



## BIOL 1610

**Division:** Natural Science and Mathematics

**Department:** Biology

**Course:** BIOL 1610

**Title:** Biology I

**Catalog Description:**

This course introduces the scientific method, cell chemistry, cell structure and function, gene action and genetics, natural selection and mechanisms of speciation, the origin of life, diversity of living organisms and classification, and surveys of viruses, bacteria, protists, and fungi, and the human immune system. This is the first semester course of a year-long sequence that is required for most biology majors, many pre-professional majors, natural resource majors and some agriculture majors.

**General Education Requirements:** Life Science

**Semesters Offered:** Fall

**Credit/Time Requirement:** Credit: 4; Lecture: 4; Lab: 0

**Clock/Hour Requirements:** 0

**Offered for Non-Credit:** No

**Prerequisites:** It is recommended that the student will have successfully completed high school biology and chemistry.

**Corequisites:** BIOL 1615

**Justification:**

The Biology I lecture course (BIOL 1610) and Biology I laboratory (BIOL 1615) have been designed as the first semester courses in a year-long exposure to biology as recommended by the State Biology Group. Biology II lecture (BIOL 1620) and Biology II laboratory (BIOL 1625) will constitute the second semester courses for the majors biology sequence. This year-long sequence of biology is required for most biology majors, many pre-professional majors, natural resource majors, and some agriculture majors.

**Student Learning Outcomes:**

Students will know the essential qualities and key processes commonly found in life forms.

Students will have begun to understand the diversity of living organisms and their myriad interrelationships in the biological world.

Students will know how to apply systematic methods to understand the complexities of an individual organism or to distinguish among diverse species.

Students will be able to use microscopes, computers, and other commonly available lab equipment and supplies.

Students will be able to read the literature of the biological sciences flexibly, analytically and imaginatively.

Students should be able to appreciate that they have been exposed to an unfortunately small number of the myriad beauties and marvels of the living world, extant or extinct.

Students will have some understanding of the role that biology plays in modern life as well as past history.

## **Content:**

### Scientific Method

- empirical observations, hypothesis formulation, testing by
- experimentation, theory and law
- limitations of science
- emergent properties

### Simple Chemistry

- basic chemistry
  - atoms, molecules, ions; covalent, ionic and
  - hydrogen bonding, van der Waals forces and hydrophobic
  - interactions; solutions, mixtures, colloids; special
  - properties of water; pH and buffers
- biological chemistry
  - carbon chains and rings, functional groups, polymers;
  - lipids, carbohydrates, amino acids and proteins,
  - nucleotides and nucleic acids

### Cell Structure and Function

- cell theory
- cell structures in prokaryotes and eukaryotes
- functions of eukaryote cell structures
  - membrane composition and structure
    - passive processes of membrane transport:
      - diffusion, osmosis, facilitated diffusion
    - active transport
  - cell signaling and communication
    - signals, receptors and transducers (secondary messengers, protein kinase cascades)
    - action potentials, neurotransmitters, excitatory and inhibitory synapses
  - cell adhesion, tight junctions, desmosomes, gap
    - junctions, plasmodesmata, attachment to cytoskeleton, extracellular matrix, cell walls
  - cytoskeleton and related structures
  - cell walls

### Metabolism

- energy transformation
- endothermic and exothermic chemical reactions
- enzymes
  - catalytic properties, inhibition (competitive, uncompetitive, irreversible), simple enzyme kinetics (Hanes versus Lineweaver-Burk plots, Michaelis-Menten plot), coenzymes and prosthetic groups, allosteric enzymes, negative and positive feedback regulation
- photosynthesis--pigments, light (photophosphorylation) and dark (Calvin-Benson Cycle) reactions in chloroplast thylakoid membranes (grana) and stroma C3, C4 and CAM plants
- cellular respiration and fermentation--glycolysis, Krebs Cycle and oxidative phosphorylation in mitochondrion matrix and cristae, lactic acid, alcoholic and pyruvate formylate lyase fermentations
- physiological genetics -- mutant dissection of biochemical pathways
- global carbon cycle
- global warming, certainties and questions

## Cell Cycle

- controls and Ras cascade
- mitosis in detail
- cytokinesis
- meiosis in detail and gamete production
  - contrast mitosis with meiosis
  - nondisjunction of chromosomes
    - common human syndromes caused by chromosomal nondisjunction
- gametic, zygotic and sporic meiosis in life cycles
- simple development -- comparison of sea urchin, frog, bird and human blastula and gastrula formation; limb development; apoptosis
- tumorigenesis and possible mechanisms

