. Experimental design concepts and application are emphasized in the laboratory. First semester of a two-semester sequence in introductory biology for the pre-professional, biology major, or others interested in an in-depth study of biology.

Schedule Course Description:

First semester, of a two-semester sequence of introductory biology An introduction to cellular and molecular aspects of biology emphasizing principles of prokaryotic and eukaryotic cell structure and function, classic and modern genetics, and concepts that integrate cellular with organismal activities. Primarily for biology and pre-professional majors.

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

III. EXPECTED OUTCOMES FOR STUDENTS:

Upon successful completion of this course, students should be able to:

A. Compare and contrast various structural characteristics of the cell (e.g. molecular makeup, membrane structure, and organelles) and relate these attributes to functional differences in the cell.
B. Identify the major anabolic and catabolic chemical pathways in cells, and relate these events to overall cell function.
C. Describe and discuss simple patterns of genetic inheritance and apply these concepts to current evolutionary theory.
D. Compare and contrast the patterns and purposes of mitosis and meiosis.
E. Predict consequences of DNA mutations on protein synthesis and gene regulation.
F. Observe biological phenomena and generate scientific hypotheses that could explain the observations.
G. Design and execute an experiment to test a hypothesis.
H. Apply simple statistical analysis to test a hypothesis.
I. Write a scientific paper in which the results of an experiment is reported and interpreted, including supporting data in the form of graphs.

VI. CONTENT

A. Science Philosophy
   1. science versus non-scientific forms of inquiry
   2. hypothetico - deductive reasoning
   3. uncertainty in science

B. Molecular Structure
   1. atomic structure
   2. chemical bond diversity
   3. nature of chemical reactions

C. Physical Properties of Water and Biological Implications
   1. specific heat
   2. freezing point
   3. heat of vaporization

D. Organic Chemistry
   1. carbon compounds
   2. functional groups

E. Biomolecules
   1. biomolecular structure and its relationship to function
   2. structure and function of lipids, carbohydrates, proteins, nucleic acids

F. Cell Structure and Function
   1. major structural and functional aspects of organelles
   2. interaction of cellular organelles

G. Cell Membrane Structure and Function
   1. fundamental structure in cell membranes
   2. functional aspects of cell membranes
   3. diversity of cell membrane structure within organisms

H. Mitosis
   1. stages of mitosis
   2. applications of the mitotic process in organisms

I. Cellular Metabolism Overview
   1. general nature of cellular metabolism
   2. enzyme structure and function
   3. relationship of anabolic and catabolic chemical reactions

J. Anaerobic and Aerobic Cellular Respiration
   1. redox reactions
   2. roles of cytoplasmic and mitochondrial reactions
   3. anaerobic fermentation
   4. aerobic catabolism
   5. chemiosmosis
   6. comparison of anaerobic and aerobic processes

K. Photosynthesis
   1. overview of photosynthesis
   2. nature of light
   3. light dependent reactions of photosynthesis
   4. light independent reactions of photosynthesis
   5. interactions of photosynthetic reactions

L. Meiosis & Sexual Reproduction
   1. methods of genetic recombination and the production of genetic variation
   2. meiotic process
   3. meiosis and sexual reproduction

M. Mendalian Genetics
   1. monohybrid crosses
   2. dihybrid crosses
   3. laws of independent assortment
   4. dominance patterns

5. additional influences (e.g. pleiotropy, epistasis)

N. DNA & Protein Synthesis
1. major transcriptional events
2. events of translation
3. protein synthesis and its relationship to cellular function

O. Gene Regulation
1. gene regulation and cellular function
2. prokaryotic regulation
3. eukaryotic regulation
4. gene regulation and organismal development

P. Morphogenesis
1. interaction of genes and morphology
2. homeotic genes and their effects on body and limb development

Lab

Q. Introduction to library research and primary scientific journals
R. Making objective observations and constructing quantifiable data
S. Measuring, summarizing, and interpreting morphological characteristics by the use of frequency histograms
T. Characterizing and interpreting population parameters using measures of central tendencies and dispersion
U. Designing, conducting, and interpreting the experimental effect of independent variables on enzyme activity

V. METHODS OF INSTRUCTION:

A. Lecture supported by audio-visual aids and demonstration materials
B. Directed discussions
C. Textbook and scientific journal readings
D. Library research
E. Formulating a question and methodology for an original scientific paper
F. Student individual and/or small group presentations
G. Laboratory experiments
H. Data analysis

VI. TYPICAL ASSIGNMENTS:

A. Reading: Using the textbook or an article from the primary scientific literature, construct a study that would evaluate the conclusions made from the reading.
B. Lab: From observational data collected from a series, construct and interpret the frequency histogram generated from the data.

VII. EVALUATION:

A. Methods of Evaluation
1. Short answer and essay exams
a. Example: How might the structure of mitochondria and chloroplasts be modified to maximize the amount of ATP made by each. Explain.
b. Example: After exposing a plant to the herbicide DCMU, you notice a dramatic drop in oxygen production followed by plant death. Explain, in detail, what is killing the plant.
c. Example: Competition and cooperation are both common in science. What roles did these two social behaviors play in Watson and Crick's discovery of the double helix? How might competition between scientists accelerate progress in a scientific field? How might it slow progress?
d. Example: When compared to the diversity of functions seen in the other biomolecular groups, carbohydrates are a functionally

humble group. Why is this the case? What attributes do the more functionally diverse groups have that carbohydrates lack?

2. Lab write-ups
   a. Example: Write a report on the results of an enzyme activity study (e.g. catalase). The report will include:
      1) predictions of the effect of temperature on enzyme activity,
      2) a description of the experimental methods used in the study,
      3) statistical analysis (ANOVA) comparing enzyme activity at different temperatures, and
      4) a comparison of predicted versus observed results with critical analysis of any discrepancies between them.
   b. Example: Write a report describing the results of a statistical (t-test) comparison of the mean lung capacities of male and female participants in the experiment. Critically examine the methods that produced these results for possible sources of error and/or uncontrolled variables.
3. Scientific paper (semester project)
   The student will formulate a question and a methodology for an original scientific paper.

B. Frequency of Evaluation:
There will be six exams given during the semester.

VIII: TYPICAL TEXTS:

A. Campbell, N. A., J. B. Reese. 2005. Biology. (7th ed.) Benjamin Cummings.
B. Purves, B., et. al. 2004. Life: the science of biology. (7th ed.) Sinauer and Freeman.
C. Ambrose, H. W., et. al. 2002. A handbook of biological investigation. (6th ed.) Hunter Textbooks.
D. Raven, P. H. et. al. 2005. Biology. (7th ed.) McGraw Hill.

IX. OTHER SUPPLIES REQUIRED OF STUDENTS: None