COURSE TITLE

Advanced Placement Biology

LENGTH

Full Year

DEPARTMENT

STEM Department

SCHOOL

Rutherford High School

DATE

September 10, 2018

Initial BOE Approval Date (Born on): 6/15/2015

Advanced Placement Biology

I. Introduction/Overview/Philosophy

Advanced Placement Biology is designed to be the equivalent of a college introductory biology course taken by biology majors during their first year. It aims to provide students with conceptual framework, factual knowledge, and analytical skills necessary to deal with the rapidly changing science of biology. The five major areas of study are:

- The Chemical and Cellular Basis of Life
- The Biology of Organisms
- The Perpetuation of Life
- The Biology of Populations and Communities
- The Genesis and Diversity of Organisms.

The course covers eight major themes that will be integrated throughout the course:

- Science as a Process
- Evolution
- Energy Transfer
- Continuity and Change
- Relationship of structure to function
- Regulation
- Interdependence in nature
- Science, Technology and Society

II. Objectives

Course Outline:

1. Analyze and compare the processes of mitosis and meiosis by:
    a. Citing experimental evidence showing the essential role of the nucleus in the life of the cell and in the transmission of hereditary information.
    b. Distinguishing between mitosis and cytokinesis.
    c. Discussing the events that occur during each stage of mitosis.
    d. Differentiating between mitosis in the plant cell and in the animal cell.
    e. Distinguishing between haploid and diploid cells.
    f. Comparing and contrasting meiosis with mitosis and giving the importance of each process in the life of the organism.
    g. Explaining why spermatogenesis produces four sperm cells whereas oogenesis produces only one egg.
    h. Indicating how the products of meiosis differ in plants and animals.
    i. Discussing reasons why natural selection has favored the more complicated process of sexual reproduction over the simpler one of asexual reproduction in a wide variety of organisms.
2. Predict patterns of inheritance by:
    a. Defining and using the terms allele, segregation, F1, F2.

b. Distinguishing between the following pairs of terms: dominant, recessive; homozygous, heterozygous; monohybrid cross, dihybrid cross; and phenotype, genotype.
c. Explaining how a test cross is performed, and why it is a useful genetic tool.
d. Using a Punnett square or probabilities to do monohybrid and dihybrid crosses.
e. Explaining how intermediate inheritance differs from complete dominance.
f. Giving the characteristic phenotypic ratios of the F1 in a dihybrid cross in which the two genes are independent. Explaining why complementary genes, epitasis, collaboration, and modifier genes alter this ratio.
g. Stating Mendel's first and second laws and relating them to the chromosomal theory of inheritance.
h. Distinguishing between multiple alleles and multiple gene inheritance.
i. Differentiating between penetrance and expressivity.
j. Explaining why statistical analysis is a useful tool.
k. Giving the possible genotypes of blood types A, B, AB, and O and explaining the importance of these blood types in giving blood transfusions.
l. Discussing the inheritance of the Rh factor and explaining why there is a potential danger to an Rh-positive fetus when the mother is Rh-negative.
m. Explaining, using an example, how lethal genes can persist in a population.
n. Giving the method of sex determination in *Drosophila* and in human beings.
o. Distinguishing between the sex chromosomes and autosomes.
p. Explaining what a Barr body is and how it affects gene expression in females.
q. Distinguishing between sex-linked and sex-influenced characteristics.
r. Showing how crossing-over frequencies are calculated and how they can be used to make chromosomal maps. Comparing the map formulated from crossing-over data on *Drosophila* with the map derived from studying the giant chromosomes.
s. Explaining how translocation, deletion, duplication, inversion and nondisjunction alter chromosomes.

