

**STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK**

COURSE OUTLINE

BIOL 150 - COLLEGE BIOLOGY I

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**SCHOOL OF SCIENCE, HEALTH, AND CRIMINAL JUSTICE
SCIENCE DEPARTMENT
APRIL 2015**

BIOL 150 - COLLEGE BIOLOGY I

- A. **TITLE:** College Biology I
- B. **COURSE NUMBER:** BIOL 150
- C. **CREDIT HOURS:** 4
- D. **WRITING INTENSIVE COURSE:** No
- E. **COURSE LENGTH:** 15 weeks
- F. **SEMESTER OFFERED:** Fall
- G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
3 hours lecture, 3 hours lab per week
- H. **CATALOG DESCRIPTION:** This course is an introduction to the fundamental biological concepts common to plants, animals, and microorganisms. Topics include the chemical and molecular basis of life, metabolism, cell biology, cellular reproduction, Mendelian and molecular genetics, gene regulation, DNA technology, and evolution. The laboratory includes the study of cells, osmosis, enzymes, cellular respiration, genetics, molecular techniques, and the dissection of a representative mammal.
- I. **PRE-REQUISITES:** New York State Regents Biology examination grade of 75+ or Introduction to Biology (BIOL 101); and HS chemistry or Intro to Chemistry (CHEM 101/100) or Investigative Chemistry (CHEM 107/108); or permission of instructor.
- J. **GOALS (STUDENT LEARNING OUTCOMES):** By the end of this course, the student will:

<i>Course Objective</i>	<i>Institutional SLO</i>
1. Describe the unifying themes that pervade biology, the chemical bonds important to life, how water contributes to the fitness of Earth for life, and the structure and function of life's major macromolecules.	3. Prof. Competence
2. Explain how cell membranes control passage of substances in and out of cells, and how living organisms transform energy and harvest the chemical energy stored in organic molecules.	2. Critical Thinking 3. Prof. Competence
3. Describe the cell cycle, how sexual reproduction	2. Critical Thinking

passes chromosomes from parents to offspring, the principles of Mendelian genetics and the chromosomal basis for the transmission of genes from parents to offspring. .	3. Prof. Competence
4. Describe the structure of DNA, how cells replicate and repair DNA, the flow of information from DNA to protein, the structure of eukaryotic chromosomes, the general mechanisms by which gene expression is regulated, and the major techniques and applications of DNA technologies.	3. Prof. Competence
5. Describe the evidence for evolution, the mechanism of natural selection, and how natural selection and other mechanisms cause populations to evolve.	3. Prof. Competence
6. Apply the scientific method in the conduct of laboratory exercises; develop proficiency with laboratory equipment, techniques, and methodology; apply biological data and draw meaningful conclusions (lab). Produce effective written laboratory assignments and reports.	1. Communication 2. Crit. Thinking 3. Prof. Competence

K. **TEXTS:** Urry et al., *Biology in Focus*, 1st edition, Benjamin/Cummings, 2013.
Erickson et. al., *Laboratory Exercises*.

L. **REFERENCES:** Internet sites too numerous to cite.

M. **EQUIPMENT:** Appropriate laboratory materials.

N. **GRADING METHOD:** A - F

O. **MEASUREMENT CRITERIA/METHODS:**

- Exams
- Quizzes
- Laboratory assignments/reports
- Laboratory practicum
- Laboratory quizzes.

P. **DETAILED COURSE OUTLINE:**

BIOL 150 College Biology I

- I. Themes in the study of life / characteristics of life.
 - a. Hierarchy and organization.
 - b. Emergent properties
 - c. Properties of life
 - d. The Cell Theory
 - e. DNA-based inheritance
 - f. Organisms as thermodynamically open systems.
 - g. Diversity and unity of life.
 - h. Evolution as the unifying theme of biology.

- II. The Scientific method.
 - a. Definition of science.
 - b. Inductive reasoning.
 - c. Deductive reasoning.
 - d. Hypotheses.
 - e. Theories.

