



Somerville Public Schools

Office of Curriculum, Instruction, and Technology

AP Biology

Grade 11 or 12

Prerequisite: None

Credit Value: 5

ABSTRACT

Advanced Placement Biology is designed as the equivalent of an introductory course usually taken by biology majors in college. Topics and laboratories include molecules and cells, genetics and evolution, and organisms and populations. Emphasis is placed on providing the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly-changing science of biology. Students are encouraged to take the AP Biology examination in May. Students will complete a summer ecology project on which they will be tested in September.

Adopted by the Somerville Board of Education on September 22, 2009



SOMERVILLE PUBLIC SCHOOLS

AP Biology Grade 11 or 12

Month/ Marking Period	Ecology (September)	Chemistry of Life (September)	Organic Compounds (September)	Free Energy (October)	Cells and Molecules (October)
NJCCCS: Note: aligned to 2009 Science Standards	5.1A1-3, 5.1B1-4, 5.1C2, 5.1D1-3, 5.2D6, 5.3B1-5, 5.3C1-2, 5.4C2, 5.4E1-3, 5.4F1-2, 5.4G1-7, 9.1A1-4, 9.1B1-2, 9.1B4, 9.2B1-3, 9.2D1, 9.2F1-5	5.1A1-3, 5.1B1, 5.1B4, 5.1D1-3, 5.2B3, 5.3B6, 9.1B2, 9.1B4-5, 9.2C1-2	5.1A1-3, 5.1B1-4, 5.1C2, 5.1D1-3, 5.2B3, 5.3A1, 5.3A3, 5.3B5, 5.4G1-2, 9.1B4-5, 9.2C2	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.2D3, 5.2D6, 5.3A1-3, 5.3A6, 5.4E1-3, 9.1B5, 9.2C2, 9.2D3, 9.2E1, 9.2F1-5	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.2D6, 5.3A1-3, 5.3A6, 9.1B5, 9.2A5, 9.2C2
Essential Question:	How are living things distributed according to the presence of natural resources?	How do the unique properties of the water molecule make life on Earth possible?	How do the structures of biological molecules account for their functions?	How do the laws of thermodynamics relate to processes by which energy is provided to living systems?	What similarities and differences between prokaryotic and eukaryotic cells account for their evolutionary relationships?
Content:	Population Dynamics, Communities and Ecosystems, and Global Issues	The Properties of the Water Molecule	Carbohydrates, Lipids, Proteins, and Nucleic Acids	Entropy, Enthalpy, and Enzymes	Structural Organization of Membranes and Compartmentalization
Skills and Topics:	<ul style="list-style-type: none"> compare the effect abiotic and biotic factors have on population size and community structure trace energy flow through an ecosystem related to trophic structure review how carbon, nitrogen, and water cycle through ecosystems describe the effects human populations have on ecosystems discuss the models that are used to describe population growth 	<ul style="list-style-type: none"> list the chemical and physical properties of the water molecule and provide real-world examples: <ul style="list-style-type: none"> capillarity surface tension adhesion cohesion pH high boiling point low freezing point density 	<ul style="list-style-type: none"> discuss the structure and function of the major molecules of life join the monomer units of each group of biological molecules using dehydration synthesis break down the polymers using hydrolysis describe the structure of all biological functional groups (e.g., -OH, -PO₄, -COOH, NH₂) discuss how structure is related to function 	<ul style="list-style-type: none"> discuss the first two laws of thermodynamics relate the concept of entropy (disorder in a system) to free energy discuss enzymes as specialized proteins that regulate the rate of chemical reactions describe the specificity between an enzyme and its substrate use graphical analysis to determine the end point of an enzyme-catalyzed reaction 	<ul style="list-style-type: none"> compare and contrast the characteristics of prokaryotic and eukaryotic cells explain the fluid-mosaic model structure of membranes discuss the permeability of membranes to substances according to their properties



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Skills and Topics:				<ul style="list-style-type: none"> design a controlled experiment to test the effect of varying pH or temperature on enzyme activity 	<ul style="list-style-type: none"> describe sub-cellular organization in terms of the division of labor within the organelles (e.g., the endomembrane system)
Assessments:	Laboratory report: <ul style="list-style-type: none"> Dissolved oxygen and primary aquatic productivity Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory report: <ul style="list-style-type: none"> pH of common solutions Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory report: <ul style="list-style-type: none"> Enzyme catalysis Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory report: <ul style="list-style-type: none"> Diffusion and osmosis Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests
Resources:	Campbell, Neil A., Reece, Jane B. (2008). <i>AP Edition Biology 8th Edition</i> . San Francisco, CA: Pearson. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Hoboken, NJ: Wiley Publishing, Inc. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program.	Campbell, Neil A., Reece, Jane B. (2008). <i>AP Edition Biology 8th Edition</i> . San Francisco, CA: Pearson. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Hoboken, NJ: Wiley Publishing, Inc. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program.	Campbell, Neil A., Reece, Jane B. (2008). <i>AP Edition Biology 8th Edition</i> . San Francisco, CA: Pearson. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Hoboken, NJ: Wiley Publishing, Inc. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program.	Campbell, Neil A., Reece, Jane B. (2008). <i>AP Edition Biology 8th Edition</i> . San Francisco, CA: Pearson. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Hoboken, NJ: Wiley Publishing, Inc. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program.	Campbell, Neil A., Reece, Jane B. (2008). <i>AP Edition Biology 8th Edition</i> . San Francisco, CA: Pearson. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Hoboken, NJ: Wiley Publishing, Inc. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program.