3. Appreciate biology as a science by:
   a. Discussing the scientific method and its applications and limitations.
   b. Explain the two parts of Darwin's theory of evolution and give the five basic assumptions upon which it rests.
   c. Naming the five kingdoms of organisms and identifying the distinguishing characteristics of each.
   d. Stating the importance of each of the following groups of plants: green algae, brown algae, red algae, mosses and vascular plants.
   e. Naming one important characteristic of each of the following groups of animals: coelenterates, flatworms, mollusks, annelids, arthropods, echinoderms, and chordates.
4. Identifying the connection between biology and chemistry by:
   a. Relating the structure of an atom to its chemical properties and the type of chemical bond it forms.
   b. Distinguishing between ionic and covalent bonds and the roles they play in the formation of biological compounds.
   c. Explaining why the most common elements in the bodies of living organisms (C, O, H, N) form highly stable molecules.
   d. Explaining the crucial role of weak chemical bonds (such as hydrogen bonds, van der Waals and hydrophobic interactions) in the organization of living materials.
   e. Distinguishing between polar and nonpolar molecules and relate the characteristics of each to their solubility in water.

f. Relating the polarity of the water molecules and their tendency to form hydrogen bonds to the special properties of water that make it the basis for life on earth.
g. Defining acid, base, buffer, pH, and explaining why the pH must be kept within certain limits within the cell or organism.
h. Identifying examples of each of the four main classes of biologically important organic molecules and the building-block units of which they are composed. Giving a major function of each of these classes.
i. Writing a condensation and hydrolysis reaction, given the reactants.
j. Listing four factors that influence the rate of chemical reactions and explain how each of these affects the rate. Knowing which of these factors are important in governing the rate of reactions within the human body.
k. Explaining why the structure and biological activity of a protein are determined by the sequence of the various amino acids in its polypeptide chains.
l. Distinguishing between an exergonic and an endergonic reaction and explaining why these reactions are usually coupled in living systems.
m. Explaining why the three-dimensional structure of an enzyme is the key to its activity, and the role that temperature, pH, and inhibitors play in altering enzyme activity.

5. Examine the structure and function of cells by:
   a. Citing the contributions of each of the following scientists to our knowledge of cells and cell structure: Anton van Leeuwenhoek, Robert Hooke, Matthias Schleiden, Theodor Schwann, Rudolf Virchow, Louis Pasteur, Camillo Golgi.
   b. Describing the roles of the light microscope, transmission electron microscope, and scanning electron microscope in developing our current understanding of the details of cell structure.
   c. Describing the Davson-Danielli and unit-membrane models of the plasma membrane, and explaining why the fluid-mosaic model has superseded them.
   d. Relating the permeability of the plasma membrane to its structure as envisioned in the fluid-mosaic model.
   e. Explaining why diffusion is driven by an increase in entropy of a system whereas exergonic chemical reactions are usually driven by a loss of heat energy.
   f. Distinguishing between the processes of active and passive transport.
   g. Indicating the role of these processes in the life of a cell.
   h. Differentiating between osmosis and diffusion.
   i. Defining the terms hypotonic, hypertonic, and isotonic and explaining why osmotic relationships are of critical importance in the life of the cell and organism.
   j. Describing the formation of the plant cell wall and its significance in the life of the plant.
   k. Describing the structure and function of the following organelles: nucleus, chromosomes, nucleoli, endoplasmic reticulum (rough and smooth), ribosomes, lysosomes, Golgi apparatus, vacuole, centriole-plastids, mitochondrion, peroxisome, cilia flagella. Indicating which of these occur in plant cells and which in animal cells.
   l. Discussing the similarities found in the structures of centrioles, basal bodies, cilia and flagella.
   m. Listing the differences between prokaryotic and eukaryotic cells.
   n. Developing the evolutionary sequence hypothesized for the evolution of eukaryotic cells from prokaryotic cells with supporting evidence.
   o. Classifying and giving the function of each of the major categories of plant and animal tissues.
6. Summarize the main events in the processes of respiration and photosynthesis by:
   a. Explaining how the First and Second Laws of Thermodynamics relate to living organisms.

