Course Description

A. COVER PAGE

Date of Submission December 1, 2006

1. Course Title
Biology Honors

2. Transcript Title(s) / Abbreviation(s)
Biology A/B (H), Biology A (H), Biology B (H)

3. Transcript Course Code(s) / Number(s)
SC2056

4. School
Ernest Righetti High School

5. District
Santa Maria Joint Union High School District

6. City
Santa Maria

7. District Web Site
http://www.smjuhsd.k12.ca.us/

8. School Course List Contact

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9. Subject Area

- ☐ History/Social Science
- ☐ English
- ☐ Mathematics
- ☒ Laboratory Science
- ☐ Language other than English
- ☐ Visual & Performing Arts
  - ☐ Intro ☐ Advanced
- ☐ College Prep Elective

10. Grade Level(s) for which this course is designed

☐ 9 ☐ 10 ☒ 11 ☒ 12

11. Seeking "Honors" Distinction?

☒ Yes ☐ No

12. Unit Value

- ☐ 0.5 (half year or semester equivalent)
- ☒ 1.0 (one year equivalent)
- ☐ 2.0 (two year equivalent)
- ☐ Other: _____

13. Is this an Internet-based course? ☐ Yes ☒ No

If "Yes", who is the provider? ☐ UCCP ☐ PASS/Cyber High ☐ Other _____

14. Complete outlines are not needed for courses that were previously approved by UC. If course was previously approved, indicate in which category it falls.

- ☐ A course reinstated after removal within 3 years. Year removed from list? _____
  - Same course title? ☐ Yes ☐ No
  - If no, previous course title? _____
- ☐ An identical course approved at another school in same district. Which school? _____
  - Same course title? ☐ Yes ☐ No
  - If no, course title at other school? _____
- ☐ Year-long VPA course replacing two approved successive semester courses in the same discipline
- ☐ Approved Advanced Placement (AP) or International Baccalaureate (IB) course
- ☐ Approved UC College Prep (UCCP) Online course
- ☐ Approved CDE Agricultural Education course
- ☐ Approved P.A.S.S./Cyber High course
- ☐ Approved ROP/C course. Name of ROP/C? _____
- ☐ Approved A.V.I.D. course
- ☐ Approved C.A.R.T. course
- ☐ Approved Project Lead the Way course
- ☐ Other. Explain: _____

15. Is this course modeled after an UC-approved course from another school <u>outside</u> your district? ☐ Yes ☒ No

If so, which school(s)? _____

Course title at other school _____

16. **Pre-Requisites**

- Successful completion of one year of laboratory science with a "B" or better.
- Successful completion of Algebra I with a B or better.

17. Co-Requisites

None

18. Is this course a resubmission? ☐ Yes ☒ No

If yes, date(s) of previous submission? _____

Title of previous submission? _____

19. Brief Course Description

This is a two semester advanced college preparatory lab science course designed to teach students the concepts and principles of biology. Students will develop a conceptual framework for modern biology and recognize unifying themes that integrate the major topics of biology. Students will learn about the scientific process, molecules and cells, cellular reproduction and genetics, evolution, ecology, and the form and function of animals. Laboratory activities stress the development of important skills such as detailed observation, accurate recording, experimental design, and data interpretation and analysis. Students will develop critical thinking skills through research and discussions about issues relating to current advancements in Biology.

Santa Maria Joint Union High School District
Course Description

Course Title: Honors Biology A/B (P)

Department: Ernest Righetti Science

Course Length: Two Semesters, 10 units

Course Adoption: UC/CSU "a-g"

Textbook: Benjamin Cummings: *Biology Concepts & Connections* 4th Edition (2003)
Campbell, Reece, Mitchell, Taylor
Benjamin Cummings: *Laboratory Investigations for Biology* 2nd Edition (2003)
Dickey

Prerequisites: 11th & 12th graders:

- Successful completion of one year of laboratory science with a "B" or better.
- Successful completion of Algebra I with a B or better.

I. Course Description:

This is a two semester advanced college preparatory lab science course designed to teach students the concepts and principles of biology. Students will develop a conceptual framework for modern biology and recognize unifying themes that integrate the major topics of biology. Students will learn about the scientific process, molecules and cells, cellular reproduction and genetics, evolution, ecology, and the form and function of animals. Laboratory activities stress the development of important skills such as detailed observation, accurate recording, experimental design, and data interpretation and analysis. Students will develop critical thinking skills through research and discussions about issues relating to current advancements in Biology.