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Technology:	Vernier™ interface and probes <i>Graphical Analysis</i> software Internet Web Quests Wireless laptop computers SMART Boards Multimedia presentations	Vernier™ interface and probes <i>Graphical Analysis</i> software Internet Web Quests Wireless laptop computers SMART Boards Multimedia presentations	Internet Web Quests Wireless laptop computers SMART Boards Multimedia presentations	Vernier™ interface and probes <i>Graphical Analysis</i> software Internet Web Quests Wireless laptop computers SMART Boards Multimedia presentations	Internet Web Quests Wireless laptop computers SMART Boards Multimedia presentations
Writing:	Open-ended responses Conclusions and analysis of exploratory activities	Open-ended responses Conclusions and analysis of exploratory activities	Open-ended responses Conclusions and analysis of exploratory activities	Open-ended responses Conclusions and analysis of exploratory activities	Open-ended responses Conclusions and analysis of exploratory activities
Careers:	Applicable career options are discussed as they arise throughout the Science course. Career options include, but are not limited to, bioengineers, cytologists, forensic specialists, and the tiered options within the medical arena.				



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Month/ Marking Period	Cell Cycle (November)	Cellular Energetics (November/December)	Heredity (December/January)	Molecular Genetics (January)	Evolutionary Biology (February)
NJCCCS*: Note: aligned to 2009 Science Standards	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.3A2-6, 5.3D3	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.3A1-3, 5.3A6, 5.3B1-6, 9.2E1, 9.2F1-5	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.3A4-6, 5.3D1-3, 5.3E1, 9.1A5, 9.1B3, 9.2A1, 9.2A3, 9.2D2	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.3A2-6, 5.3D1-3, 5.3E1-2, 9.1A5, 9.1B3, 9.2A1, 9.2F1-5	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.2D6, 5.3A1, 5.3A3-5, 5.3B4, 5.3C2, 5.3D2, 5.3E1, 5.3E3-4, 5.4A2, 5.4B1-3, 9.1A5, 9.1B3, 9.2A1, 9.2A3
Essential Question:	How does the cell cycle ensure genetic continuity?	What is the role of ATP in coupling on cells' anabolic and catabolic processes?	What features of meiosis are important to heredity?	How do the structure of nucleic acids relate to their functions of information storage and protein synthesis?	What role does natural selection play in the process of evolution?
Content:	Gap ₁ or Growth ₁ , Synthesis, Gap ₂ , Mitosis, and Cytokinesis	Photosynthesis, Cellular Respiration, Glycolysis, and Fermentation	Inheritance Patterns, Linkage, Meiosis, and Sexual Reproduction	Mutations, Replication, Transcription, Translation, Gene Regulation, and Nucleic Acid Technology	Early Evolution of Life, Evidence of Evolution, and Evolutionary Mechanisms
Skills and Topics:	<ul style="list-style-type: none"> list and describe the regulation of the stages of the cell cycle explain the process of DNA replication 	<ul style="list-style-type: none"> describe the anatomy of the mitochondria (cristae, matrix) and chloroplast (stoma, thylakoid membranes) explain the movement of electrons across the inner and outer membranes of the mitochondria (respiration) and the chloroplast (photosynthesis) discuss the process of catabolically breaking down organic molecules 	<ul style="list-style-type: none"> discuss the steps of meiosis delineate the process of gametogenesis explain the importance of reduction division of genetic material by two divisions determine the cross-over rate between two strains of mold explain the mechanism of the principle patterns of inheritance: <ul style="list-style-type: none"> single allele double allele incomplete dominance 	<ul style="list-style-type: none"> compare and contrast the structure and function of RNA with DNA discuss gene regulation (e.g., Lac-operon, Trp-operon) discuss viral structure and replication (e.g., lytic, lysogenic cycles) describe how reverse transcriptase allows versatility among the retroviruses 	<ul style="list-style-type: none"> describe current models for the origin of prokaryotic and eukaryotic cells explain the types of evidence supporting the evolutionary view of life account for speciation and macroevolution explain how heredity and natural selection are involved in the process of evolution