b. Explaining how light energy is transformed into chemical energy in the light reactions of photosynthesis and what role is played by the accessory pigments in this process.
c. Defining the terms oxidation and reduction, and explaining how most oxidation-reduction reactions are carried out in living system.
d. Comparing the processes of cyclic and noncyclic photophosphorylation, and identifying the products of each.
e. Giving the structure of the ATP molecule, explaining how it is formed and what role it plays in the transfer of energy.
f. Explaining how the products of the light reactions are used to reduce CO2 to form PGAL, and describing the fate of this PGAL.
g. Describing the process of photorespiration and indicating why it appears to be a wasteful process. Discussing the relationship between photosynthesis and photorespiration. Relate to the evolutionary development of the photosynthetic process.
h. Describing the structural differences between C3 and C4 plants; explaining the functional significance of the Kranz anatomy.
i. Describing the process of cellular respiration, including the main stages in the process, the role of oxygen, and the amount of energy produced.
j. Contrasting the roles played by the electron acceptors NADP and NAD in metabolic processes.
k. Accounting for the critical importance of the respiratory electron-transport chain, and explaining why cyanide and certain other poisons that block the chain are lethal.
l. Relating the structure of a mitochondrion to its function.
m. Citing differences between poikilothermic and homeothermic animals; explaining how these differences relate to their activity level.
n. Stating the relationship between body size and metabolic rate, and explaining its implications for small animals.
o. Evaluating the evolutionary sequence in the development of the processes of anaerobic and aerobic respiration and photosynthesis.

7. Examine plant systems by:
    a. Describing the structure and function of plants, roots, and leaves.
    b. Relating structures to nutrient requirements.
    c. Evaluating transport in plants.
    d. Explaining the role of plant hormones.
    e. Analyzing the evolution of plant diversity.
    f. Discussing the significance of plant adaptations to their respective environments.
    g. Accounting for plant responses to environmental pressures.
    h. Describing the developments in plant biotechnology.
8. Investigate animal systems by:
    a. Describing the structure and function of the following animal systems:
        i. Digestive systems.
        ii. Respiratory systems and gas exchange.
        iii. Circulatory systems.
        iv. Immune systems.
        v. Excretory systems.
        vi. Endocrine systems.
        vii. Reproductive systems.
        viii. Nervous systems and sensory mechanisms.
        ix. Movement and muscle anatomy.

b. Comparing system development in animal phyla and include evolutionary trends.
c. Describing the evolutionary history of the vertebrate brain from fish through amphibians and reptiles to mammals.
d. Evaluating the movement of organisms both plant and animal from water to land and adaptations and evolutionary development expressed in that movement.
e. Describing the methods used to study the evolution of behavior patterns.

9. Investigate the mechanism of gene action by:
    a. Naming the three components of nucleotides and the four nitrogen bases found in DNA; indicating which are pyrimidines and which are purines.
    b. Describing the Watson-Circle model. Showing how the mode accounts for precise replication of the genetic material.
    c. Stating the one gene-one enzyme hypothesis and indicating how it has been modified.
    d. Indicating the differences between DNA and RNA.
    e. Naming the three types of RNA, and indicating where each is synthesized and where each is active.
    f. Discussing the processes of transcription and translation and explaining how genes control cellular functioning.
    g. Defining mutation, indicating the different types of mutations and how mutations can be induced.
    h. Discussing the various definitions of gene and the advantages and disadvantages of each.
    i. Discussing how extra chromosomal inheritance occurs in bacteria.
    j. Discussing the lytic and lysogenic cycles of bacteriophage viruses.
    k. Explaining recombinant DNA technology - its advantages and disadvantages.
10. Relate the mechanisms controlling cell activity by:
    a. Explaining why cells from different parts of an organism have different structural and functional characteristics even though they are genetically identical.
    b. Describing the Jacob-Monod operon model, its component units and their individual functions.
    c. Explaining how end-product corepression and the cAMP-CAP complex control gene transcription and how these mechanisms differ from control by substrate induction.
    d. Naming the substances that may act as selective agents of gene control in eukaryotic cells.
    e. Explaining why *Drosophila* salivary chromosomes have areas that puff out.
    f. Defining gene amplification and relating this process to the formation of the nuclear and extra chromosomal nucleoli.
    g. Describing the points at which cellular control can be applied in the path of information flow from the genes to their phenotypic expression.
    h. Indicating the principal differences in identifying cancer cells from normal cells.
11. Appreciate the development of evolutionary theory through:
    a. Reviewing the historical background.
    b. Summarizing Darwin's information gathered from his voyage on the *Beagle* along with writings on populations and geology.
    c. Citing evidence for evolution.
    d. Investigating the Hardy-Weinberg theorem.
    e. Comparing microevolution and macroevolution.
    f. Relating evolution in systems as discussed in the animal system and structure unit.
    g. Assessing evolution and natural selection in the present, such as bacterial and tuberculosis drug resistance.
12. Describe the characteristics of protozoans by:

a. Explaining why many biologists prefer to consider the protozoans as acellular organisms.
b. Listing the four protozoan phyla discussed in the text and giving two distinguishing characteristics for each.
c. Describing the life cycle of the organism that causes African sleeping sickness and that of the organisms that cause malaria.

13. Identify and compare the characteristics of animals by:
    a. Giving three characteristic features of the Porifera, and reasons why the Porifera are believed to have evolved independently of other multicellular animals.
    b. Giving the major characteristics of the Platyhelminthes, and listing and distinguishing among the three classes.
    c. Giving two important evolutionary advances of the Nemertina.
    d. Giving four fundamental differences between the Protostomia and Deuterostomia
    e. Giving the distinguishing features of the Aschelminthes, and describing the structure and distribution of the Nemaatoda.
    f. Naming four nematodes that parasitize human beings.
    g. Describing and giving the function of the lophophore, and naming three phyla possessing this structure.
    h. Describing the body plan common to all mollusks.
    i. Listing the classes and identifying characteristics of the annelids, and giving representative examples of each class.
    j. Describing the ways in which the Onychophora resemble the annelids and ways in which they resemble the arthropods.
    k. Giving the distinguishing features of the arthropods; listing and describing the three subphyla, and giving representative examples of each.
    l. Giving the distinguishing characteristics of the Crustacea, Chilopoda, Diplopoda, and Insecta, and listing representative examples of each.
    m. Describing the structure of the generalized insect body.
    n. Listing the classes and the identifying features of the Echinodermata, and giving representative examples of each class.
    o. Discussing and giving evidence for the echinoderm theory of chordate origin.
    p. Giving three distinguishing features of the Chordata, and listing the three subphyla.
    q. Describing the adult and larval forms of the tunicates, and suggesting an evolutionary relationship between the tunicate and vertebrates.
    r. Listing the vertebrate classes and the general characteristics of each.
    s. Tracing the evolutionary relationships between the major classes of vertebrates.
    t. Listing eight characteristics shared by all primates.
    u. Discussing current ideas of the evolutionary history of man.

14. Relate ecology to ecosystems and the biosphere by:
    a. Investigating the characteristics of biomes.
    b. Exploring various ecosystems.
    c. Recognizing ecological succession.
    d. Interpreting trophic levels and energy transfer.
    e. Summarizing population ecology.
    f. Exploring conservation biology.
    g. Determining the impact of carbon dioxide emissions and ozone levels on ecosystems.

Student Outcomes:

After successfully completing this course, the student will:

- Acquire the habit of critical thinking.
- Develop the skill to utilize some of the methods and processes by which problems can be solved scientifically.
- Learn the scientific terms, concepts, principles and theories associated with the structure and function of organisms.

New Jersey Student Learning Standards

CAREER READY PRACTICES

CRP1 Act as a responsible and contributing citizen and employee.

Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

CRP2 Apply appropriate academic and technical skills.

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

CRP4 Communicate clearly and effectively and with reason.

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP6. Demonstrate creativity and innovation.

Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP7. Employ valid and reliable research strategies.

Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP9. Model integrity, ethical leadership and effective management.
Career-ready individuals consistently act in ways that align personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the directions and actions of a team or organization, and they apply insights into human behavior to change others' action, attitudes and/or beliefs. They recognize the near-term and long-term effects that management's actions and attitudes can have on productivity, morals and organizational culture.

CRP10. Plan education and career paths aligned to personal goals.
Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

CRP11. Use technology to enhance productivity.
Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

TECHNOLOGY

Standard 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Strand A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
8.1.12.A.4- Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
Strand E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
8.1.12.E.1- Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
Standard 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Strand B. Technology and Society: Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in the global society.
8.2.12.B.2- Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
Strand C. Design: The design process is a systematic approach to solving problems.
8.2.12.C.4- Explain and identify interdependent systems and their functions.

21ST CENTURY LIFE AND CAREERS

9.1 Personal Financial Literacy
Strand F: Civic Financial Responsibility
9.1.12.F.3 Analyze how citizen decisions and actions can influence the use of economic resources to achieve societal goals and provide individual services.
9.2 Career Awareness, Exploration, and Preparation
Strand C: Career Preparation
9.2.12.C.1 Review career goals and determine steps necessary for attainment.

COMPANION STANDARDS FOR SCIENCE AND TECHNICAL SUBJECTS

RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
RST.11-12.5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
RST.11-12.6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
WHST.11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST.11-12.6. Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.
WHST.11-12.9. Draw evidence from informational texts to support analysis, reflection, and research.

NEW JERSEY STUDENT LEARNING STANDARDS- SCIENCE

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

III. Proficiency Levels

This Advanced Placement course is designed for students who have successfully completed Biology and Chemistry, and who meet the designated criteria for this course. Students who take AP Biology should be motivated to complete college level work and prepare to take the Advanced Placement Test in Biology.

IV. Methods of Assessment

Student Assessment
The teacher will provide a variety of assessments including homework, quizzes, weekly laboratory reports, projects and reports.

Curriculum/Teacher Assessment
The teacher will provide the subject area supervisor with suggestions for changes on an ongoing basis.

V. Grouping

This course is open to juniors and seniors who have fulfilled the prerequisites stated above.

VI. Articulation/Scope & Sequence/Time Frame

Course length is one year.

VII. Resources

Texts/Supplemental Reading/References

A. Text
   1. Campbell, Neil A. and Reece, Jane B., Biology, Ninth Edition, Benjamin Cummings, 2011.

B. Resources
   1. Campbell, Neil A. and Reece, Jane B., Practicing Biology, A Student Workbook. Benjamin Cummings, 2011.
   2. Holtzclaw, Fred W. and Theresa Knapp, AP Biology, AP Test Prep Series, Benjamin Cummings, 2011.
   3. Arms, Karen and Camp, Pamela, Biology, Fourth Edition. Orlando, FL: Saunders College Publishing, Harcourt Brace College Publishers, 1995.
   4. Raven, Peter, and Johnson, George, Biology, Sixth Edition. New York, NY: McGraw-Hill, Inc., 2002.
   5. Keeton, William T. and Gould, James L., Biological Science, Sixth Edition. New York: W. W. Norton, 1996.

VIII. Suggested Activities

Appropriate activities are listed in the curriculum map.

IX. Methodologies

The following methods of instruction are suggested: lecture, group projects, demonstration, hands-on applications, and class presentations.

X. Interdisciplinary Connections

Connections are made to mathematics through the use of statistics, probability and processing of laboratory data. Connections are also made to the disciplines of Language Arts and technology.

XI. Differentiating Instruction for Students with Special Needs: Students with Disabilities, Students at Risk, English Language Learners, and Gifted & Talented Students

Differentiating instruction is a flexible process that includes the planning and design of instruction, how that instruction is delivered, and how student progress is measured. Teachers recognize that students can learn in multiple ways as they celebrate students' prior knowledge. By providing appropriately challenging learning, teachers can maximize success for all students.