II . Course Goals and/or Major Student Outcomes

A. Students will develop a conceptual framework for modern biology and recognize unifying themes that integrate the major topics of biology.

B. Students will understand that scientific discovery is a process.

C. Students will develop advanced laboratory skills that require both qualitative and quantitative analysis of results.

D. Students will understand that the application of biological knowledge and critical thinking can be applied to environmental and social concerns.

III. Course Objectives

The Santa Maria Joint Union School District science courses are designed to meet or exceed the California State Science Standards. The knowledge and skills listed below are those targeted learning objectives that will be assessed in this course.

At the completion of the Honors Biology course students will:

Unit 1. The Process of Science

- Describe the goals and limits of scientific investigations.
- Define a hypothesis and compare inductive and deductive reasoning.
- Explain the differences between discovery science and hypothesis-driven science.
- Describe the scientific method.
- Explain the importance of experimental design (testable hypothesis, independent and dependent variables, controls, and sample size).
- Draw conclusions and inferences based on data interpretation and analysis.
- Explain why an understanding of biology is essential to all of our lives.
- Objectively read publications containing current science and technology topics.

Unit 2. The Molecules and Cells

- Define matter, an element, and a trace element.
- Define a compound and explain how compounds in living organisms are different from compounds in non-biological materials.
- Describe the structure of an atom.
- Define the atomic number and mass number of an atom.
- Define an isotope and explain what makes some isotopes radioactive.
- Explain why radioactive isotopes are important to biologists.
- Explain how the electron configuration of an atom influences its chemical behavior.
- Distinguish among non-polar covalent, polar covalent, and ionic bonds, noting their relative strengths and functions and the methods by which they are diagrammed.
- Describe the special properties of water that make it vital to living systems. Explain how these properties are related to hydrogen bonding.
- Define a solute, a solvent, and a solution.
- Explain how acids and bases directly or indirectly affect the hydrogen ion concentration of a solution.
- Explain the basis for the pH scale.
- Explain how buffers work.
- Describe the causes of acid precipitation and explain how it adversely affects the fitness of the environment.
- Define a chemical reaction and distinguish between the reactants and the products.
- Explain why carbon is unparalleled in its ability to form large, diverse molecules.
- Define organic compounds, hydrocarbons, a carbon skeleton, and an isomer.
- Describe the properties of and distinguish between the four functional groups of organic molecules.
- List the four classes of macromolecules and explain the relationship between monomers and polymers.
- Compare the processes of dehydration synthesis and hydrolysis.
- Describe the structures, functions, properties, and types of carbohydrate molecules.
- Describe the structures, functions, properties, and types of lipid molecules.
- Describe the structures, functions, properties, and types of proteins.
- Compare the structures and functions of DNA and RNA
- Compare the designs and images produced by a light microscope, scanning electron microscope, and transmission electron microscope.
- Distinguish between magnification and resolving power.
- Define cell theory and briefly describe the discoveries that led to its development.
- Explain why cell size and shape varies.
- Explain the relationships between nanometers, micrometers, millimeters, centimeters, and meters.
- Explain why there are both upper and lower limits to cell size.
- Distinguish between prokaryotic and eukaryotic cells.
- Explain why compartmentalization is important in eukaryotic cells.