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Skills and Topics:		<ul style="list-style-type: none"> compare and contrast aerobic and anaerobic respiration in terms of net yield of energy trace the number of ATP molecules released through the Krebs cycle delineate the steps of glycolysis, the Krebs cycle, and the electron transport chain describe the role of oxaloacetate in the Citric acid cycle apply $PV=nRT$ to measure the rate of cellular respiration experimentally compare and contrast the different photosynthetic pathways (C_3, C_4, and CAM) explain the steps of the light-dependent and light-independent reactions of photosynthesis 	<ul style="list-style-type: none"> codominance multiple alleles sex-linkage create family pedigrees to track a trait through generations use cross-over rates to determine linkage groups use linkage groups to map chromosomes explore the inheritance patterns in a real-world organism use technological systems and equipment to generate and analyze useful data 	<ul style="list-style-type: none"> use restriction enzymes to cut DNA into bands and separate using gel electrophoresis insert a gene into a bacteria allowing antibiotic resistance use technological systems and equipment to generate and analyze useful data 	<ul style="list-style-type: none"> determine the frequency of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg Law of Genetic Equilibrium use technological systems and equipment to generate and analyze useful data



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Skills and Topics:		<ul style="list-style-type: none"> • use a spectrophotometer to measure photosynthetic rate at different light intensities • separate plant pigments chromatographically and calculate the R_F values • discuss the adaptations that have evolved in response to different environmental conditions (e.g., stomates, location of chloroplasts, day storage, night production of carbohydrates) 			
Assessments:	Laboratory report: <ul style="list-style-type: none"> ○ Mitosis Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory reports: <ul style="list-style-type: none"> ○ Cell respiration ○ Plant pigments Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory reports: <ul style="list-style-type: none"> ○ Genetics of <i>Drosophila melanogaster</i> ○ Meiosis: cross-over in <i>Sordaria fimicola</i> Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory reports: <ul style="list-style-type: none"> ○ Bacterial transformation ○ Restriction enzyme cleavage of DNA Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests Midterm examination	Laboratory report: <ul style="list-style-type: none"> ○ Population genetics and evolution Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests Midterm examination



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Month/ Marking Period	Organisms and Populations (March)	Structure and Function of Plants and Animals (April/May)	Science, Technology, and Society (June)
NJCCCS*: Note: aligned to 2009 Science Standards	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.2D6, 5.3C2, 5.3E2, 5.3E4, 9.1B3	5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.2D6, 5.3D3, 9.2F1-5	3.3D1-6, 5.1A1-3, 5.1B1-4, 5.1C1-3, 5.1D1-3, 5.3A6, 5.3C2, 5.3D2, 5.3E1, 5.4G1-7, 9.2A2, 9.2A4, 9.2B2-3, 9.2D2, 9.2D4-5, 9.2F1-5
Essential Question:	How does the taxonomic system reflect current understandings of phylogenetic relationships among organisms?	How does the organization of cells, tissues, and organs determine the structures and functions in plant and animal systems?	How are scientists limited through societal bioethical controls?
Content:	Diversity of Organisms and Phylogenetic Classification	Patterns of Reproduction, Development, and Regulation, Interdependency of Organ Systems, and Adaptive Features	Bioethics, Use of technology for research, Disease, Pathogens, and Vectors
Skills and Topics:	<ul style="list-style-type: none"> explore the major body plans of plants and animals (e.g., ectoderm, endoderm, mesoderm, coelomates) examine representative organisms of the groups Archaea, Eukarya, and Eubacteria compare and contrast the distinguishing characteristics of each group (e.g., domains, kingdoms, major phyla, and divisions of plants and animals) 	<p><u>Plants:</u></p> <ul style="list-style-type: none"> distinguish among the major tissue types of vascular plants (e.g., ground, dermal, vascular) trace the reproductive process of plants (e.g., angiosperm: double fertilization – seed [embryo + endosperm], germination, development) identify and explain the biochemical structure and function of plant hormones provide examples of plant response to stimuli (tropisms) explain the concept of photoperiodism <p><u>Animals:</u></p> <ul style="list-style-type: none"> explore the evolution, organization, and structure and function of the constituent tissues and organs of the following systems: <ul style="list-style-type: none"> respiratory circulatory excretory digestive nervous 	<ul style="list-style-type: none"> use scientific journals and the Internet to research a bioethical challenge research the structure and function of a disease (e.g., genetic or infectious) and the mode of transmission prepare, rehearse, and deliver a formal presentation in logical or sequential order using clear, precise, organized language appropriate to the topic use visuals, such as charts, graphs, and/or props when presenting for clarification explore the tissues and organs of a representative higher-order mammal as a model of the systems and organization of life