- III. Chemistry of life.
 - a. Definitions: element, molecule, compound.
 - b. Major elements of living organisms.
 - c. Atomic structure.
 - d. Isotopes and their biological applications.
 - e. Electron configuration.
 - f. Electrons and chemical reactions.
 - g. Covalent bonds.
 - h. Electronegativity.
 - i. Polar and nonpolar bonds.
 - j. Ionic bonds.
 - k. Hydrogen bonds.
 - l. Chemical reactions.
 - m. Chemical equilibrium.

- IV. Water and the environment of life.
 - a. Polarity
 - b. Cohesive behavior.
 - c. Specific heat.
 - d. Heat of vaporization.
 - e. Density as a function of temperature.
 - f. Versatility as a solvent.
 - g. pH.
 - h. Buffers.

- V. Organic chemistry - carbon.
 - a. Characteristics of the carbon atom.

- b. Isomers.
- c. Functional groups.

VI. Structure & function of macromolecules.

- a. Polymers and monomers.
- b. Carbohydrates.
 - 1. Monosaccharides.
 - 2. Disaccharides.
 - 3. Polysaccharides.
- c. Lipids.
 - 1. Fats.
 - 2. Phospholipids.
- d. Proteins.
 - 1. Amino acid structure.
 - 2. Conformation.
 - 3. Levels of protein structure.
 - 4. Influence of environmental conditions on conformation.
- e. Nucleic acids.
 - 1. DNA
 - 2. RNA
 - 3. Energy transfer molecules - ATP, NAD⁺.

VII. Metabolism.

- a. Metabolic pathways - anabolic and catabolic.
- b. Kinetic energy & potential energy.
- c. Thermodynamics - 1st and 2nd Laws.
- d. Free energy.
- e. Spontaneous & nonspontaneous reactions.
- f. Equilibrium
- g. Exergonic & endergonic reactions.
- h. Energy coupling.
- i. ATP and how it performs cellular work.
- j. Enzymes as biological catalysts.
 - 1. Activation energy.
 - 2. Substrate specificity.
 - 3. Active sites
 - 4. Kinetics
 - 5. Influence of the environment on activity
- k. Feedback inhibition.

VIII. Cellular structure and function.

- a. The cell as the unit of biological structure and function.
- b. The concept of self-assembly.
- c. Microscopes.

- d. Cell types: prokaryotic & eukaryotic.
- e. Cell sizes.
- f. Compartmental organization.
- g. Cell structures:
 - 1. Nucleus.
 - 2. Ribosomes.
 - 3. Endomembrane system: endoplasmic reticulum, Golgi, lysosomes, vacuoles, peroxisomes.
 - 4. Mitochondria & chloroplasts.
 - 5. Cytoskeleton.
 - 6. Cell walls.
- h. Extracellular matrix.
- i. Intercellular junctions.

IX. Membrane structure & function.

- a. Membrane structure: the Fluid Mosaic model.
- b. The fluid quality of membranes.
- c. Cholesterol as a membrane component.
- d. Integral & peripheral proteins.
- e. Membrane carbohydrates.
- f. Membrane permeability characteristics.
- g. Diffusion.
- h. Passive transport.
- i. Osmosis
- j. Facilitated diffusion.
- k. Active transport.
- l. Ion pumps and electrochemical gradients.
- m. Cotransport.
- n. Exocytosis & endocytosis.

X. Cellular respiration.

- a. How cells harvest chemical energy.
- b. Overview of cellular respiration.
- c. Oxidation-reduction reactions.
- d. NADH.
- e. Electron transport chains.
- f. Oxidative & substrate-level phosphorylation.
- g. Glycolysis.
- h. The citric acid cycle.
- i. ATP synthase and chemiosmosis.
- j. The proton-motive force.
- k. ATP generated by cellular respiration.
- l. Efficiency of cellular respiration.
- m. Fermentation.

- n. Connection of glycolysis and the Krebs's cycle to other metabolic pathways.
- o. Feedback mechanisms controlling cellular respiration.