- Compare the structures of plant and animal cells. Note the function of each cell part.
- Describe the structures and functions of the nucleus, endomembrane system, rough and smooth endoplasmic reticulum, Golgi apparatus, and lysosomes.
- Explain how impaired lysosomal function can cause the symptoms of storage diseases.
- Compare the structures and functions of mitochondria and chloroplasts.
- Compare the structures and functions of microfilaments, intermediate filaments, and microtubules.
- Explain how the structure of cilia and flagella relate to their functions.
- Compare the structures and functions of cell surfaces and intercellular junctions of plant and animal cells.
- Describe the four functional categories of eukaryotic organelles, noting which organelles are in each group.
- Define and compare kinetic energy, potential energy, chemical energy, and heat.
- Define the first and second laws of thermodynamics. Explain how the nature of energy transformations are guided by the laws of thermodynamics.
- Define and compare endergonic and exergonic reactions. Explain how cells use these reactions to survive.
- Describe the importance of energy coupling in cellular reaction.
- Explain how ATP functions as an energy shuttle.
- Explain how enzymes speed up chemical reactions.
- Describe the structure of an enzyme-substrate interaction.
- Explain how the cellular environment affects enzyme activity.
- Explain how competitive and noncompetitive inhibitors alter an enzyme's activity.
- Explain how certain pesticides and antibiotics work by inhibiting enzymes.
- Explain how membranes help organize the chemical activities of a cell.
- Relate the structure of phospholipid molecules to the structure and properties of cell membranes.
- Describe the fluid mosaic structure of cell membranes.
- Describe the diverse functions of membrane proteins.
- Describe the process of passive transport.
- Explain why osmosis is the passive transport of water.
- Distinguish between hypertonic, hypotonic, and isotonic solutions.
- Explain how plant and animal cells change when placed into a hypertonic or hypotonic solution.
- Compare the processes of facilitated diffusion and active transport.
- Distinguish between exocytosis, endocytosis, phagocytosis, pinocytosis, and receptor-mediated endocytosis.
- Describe the cause of hypercholesterolemia.
- Describe the central role of chloroplasts and mitochondria in harvesting energy and making it available for cellular work.

Unit 3. Cellular Reproduction and Genetics

- Compare the relationship between a parent and its offspring resulting from asexual versus sexual reproduction.
- Explain the significance of Virchow's principle regarding cellular reproduction.
- Explain how daughter prokaryotic chromosomes are separated from each other during binary fission.
- Compare the structure of prokaryotic and eukaryotic chromosomes.
- Describe the stages and significance of the cell cycle.
- List the phases of mitosis and describe the events that are characteristic of each phase. Recognize the phases of mitosis from diagrams and micrographs.
- Compare cytokinesis in animals and plants.
- Explain how anchorage, cell density, and growth factors control the cell cycle.
- Explain how cancerous cells are different from healthy cells; distinguish between benign and malignant tumors; and explain the strategies behind some common cancer treatments.
- Describe the functions of mitosis.
- Explain how chromosomes are paired.
- Distinguish between (a) somatic cells and gametes, (b) diploid cells and haploid cells, and (c) autosomes and sex chromosomes.
- List the phases of meiosis I and meiosis II and describe the events that are characteristic of each phase.
- Recognize the phases of meiosis from diagrams or micrographs.
- Describe key differences between mitosis and meiosis. Explain how the end result of meiosis differs from that of mitosis.