Differentiating in this course includes but is not limited to:

Differentiation for Support (ELL, Special Education, Students at Risk)

- Peer mentoring on problems
- Differentiated teacher feedback on assignments
- Modeling out problems on whiteboard
- Visual aids as we project problems on whiteboard
- Study guides
- Tiered assignments
- Scaffolding of materials and assignments
- Re-teaching and review
- Guided note taking
- Exemplars of varied performance levels
- Multi-media approach to accommodating various learning styles

Differentiation for Enrichment

- Supplemental reading material for independent study
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Enhanced expectations for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix

XII. Professional Development

The teacher will continue to improve expertise through participation in a variety of professional development opportunities.

XII. Curriculum Map/Pacing Guide

Unit Topic	**Time Allocated**	**Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students**	**Standards**	**Assessments**
Population Dynamics, Communities and Ecosystems, and Global Issues • 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	3 weeks	*For Support:* Test Corrections Teacher Modeling Pairing of students Albert Practice Tests -POGIL -Eutrophication -Global Climate Change *For Enhancement:* Bozeman Biology- -Biotic and Abiotic Interactions -Communities -Ecosystems -Populations -Ecosystem Changes -Cooperative Interactions -Biodiversity Critical/Analytical thinking tasks Inquiry based instruction	NJSLS-HS-LS2-1 NJSLS-HS-LS2-2 NJSLS-HS-LS2-4 NJSLS-HS-LS2-6 NJSLS-HS-LS2-7 NJSLS-HS-LS2-8 NJSLS-HS-LS4-6 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9 8.1.12.A.4 8.1.12.E.1 8.2.12.B.2 8.2.12.C.4 9.1.12.F.3 9.2.12.C.1	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab-Population Sampling Lab- Inquiry- DO and primary aquatic productivity Test- Ecology
The Properties of the Water Molecule Carbohydrates, Lipids, Proteins, and Enzymes • list the chemical and physical	3 weeks	*For Support:* -Albert Practice Tests -Test Corrections -POGIL-	NJSLS-HS-LS1-6 NJSLS-HS-LS1-1 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides

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properties of the water molecule and provide real world examples: o capillarity o surface tension o adhesion o cohesion o pH o high boiling point o low freezing point o density • 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 discuss enzymes as specialized proteins that regulate the rate of chemical reactions • describe the specificity between an enzyme and its substrate		-Biochemistry Basics -Protein Structure -Enzymes and Cellular Regulation *For Enhancement:* Bozeman Biology -Biological Molecules -Enzymes -Enzyme Catalysis Inquiry based- factors affecting enzymatic action	WHST.11-12.2,4,5,6,9 8.1.12.A.4	Classwork *Summative Assessment* Lab pH of common solutions Lab- Enzyme Catalysis Quiz- Chemistry Test- Biochemistry
Structural Organization of Membranes and Compartmentalization • compare and contrast the characteristics of prokaryotic and eukaryotic cells	4 weeks	*For Support:* -Test Corrections -Albert Practice Tests -POGIL- -Membrane Structure -Membrane Function	NJSLS-HS-LS1-2 NJSLS-HS-LS1-3 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9 8.1.12.A.4	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork

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• explain the fluid-mosaic model structure of membranes • discuss the permeability of membranes to substances according to their properties • describe sub-cellular organization in terms of the division of labor within the organelles (e.g., the endomembrane system)		*For Enhancement:* Bozeman Biology- -Cellular Organelles -Cellular Specialization -Cell Membranes -Transport Across Cell Membranes -Diffusion & Osmosis -Osmosis Lab walkthrough Inquiry based instruction	8.2.12.C.4	*Summative Assessment* Lab- Osmosis and Cell Size Lab- Inquiry- Determine water potential in various cells Quiz- Organelles Benchmark- Biochemistry, Cell Membrane and Homeostasis
Mitosis, Meiosis, and Cytokinesis • list and describe the regulation Acid Technology of the stages of the cell cycle • compare and contrast the steps of the processes Mitosis and 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 • discuss the biological basis of cancer	2 weeks	*For Support:* Albert Practice Tests Test Corrections POGIL- -Cell Cycle Regulation *For Enhancement:* Bozeman Biology -Cell Cycle, Mitosis & Meiosis -Sodaria Cross -Lab- Mitosis & Meiosis Higher order thinking skills	NJSLS-HS-LS3-2 NJSLS-HS-LS1-2 NJSLS-HS-LS1-3 NJSLS-HS-LS1-4 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab- Mitosis- Stage Identification and time in each stage Lab- Meiosis- Crossing Over in Sordaria Chromosome modeling Quiz- Mitosis Quiz- Meiosis Test- Mitosis and Meiosis
Photosynthesis, Cellular Respiration- Aerobic, and Fermentation • describe the anatomy of the mitochondria (cristae, matrix) and chloroplast (stoma, thylakoid	3 weeks	*For Support:* Test Corrections Albert Practice Tests POGIL- -ATP- Free Energy Carrier	NJSLS-HS-LS1-7 NJSLS-HS-LS1-5 NJSLS-HS-LS2-3 NJSLS-HS-LS2-4 NJSLS-HS-LS2-5	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork

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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 • 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 • explain the steps of the light dependent and light independent reactions of photosynthesis • separate plant pigments chromatographically and calculate the RF values • discuss the adaptations that have evolved in response to different environmental conditions (e.g., stomata, location of chloroplasts, day storage, night production of carbohydrates)		-Cellular Respiration- An Overview -Glycolysis and the Krebs Cycle -Oxidative Phosphorylation -Photosynthesis *For Enhancement:* Bozeman Biology -Life Requires Free Energy -Photosynthesis & Respiration -Lab- Cell Respiration Walkthrough -Lab- Plant Pigments & Photosynthesis- Walkthrough -Lab- Floating Disk Walkthrough Inquiry based instruction	CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9	*Summative Assessment* Lab- Inquiry- Cell Respiration in peas and other seeds Lab- Plant Pigments Lab- Floating Disk Leaf Assay Test- Respiration Test- Photosynthesis

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Structure, Transport, Reproduction, and Response in Plants • distinguish among the major tissue types of vascular plants (e.g., ground, dermal, vascular) • trace transport of nutrients and water throughout a vascular plant • 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	2 weeks	*For Support:* Albert Practice Tests Test Corrections POGIL- -Plant Hormones *For Enhancement:* Bozeman Biology -Lab- Transpiration -Finding Stomata Inquiry based instruction	NJSLS-HS-LS1-2 NJSLS-HS-LS1-3 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9 8.2.12.C.4	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab- Transpiration Quiz- Plant Hormones
Inheritance Patterns and Linkage • explain the mechanism of the principle patterns of inheritance: o single allele o double allele o incomplete codominance o multiple alleles o 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	3 weeks	*For Support:* Test Corrections Albert Practice Tests POGIL- -The Statistics of Inheritance -Chi-Square *For Enhancement:* Bozeman Biology -Genotypes & Phenotypes -Increasing Genetic	NJSLS-HS-LS1-1 NJSLS-HS-LS3-1 NJSLS-HS-LS3-2 NJSLS-HS-LS3-3 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab-Chi Square Quiz- Chi Square Benchmark- Photosynthesis, Respiration, Plants and genetics

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• explore the inheritance patterns in a real-world organism		Variation -Genotype Expression -Chi Square Test Interest based content Real world problems and scenarios		
Mutations, Replication, Transcription, Translation, Gene Regulation, and Nucleic • compare and contrast the structure and function of RNA with DNA • explain the processes of DNA replication and RNA/protein synthesis • explore and investigate DNA technology: o cloning o plasmid transformation o gel-electrophoresis • discuss eukaryotic gene regulation • discuss prokaryotic 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 • use restriction enzymes to cut DNA into bands and separate using gel electrophoresis • insert a gene into bacteria allowing antibiotic resistance • use technological systems and	5 weeks	*For Support:* Albert Practice Tests Test Corrections POGIL- -Gene Expression-Transcription -Gene Expression-Translation -Gene Mutations -Control of Gene Expression in Prokaryotes *For Enhancement:* Bozeman Biology -Molecular Biology -Gene Regulation Interest based content	NJSLS-HS-LS1-1 NJSLS-HS-LS1-3 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9 8.1.12.E.1 9.2.12.C.1	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab- Restriction enzyme cleavage of DNA Lab- Bacterial transformation Lab- Human DNA extraction Quiz- DNA Test- DNA, RNA and Protein Synthesis