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Skills and Topics:		<ul style="list-style-type: none"> ○ muscular ○ immune ○ endocrine ● use a sphygmomanometer and technology to measure blood pressure in a human being ● determine the heart rate at varying temperatures in an ectotherm (<i>Daphnia magna</i>) 	
Assessments:	Laboratory report: <ul style="list-style-type: none"> ○ Construct an experimental phylogenetic tree of animals Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests	Laboratory reports: <ul style="list-style-type: none"> ○ Transpiration ○ Physiology of the Circulatory System ○ Animal behavior Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests Advanced Placement examination	Laboratory report: <ul style="list-style-type: none"> ○ Dissection of the fetal pig Warm-up activities Exploratory activities Class discussions Student participation Quizzes Tests Oral Presentation Final examination
Resources:	Campbell, Neil A., Reece, Jane B., <i>AP Edition Biology 8th Edition</i> (2008). Pearson, San Francisco, CA. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Wiley Publishing, Inc., Hoboken, NJ.	Campbell, Neil A., Reece, Jane B., <i>AP Edition Biology 8th Edition</i> (2008). Pearson, San Francisco, CA. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Wiley Publishing, Inc., Hoboken, NJ.	Campbell, Neil A., Reece, Jane B., <i>AP Edition Biology 8th Edition</i> (2008). Pearson, San Francisco, CA. <i>Biology Course Description</i> (2005). The College Board Advanced Placement Program. <i>Biology Lab Manual</i> (2001). The College Board Advanced Placement Program. Pack, Phillip, E. <i>Cliffs AP Biology 3rd Edition</i> (2007). Wiley Publishing, Inc., Hoboken, NJ.



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Somerville Public Schools

AP Biology Course Requirements

Grade: 11 or 12

Prerequisites: None

Credit Value: 5

Length of Course: Academic Year

Course Description

Advanced Placement Biology is designed as the equivalent of an introductory course usually taken by biology majors in college. Topics and laboratories include molecules and cells, genetics and evolution, and organisms and populations. Emphasis is placed on providing the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly-changing science of biology. Students are encouraged to take the AP Biology examination in May. Students will complete a summer ecology project on which they will be tested in September.

Course Content

This course will consist of the following units of study:

- Population Dynamics, Communities, and Ecosystems and Global Issues
- The Properties of the Water Molecule
- Carbohydrates, Lipids, Proteins, and Nucleic Acids
- Entropy, Enthalpy, and Enzymes
- Structural Organization of Membranes and Compartmentalization
- Gap₁ or Growth₁, Synthesis, Gap₂, Mitosis, and Cytokinesis
- Photosynthesis, Cellular Respiration, Glycolysis, and Fermentation
- Inheritance Patterns, Linkage, Meiosis, and Sexual Reproduction
- Mutations, Replication, Transcription, Translation, Gene Regulation, and Nucleic Acid Technology
- Early Evolution of Life, Evidence of Evolution, and Evolutionary Mechanisms
- Diversity of Organisms and Phylogenetic Classification
- Patterns of Reproduction, Development, and Regulation, Interdependency of Organ Systems, and Adaptive Features
- Bioethics, Use of Technology for Research, Disease, Pathogens, and Vectors

Course Objectives

The student will:

- apply chemical principles and physics concepts to the molecules important to life.
- delve into the physical boundaries and study how materials cross these boundaries.
- relate specialized molecules of life to their role in regulation.
- describe subcellular interrelationships.
- design and execute controlled experiments.
- evaluate the regular process of DNA replication and the consequences of deviations from that process.
- analyze the energy transfers essential to sustaining life.
- trace the evolution of life on earth.
- use technological systems and equipment effectively.
- generate and analyze useful data.
- compare and contrast the major attributes of plant and animal systems.
- distinguish among the characteristics of phylogenetic groups of organisms.
- describe the ethical issues that place limitations on the scientist.
- study how disease is transferred.

Evaluation Process

A final average of 65% or better is required. Throughout the length of this course, students will be evaluated on the basis of:

- Unit Tests and Performance Assessments
- Quizzes
- Projects
- Class Participation
- Homework
- Midterm Examination
- Final Examination

Specific weights will be determined by course and level.



Somerville Public Schools

AP Biology Student Agreement

STUDENT NAME: _____
Last Name First Name

GRADE: _____

My signature below indicates that I have received my copy of the Somerville Public Schools Course Requirements for AP Biology.

I acknowledge my responsibility to read and understand all of the information contained in the AP Biology Course Requirements information and syllabus packet.

Student Signature

Date

Note: Be sure to share the course requirements for AP Biology with your parents.