- Explain how independent orientation, crossing over, and random fertilization contribute to genetic variation in sexually reproducing organisms.
- Explain how and why karyotyping is performed.
- Describe the causes and symptoms of Down syndrome.
- Define nondisjunction and explain how it can occur.
- Describe the consequences of abnormal numbers of sex chromosomes.
- Describe the main types of chromosomal changes.
- Describe the pangenesis theory and blending hypothesis. Explain why both ideas are now rejected.
- Explain why Mendel's decision to work with peas was a good decision.
- Define and distinguish between true-breeding organisms, hybrids, the P generation, the F1 generation, and the F2 generation.
- Define and distinguish between the following pairs of terms: genotype vs. phenotype, dominant allele vs. recessive allele, and heterozygous vs. homozygous. Also define a monohybrid cross and a Punnett square.
- Explain how Mendel's principle of segregation describes the inheritance of a single characteristic.
- Describe the relationship between alleles for the same gene on separate homologous chromosomes.
- Explain how Mendel's principle of independent assortment applies to a dihybrid cross. Illustrate this principle with examples of Mendel's work with peas and recent research on Labrador Retrievers.
- Explain how a testcross is performed to determine the genotype of an organism.
- Explain when the rule of addition and the rule of multiplication should be used to determine the probability of an event. Explain why Mendel was wise to use large sample sizes in his studies.
- Explain how family pedigrees can help determine the inheritance of many human traits.
- Explain how recessive and dominant disorders are inherited. Provide examples of each.
- Compare the health risks, advantages, and disadvantages of the following forms of fetal testing: amniocentesis, chorionic villus sampling, and ultrasound imaging.
- Describe the inheritance patterns of incomplete dominance, multiple alleles, and pleiotropy.
- Define and distinguish between carrier testing, diagnostic testing, prenatal testing, newborn screening, and predictive testing.
- Explain how a single characteristic can be influenced by many genes.
- Define the chromosome theory of inheritance. Explain the chromosomal basis of the principles of segregation and independent assortment.
- Explain how linked genes are inherited differently from other, nonlinked genes.
- Describe T. H. Morgan's studies of crossing over and explain how Sturtevant created linkage maps.
- Explain how sex is genetically determined in humans and the significance of the *SRY* gene. Explain how sex is determined differently in other organisms.
- Describe the patterns of sex-linked inheritance, noting examples in fruit flies and humans.
- Describe the experiments of Griffith and Hershey and Chase, which demonstrated that DNA is the genetic material.
- Compare the structure of DNA and RNA.
- Explain how the structure of DNA facilitates its replication.
- Describe the process of DNA replication.
- Describe the locations, reactants, and products of transcription and translation.
- Explain the "languages" of DNA and RNA that are used to produce polypeptides.
- Explain how RNA is produced.
- Explain how eukaryotic RNA is processed before leaving the nucleus.
- Explain how tRNA functions in the process of translation.
- Describe the structure and function of ribosomes.
- Explain how translation begins.
- Describe the step-by-step process by which amino acids are added to a growing polypeptide chain.
- Diagram the overall process of transcription and translation.
- Describe the major types of mutations and their possible consequences.
- Compare the lytic and lysogenic reproductive cycles of a phage.
- Describe the reproductive cycle of an enveloped virus. Explain how the herpes virus is different from this cycle.
- Explain how new viruses evolve and why certain viruses emerge as major threats.
- Explain how the AIDS virus enters a host cell and reproduces.
- Differentiation yields a variety of cell types, each expressing a different combination of genes.

- Differentiated cells may retain all of their genetic potential.
- Importance of the Human Genome Project.

Unit 4. Evolution

- Briefly describe the history of evolutionary thought.
- Explain how Darwin's voyage on the *Beagle* influenced his thinking.
- Describe the ideas and events that resulted in Darwin's 1859 book.
- Explain how fossils form, noting examples of each process.
- Explain how the fossil record provides some of the strongest evidence of evolution.
- Explain how biogeography, comparative anatomy, comparative embryology, and molecular biology document evolution.
- Describe Darwin's assumptions in developing the concept of natural selection.
- Explain how artificial selection supports natural selection.
- Describe known examples of natural selection. Note key points about how natural selection works.
- Define a population and a species.
- Explain how microevolution occurs.
- Explain the significance of Hardy-Weinberg equilibrium to natural populations and in public-health science.
- Describe the five conditions required for Hardy-Weinberg equilibrium.
- Explain how the bottleneck effect, the founder effect, gene flow, and mutation influence microevolution.
- Explain how natural selection results from changes in genetic equilibrium.
- Explain why only some variation is heritable. Explain how genetic variation is measured.
- Explain how mutation and sexual recombination produce genetic variation.
- Explain how genetic variation is maintained in populations.
- Explain what is meant by neutral variation.
- Explain why genetic bottlenecks threaten the survival of certain species.
- Define Darwinian fitness.
- Describe the three general outcomes of natural selection.
- Define and compare intrasexual selection and intersexual selection.
- List four reasons why natural selection cannot produce perfection.
- Explain why antibiotic resistance has evolved.
- Compare the different definitions of a species and the usefulness of each definition.
- Describe prezygotic barriers and postzygotic barriers that prevent populations belonging to closely related species from interbreeding.
- Explain how geologic processes can fragment populations and lead to speciation.
- Define adaptive radiation and explain why the Galápagos finches are a good example.
- Explain how sympatric speciation can occur and how it typically happens in plants.
- Explain why polyploidy is important to modern agriculture.
- Explain how modern wheat evolved.
- Explain how reproductive barriers might evolve in isolated populations of animals.
- Compare the gradualist model and the punctuated equilibrium model of evolution. Explain which model best explains the fossil record.
- Describe the work and discoveries of Peter and Rosemary Grant working with Darwin's finches.

