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ADVANCED BIOLOGY (DUAL CREDIT) SYLLABUS

The *Advanced Biology* course is designed to be the equivalent of the general biology course usually taken during the first college year. This is a year-long course that meets every day for fifty minutes for classroom instruction and lab activities. **However, due to the extended time required for labs to be completed, a limited number of after school and SRT laboratories may be required.**

The course expands on topics covered in Biology I, and explores additional topics such as organic chemistry, molecular biology, DNA technology, and human evolution. The curriculum will be designed to incorporate specific topics for those students planning to enter the medical or health field as well as for those students planning to study other life sciences. Extensive group and individual lab work is done throughout the entire year. A major goal of this course is for students to use their understanding of biology to solve problems experimentally. Although most lab work will be done in pairs or small groups, each student will be required to complete and submit lab data individually.

Recommended grade level: 11 or 12

Prerequisites: A grade of C or higher in Chemistry I and a grade of C or higher in Biology I

Classroom Rules

1. Treat others the way you want to be treated.
2. Do your own work.
3. All BNI handbook rules will be enforced.

Textbook and Companion Laboratory Experiments Book

Campbell, Reece, Urry, Cain, Wasserman, Minorsky, Jackson. *Biology: AP Edition*; 11th Edition. Pearson as Benjamin Cummings, San Francisco, CA, 2008.
ISBN 978-0-13-443369-1

Additional Supplies You MUST Bring To Class

A scientific calculator and a composition notebook to use for lab reports

*Please note that you will **not** be allowed to use a graphing calculator for quizzes and tests*

Gmail Account

Please create a Gmail account if you haven't already. With a Gmail account, you will be able to easily access all missed class work assignments, lecture notes, and etc. through Google Documents. Reading assignments, lecture outlines, and pre-lab exercises will be posted ahead of time per the syllabus.

Course Format

Lecture, individual work, group work in class, laboratory experiments and lab reports are all essential parts of this course. Each unit of study will have an end-of-unit exam. There will be short weekly quizzes to help students keep up with reading their textbook. You will take a comprehensive midterm exam at the end of the first semester and a comprehensive final exam at the end of the second semester. Late work will not be accepted. Grading is based upon the Bishop Noll Institute grading scale. (90/80/70/60).

Exams: 50%

Labs: 40%

Quizzes/Classwork: 10%

Laboratory

Laboratory experiments are an integral part of the course. You will be in the laboratory performing experiments on a regular basis. You will be handling hazardous chemicals, using bunsen burners, and etc. Following laboratory safety procedures will be extremely important. You will sign a contract pledging to do so, and I will have the right to revoke lab privileges from anyone who fails to do so. Losing lab privileges will seriously impact your ability to achieve a passing grade in the course.

Pre-lab assignments must be completed prior to scheduled lab time. There will be no make-up lab time scheduled for unexcused absences.

Excused Absences

It is your responsibility to obtain missing classroom assignments or lecture notes after an absence. All material required for make-up will be posted through Google Documents or Gmail on the day of your absence.

Unit 1: The Chemistry of Life

The Chemical Context of Life; Water and the Fitness of the Environment; The Structure of Large Biological Molecules; Carbon and the Molecular Diversity of Life

Upon completion of this unit, students will know and understand the following:

- *how the polarity of water molecules results in hydrogen bonding*
- *how the four emergent properties of water contribute to the Earth's fitness for life*
- *how acidic and basic conditions affect living organisms*
- *an element's properties depend upon the structure of its atoms*
- *the formation and function of molecules depend upon chemical bonds*
- *chemical reactions make and break chemical bonds*
- *the definition of a macromolecule*
- *structure and function of carbohydrates, lipids, and proteins*
- *how nucleic acids store and transmit hereditary information*
- *the definition of organic chemistry*
- *how carbon atoms form diverse molecules by bonding to four other atoms*
- *molecular diversity arising from carbon skeleton variation*
- *the small number of chemical functional groups that are key to biological molecules*