## Simple Genetics

- Mendelian (transmission) genetics
  - learn basic vocabulary in Mendelian genetics to understand up to dihybrid cross results in F2 generation and F1 testcross -- dominant or recessive alleles in complete dominance, incomplete (partial) dominance, codominance, X- (sex) linkage, sex-limited and sex-influenced traits, pleiotrophy, epistasis, polygenic or quantitative traits
- relate meiosis to transmission (Mendelian) genetics -- laws of segregation and independent assortment
- pedigrees for human genetic diseases

## Central Dogma

- classical DNA experiments elucidating structure and function
- DNA replication, mutations and repair
- DNA transcription and RNA processing
- RNA translation or protein synthesis
  - genetic code, mRNA, tRNA, rRNA, ribosomes
- prokaryote and eukaryote structural gene comparisons
- transcriptional controls in prokaryotes
- transcriptional, translational, and post-translational controls in eukaryotic gene expression

- recombinant DNA and biotechnology
- plasmids and episomes
- transformation
- bacterial conjugation and sexduction
- lysogenic and lytic cycles
- transduction
- resistance factors
- restriction endonucleases and cleavage sites; sticky ends and DNA splicing
- cloning and expression vectors
- selection of transgenic lines
- complementary DNA (cDNA)
- cDNA library versus genomic DNA library
- gel electrophoresis
- Southern, Northern and Western blotting
- probes, hybridization, detection
- RFLPs (probe-restriction enzyme combinations)
- PCR (unique primer pairs)
- some examples of biotechnology
- ethics issues

## Speciation and Evolution

- introduce Hardy-Weinberg equilibrium and assumptions
  - mutation and independent assortment as causes of genetic variation
- natural selection and differential reproduction
- types of selection
  - directional, stabilizing, disruptive
- mechanisms of speciation
  - allopatric, sympatric, parapatric
- convergent evolution, parallel adaptation, adaptive
  - radiation, divergent evolution
- outline organic evolution
- other ideas on origin of life
- punctuated equilibrium versus gradualism

## Systematics and Taxonomy

- classification of life (3 domains and eukaryote kingdoms or the T. Cavalier-Smith 8 kingdom system)
- binomial system for naming organisms
- introduce dichotomous keys
- archae- and eubacteria
  - major groups
    - key traits, diseases, benefits and ecology
- viruses as non-living parasites
- disease control triangle
- endosymbiosis
- protists
  - major phyla

- key traits, diseases and ecology
- fungi
  - major phyla
    - key traits, beneficials and harmfuls, ecology

### Human Immune System

- nonspecific versus specific defense mechanisms
- humoral and cellular components of the immune response
- antibody diversity versus immunoglobulin classes
- major histocompatibility complexes

### General Education Outcomes:

#### 1) Read effectively, constructively, and critically.

Students read the text throughout the course to give them a basis for understanding current scientific literature and research. There will be at least one library research project in which students read scientific literature. Project(s), test essay questions, discussions, etc. are evaluated on synthesis and critical thinking processes.

#### 2) Write clearly, informatively, and persuasively.

Students will complete at least one library project and several test essay questions over the course of the semester that will be evaluated for skills in writing as well as in the areas of synthesis and critical thinking.

#### 4) Retrieve, evaluate, interpret, and deliver information through a variety of traditional and electronic media.

Students will complete at least one library project which will require the use of traditional and electronic media.

#### 7) Apply scientific reasoning to a variety of contexts.

Students will demonstrate scientific reasoning throughout the various topics considered in course content in their responses to tests, quizzes, projects, discussions, etc.

### Key Performance Indicators:

Since different faculty teach the lecture course, teaching styles will vary as will evaluation methods. The biology department allows a variable number of quizzes and tests, projects, etc. in the evaluation process. The department encourages that essay questions be given. Each instructor will administer his/her own comprehensive final which should count at least 20% of the course grade.

### Representative Text and/or Supplies:

Campbell & Reece. Biology, current edition. Pearson Education, Inc./Benjamin Cummings.

Purves, Sadava, Orians & Heller. Life: the Science of Biology, current edition. Sinauer Associates, Inc. W. H. Freeman and Company.

Raven & Johnson. Biology, current edition. William C. Brown/The McGraw-Hill Companies.

Raven, Evert and Eichhorn. Biology of Plants, current edition. Worth Publishers. W. H. Freeman and Company.

**Optimum Class Size: 24**

**Maximum Class Size: 48**

**Signatures:**

I hereby submit this course syllabus:

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Allan Stevens, , Professor

I hereby find this course consistent with the goals and resources of the Biology Department:

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Allan Stevens, , Professor, Chair

I hereby find this course consistent with the goals and resources of the Natural Science and Mathematics Division:

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Dan Black, EdD, Associate Professor, Dean

I have discussed the need for library resources related to this class with the person submitting the syllabus:

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Lynn Anderson, MLIS, Technical Services Librarian (Main Campus)

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Michelle Olsen, MLS, Campus Librarian (Richfield Campus)