XI. Cell reproduction.

- a. Function of cell division.
- b. Binary fission in prokaryotes.
- c. Diploid & haploid conditions.
- d. The cell cycle.
- e. Stages of mitosis.
- f. Factors that influence cell division.
- g. Mitotic regulatory proteins.
- h. Control of the cell cycle.
- i. Heredity and variation.
- j. Asexual vs. sexual reproduction.
- k. Sexual life styles.
- l. Function of meiosis.
- m. Stages of meiosis.
- n. Comparison of mitosis and meiosis.
- o. How sexual reproduction produces genetic variation: independent assortment, crossing-over, random fertilization.
- p. Genetic variation as the raw material for natural selection.

XII. Mendelian genetics.

- a. Brief history.
- b. Definitions & vocabulary.
- c. Law of Segregation.
- d. Monohybrid crosses.
- e. Law of Independent Assortment.
- f. Probability: rule of multiplication, rule of addition.
- g. Multiple trait crosses.
- h. Dominance / recessiveness relationships.
- i. Incomplete dominance.
- j. Multiple alleles.
- k. Codominance.
- l. Pleiotropy.
- m. Epistasis.
- n. Polygenic inheritance.
- o. Environmental impact on phenotype.

XIII. Molecular genetics.

- a. The chromosomal basis of inheritance
 - 1. The chromosome theory of inheritance.
 - 2. Linked genes.

3. The chromosomal basis of sex.
 4. Sex-linked disorders in humans.
 5. X-inactivation.
 6. Alterations of chromosome number: aneuploidy & polyploidy.
 7. Alterations of chromosome structure.
 8. Extranuclear genes.
- b. The molecular basis of inheritance: DNA.
1. DNA structure.
 2. The “Central Dogma” of biology.
 3. Semiconservative replication.
 4. Origins of replication.
 5. Elongation of a new DNA strand.
 6. Priming DNA synthesis.
 7. Proofreading & repair.
 8. Telomeres.
- c. From gene to protein.
1. The genetic code.
 2. Transcription.
 3. RNA processing.
 4. Translation.
 5. Mutations.

XIV. Gene regulation.

- a. The operon concept.
- b. The tryptophan operon.
- c. The lac operon.
- d. Positive control - cAMP.

XV. Genome organization & expression.

- a. Prokaryotic genome vs. eukaryotic genome.
- b. Structural organization of eukaryotic DNA.
- c. Noncoding sequences & gene duplications.
- d. Transcriptional control.
- e. Posttranscriptional control.
- f. Regulation by hormones.

XVI. DNA technology.

- a. Restriction enzymes.
- b. Vectors.
- c. Recombinant DNA technology.
- d. Gel electrophoresis.
- e. DNA synthesis and sequencing.
- f. Polymerase chain reaction.
- g. RFLP analysis.

h. Medical, environmental & agricultural applications of DNA technology.

XVII. Evolution.

- a. Short history of evolutionary thought.
- b. Lamarck and the inheritance of acquired characteristics.
- c. Darwin and modification by descent.
- d. The occurrence of evolution.
- e. The logic of natural selection.
- f. Important aspects of natural selection.
- g. Evidence for evolution.
 1. Biogeography.
 2. The fossil record.
 3. Comparative anatomy.
 4. Comparative embryology.
 5. Molecular biology.
 6. Evidence from imperfection.

Q. LABORATORY OUTLINE:

- I. The Dichotomous Key - Tree Identification
- II. Scientific Investigation
- III. Microscopy
- IV. Cell Structure & Function
- V. Osmosis & Diffusion
- VI. Enzymes
- VII. Cellular Respiration
- VIII. DNA Isolation
- IX. Mendelian Genetics – FlyLab I
- X. Mendelian Genetics – FlyLab II
- XI. Fetal Pig 1
- XII. Fetal Pig 2

XIII. Fetal Pig 3

XIV. DNA Electrophoresis