Textbook chapters

2 3 4 5

Lab topics: The Effectiveness of Biological Buffers

Preparation of Aspirin and Oil of Wintergreen

Analysis of Water for Dissolved Oxygen

Unit 2: The Cell and Energy

Cellular Structures and Functions; Membrane Structure and Function; Metabolism

- eukaryotic and prokaryotic cellular structure and function*
- cell membrane structure, function, and transport mechanisms*
- the organization of the chemistry of life into metabolic pathways*
- forms of energy*
- the laws of energy transformation*
- how free energy relates to stability, equilibrium, and metabolism*
- the structure, hydrolysis, function, and regeneration of ATP*
- the activation energy barrier and how enzymes lower the barrier*
- substrate specificity of enzymes*
- catalysis in the enzyme's active site*

- the effect of local conditions on enzyme activity and cellular locations of specific enzymes*
- allosteric regulation of enzymes*

Textbook chapters

6 7 8

Lab topics: Diffusion and Osmosis Using Dialysis Tubing to Represent the Cell Membrane

Entropy and Enthalpy: A Lab Investigation

Enzyme Catalysis

Unit 3: Cellular Processes and Communication

Cellular Respiration; Photosynthesis; Cell Communication, Cell Cycle

Upon completion of this unit, students will know and understand the following:

- catabolic pathways and the production of ATP*
- oxidation-reduction reactions*
- the stages of cellular respiration: glycolysis, the citric acid cycle, and electron transport*
- chemiosmosis*
- the accounting of ATP production in cellular respiration*
- fermentation and anaerobic respiration*
- catabolism in other metabolic pathways*
- anabolic pathways*
- regulation of cellular respiration via feedback mechanisms*
- the structure and function of chloroplasts and the comparison to mitochondria*
- the oxidation-reduction of the chemical equation for photosynthesis*
- the structure and function of chlorophyll*
- the nature of sunlight*
- the light reaction and electron flow*
- the Calvin cycle*
- the alternative mechanisms of carbon fixation*
- the evolution of cell signaling*
- local and long-distance signaling*
- the three stages of cell signaling, including the cellular structures, pathways, and chemical compounds involved in the processes*
- apoptosis*
- the evidence for cytoplasmic signals*
- the cell cycle control system*

-loss of cell cycle controls in cancer cells

Textbook chapter:

9 10 11 12

Lab topic: The Rate of Cellular Respiration in Germinating vs. Non-germinating Peas
Inquiry Lab: What Factors Affect the Rate of Photosynthesis in Living Leaves?
Microscopic Preparation and Observation of Mitotic Activity in Onion Tips

Unit 4: Introduction to Genetics

Meiosis; Mendel and the Gene Idea; Chromosomal Basis of Inheritance

Upon completion of this unit, students will know and understand the following:

- origins of genetic variation among offspring*
- the evolutionary significance of genetic variation within populations*
- the specific gene-specific chromosome link*
- the chromosomal basis of sex*
- the inheritance of sex-linked genes*
- X-inactivation in female mammals*
- how linkage affects inheritance*
- genetic recombination and linkage*
- genomic imprinting*
- the genetic program for embryonic development*
- cellular differentiation and pattern formation of the body*
- the role of hormones in determination of sex in humans*
- basic structures and functions of the endocrine system*

Textbook chapter:

13 14 15

Lab topics: Examination of Genetic Crosses Using *Drosophila Melanogaster*

Unit 5: The Central Dogma of Biology (Gene to Protein)

DNA; Replication; RNA; Transcription; Translation; Mutation; Regulation of Gene Expression; Biotechnology; Genomics

Upon completion of this unit, students will know and understand the following:

- the evidence for the one gene-one enzyme theory*
- the molecular components and the processes for transcription and translation*

- how point mutations can affect protein structure and function*
- the comparison of gene expression in bacteria and eukarya*
- DNA cloning and its applications*
- DNA sequencing*
- the practical medical applications of DNA technology*
- the historical perspective of the human genome project*
- the ethical, legal, and social implications of genome research*
- an understanding of family history in relation to disease risk*

Textbook chapter:

16 17 18 20 21

Lab topics: Geno 2.0 Project

Unit 6: Evolution

Evolutionary Mechanisms and Evidence; Descent with Modification; Darwin; Evolution of Populations; Origin of Species; History of Life on Earth; Systematics, Phylogenies, and Comparative Biology; Genome Evolution

Upon completion of this unit, students will know and understand the following:

- overwhelming evidence of evolution*
- descent with modification by natural selection explains the adaptations of organisms and diversity of life*
- how mutation and sexual reproduction produce genetic variation*
- gene pools and allele frequencies*
- the Hardy-Weinberg principle*
- how natural selection, genetic drift, and gene flow alter allele frequencies*
- the role that natural selection plays in adaptive evolution*
- sexual selection*
- the preservation of genetic variation*
- speciation*
- fossil record*

Textbook chapter:

21 22 23 24 25 26

Lab topic: Estimating Allele Frequencies for a Specific Trait within a Sample Population
Additional lab topics TBA

Unit 7: The Diversity of Microorganisms

Viruses; Bacteria; Archaea; Protists

Upon completion of this unit, students will know and understand the following:

- the structure of viruses*
- the features of viral reproductive cycles*
- the evolution of viruses*
- the anatomy and physiology of the human immune system*
- innate and acquired immunity in humans*
- active and passive immunization*
- how structural and functional adaptations contribute to the success of bacteria*
- the genetic recombination mechanisms that promote adaptive evolution in bacteria*
- the harmful and beneficial impact of bacteria on humans*

Textbook chapter:

19 27 28

Lab topic: Genetically-Modified Organisms Virtual Lab
Effect of Disinfectants and Antiseptics on Bacteria

Unit 8: The Diversity of Plants and Fungi

Fungi; Seedless Plants; Seeded Plants

Upon completion of this unit, students will know and understand the following:

- how land plants evolved from green algae*
- life cycles of mosses and other nonvascular plants*
- how ferns and other seedless vascular plants were the first to grow tall*
- how seeds and pollen grains are key adaptations for life on land*
- gymnosperms bear seeds in cones*
- reproductive adaptations of angiosperms*
- human dependence on seed plants*
- fungi are heterotrophs and produce spores*
- fungi descended from aquatic, single-celled, flagellated protist and have diversified*
- roles in nutrient cycling, ecological interactions, and human welfare*

Textbook chapter:

29 30 31

Lab topic: Coniferous vs. Deciduous Comparison Lab

Mold Types Lab

Unit 9: Animal Diversity

Protostomes; Deuterostomes; Invertebrates; Vertebrates

Upon completion of this unit, students will know and understand the following:

- how animals are characterized by body plans*
- how new views of animal phylogeny are emerging from molecular data*
- various animal phyla and how they are classified*

Textbook chapter:

32 33 34

Lab topic: Fetal Pig Dissection

The Effect of Temperature on the Heart Rate of *Daphnia Magna*

Unit 10: Plant Form and Function

Plant Structure, Growth, and Development; Transport in Plants; Soil and Plant Nutrition; Plant Reproduction; Sensory Systems in Plants; Plant Defense Responses

Upon completion of this unit, students will know and understand the following:

- plant body has hierarchy of organs, tissues, and cells*
- primary and secondary growth patterns in roots and stems*
- how water and minerals are transported from roots to shoots*
- how stomata help regulate the rate of transpiration*
- how sugars are transported from leaves to sites of use or storage*
- soil is a living, finite source*
- plants require essential elements to complete their life cycle*
- flowers, double fertilization, and fruits are unique features of the angiosperm life cycle*
- flowering plants reproduce sexually, asexually, or both*
- plants respond to a wide variety of stimuli*

Textbook chapter:

35 36 37 38 39

Lab topic: Plant Nutrition with Varying Soil Comparison Lab

Unit 11: Behavioral Biology

Animal Behavior

Upon completion of this unit, students will know and understand the following:

- both genetic makeup and environment contribute to the development of behaviors*
- selection for individual survival and reproductive success can explain most behaviors*
- inclusive fitness can account for the evolution of altruistic social behavior*

Textbook chapter:

51

Lab topic: Ornithology Lab (Bird watching for behavior observations)

Unit 12: Ecology

Biosphere; Population Ecology; Community Ecology; Ecosystems; Conservation Biology

Upon completion of this unit, students will know and understand the following:

- how interactions between organisms and the environment limit the distribution of species*
- aquatic biomes are diverse*
- structure and distribution of terrestrial biomes are controlled by climate and disturbance*
- dynamic biological processes influence population density, dispersion, and demographics*

Textbook chapter:

52 53 54 55 56

Lab Topic: The Effect of Temperature on the Heart Rate of *Daphnia Magna*