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equipment to generate and analyze useful data				
Evolution of Life, Evidence of Evolution, and Evolutionary Mechanisms • 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 • contrast between domains and kingdoms of living things • construct a cladogram and analyze • 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	5 weeks	*For Support:* Test Corrections Albert Practice Tests POGIL- -Evolution & Speciation -Phylogenic Trees -The Hardy-Weinberg Equation -Mass Extinction *For Enhancement:* Bozeman Biology -Natural Selection -Genetic Drift -Evidence for Evolution -Phylogenetics -Speciation and Extinction -Lab- Population Genetics & Evolution -Comparing DNA sequences -Abiogenesis -The Origin of Life- Scientific Evidence Independent Study	NJSLS-HS-LS4-1 NJSLS-HS-LS4-2 NJSLS-HS-LS4-3 NJSLS-HS-LS4-4 NJSLS-HS-LS4-5 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork *Summative Assessment* Lab- Population genetics and evolution Lab- Gene BLAST Lab- Mathematical modeling of Hardy-Weinberg Quiz- Hardy- Weinberg Test- Evolution Benchmark- DNA, RNA, Protein Synthesis and Evolution

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Patterns of Reproduction, Development, and Regulation Interdependency of Organ Systems and Adaptive Features • investigate animal communication and defense processes • explain how does cell signaling lead to the maintenance of homeostasis and differentiation in development • explore the evolution, organization, and structure and function of the constituent tissues and organs of the following systems: o nervous o endocrine o immune • investigate animal behavior patterns • determine the heart rate at varying temperatures in an ectotherm (Daphnia magna)	6 weeks	*For Support:* Test Corrections Albert Practice Tests POGIL- -Feedback Mechanisms -Control of Blood Sugar Levels -Neuron Structure -Neuron Function -Immunity *For Enhancement:* Bozeman Biology -Organ system -Signal Transmission -Cell communication -Signal Transduction in Pathways -Information Exchange -Nervous System -Animal Behavior -Positive & Negative Feedback Loops -Response to External Environments Inquiry based instruction Student driven project	NJSLS-HS-LS1-2 NJSLS-HS-LS1-3 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9 8.2.12.C.4	*Formative Assessment:* Textbook reading and notes Closure Questions Study Guides Classwork Presentation- Research on animal systems and interactions *Summative Assessment* Lab- Animal Behavior- Taxis and Kinesis in Isopods Quiz- Digestion, Respiration and Circulatory systems Quiz- Endocrine system and Reproductive System Essay- Cell Communication Test- Nervous and Muscular system Advanced Placement Exam

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Animal Diversity • History of animals • Body plans of animals • Invertebrates o Hydrozoans o Scyphozoans o Anthozoans o Flatworms o Rotifers o Lophophorates o Molluscs o Annelids o Nematodes o Arthropods o Echinoderms • Vertebrates o Chordates	4 weeks	*For Support:* Packet- Parade through the Kingdoms Visual learning *For Enhancement:* Inquiry based instruction Student driven projects	NJSLS-HS-LS1-2 CRP1,4,6,7,8,9,11 RST.11-12.3,4,5,6,7,8 WHST.11-12.2,4,5,6,9	*Formative Assessment:* Textbook reading and notes Questions asked and answered during research and peer presentations *Summative Assessment* Presentations: Research of the different animals Benchmark- Organ Systems & Phyla