Unit 5. Ecology

- Describe the characteristics of the biosphere.
- Describe the abiotic factors that affect organisms.
- Describe the different types of aquatic biomes.
- Describe the different types of freshwater biomes.
- Describe the types of characteristics used to define terrestrial biomes.
- Define population density and describe techniques to measure it. List the main types of dispersion patterns.
- Describe and compare the exponential growth model and the logistic growth model, illustrating both with examples. Explain the concept of carrying capacity.
- Describe the factors that regulate growth in natural populations.
- Define boom-and-bust cycles, explain why they occur, and note examples.
- Explain how life tables are used to track mortality and survivorship in populations. Compare Type I, Type II, and Type III survivorship curves.

- Explain how the life history traits vary with environmental conditions and with population density. Compare *r*-selection and *K*-selection and indicate examples of each.
- Explain how the human population is changing and the impact this has had and continues to have on the Earth. Use the concept of an ecological footprint to compare the impacts of humans living in different countries.
- Define the demographic transition. Explain how the age structure of a population can be used to predict changes in population size.
- Describe the inherent problems of managing populations.
- Describe the four properties of a community.
- Describe the concepts of the "competitive exclusion principle," "resource partitioning," and an ecological "niche."
- Describe the different types of predation, define coevolution, and distinguish between Batesian and Müllerian mimicry.
- Define a keystone species and describe two examples.
- Describe the three different types of symbiotic relationships, noting examples of each.
- Explain how disturbances can be beneficial to a community. Distinguish between primary and secondary succession.
- Describe the roles of fire in shaping ecosystems.
- Describe and compare energy flow and chemical cycling in ecosystems.
- Describe the trophic structure of food chains.
- Explain how food chains interconnect to form food webs.
- Describe the movement of energy through a food chain. Explain why there are more producers than consumers and why eating meat is considered a great luxury.
- Explain how water, carbon, nitrogen, and phosphorus are cycled within ecosystems.
- Define eutrophication and explain how we learned that phosphorus is the main cause of this problem.

Unit 6. Animals: Form and Function

- Describe the levels of organization in an animal's body.
- Describe the four main tissues, noting their structures and their functions.
- Describe the structure of organs.
- Describe the general structures and functions of the twelve major organ systems in vertebrate animals.
- Describe the main components of the human alimentary canal and the associated digestive glands.
- Describe the functions of the molecules in saliva and the roles of the tongue and teeth in digestion.
- Explain how swallowing occurs and how food is directed away from the trachea.
- Explain how the structure of the esophagus functions to propel food.
- Relate the structure of the stomach to its functions.
- Describe the functions of the secretions of the stomach.
- Explain the causes of heartburn and why the stomach does not digest itself.
- Describe the most common cause of stomach ulcers and the primary forms of treatment.
- Describe the different types of chemical digestion that occur in the small intestine.
- Explain how the structure of the small intestine promotes nutrient absorption.
- Describe the structure and functions of the large intestine and rectum.
- Describe the three common nutritional needs of all animals.
- Explain why exercise and a balanced diet of 1200 kcal or more is the best way to lose weight.
- Define essential amino acids.
- Define a vitamin and distinguish between water-soluble and fat-soluble vitamins.
- Define dietary minerals and explain why they are important in the diet.
- Describe the types of information found on food labels.
- Explain how diet can influence the risks of cardiovascular disease and cancer.
- Describe the three main phases of gas exchange.
- Describe the structures and functions of a mammalian respiratory system.
- Describe the impact of smoking on human health.
- Explain how breathing is controlled in humans.
- Explain how blood transports gases between the lungs and tissues of the body.
- Describe the functions of hemoglobin.
- Describe the pathway of blood through the mammalian cardiovascular system.
- Relate the structure of blood vessels to their functions.

- Distinguish between diastole and systole. Explain what keeps blood moving in the correct direction within the heart and what causes heart “beats.”
- Explain how heartbeats are controlled.
- Define a heart attack and heart disease and explain the causes of these serious health problems.
- Explain how and why blood pressure changes as blood moves away from the heart.
- Explain how blood pressure is measured. Note normal and high blood pressure readings.
- Explain how blood flow through capillaries is regulated.
- Explain how the structure of a capillary is related to its functions.
- Describe the components of blood and their functions.
- Describe the structure, function and production of red blood cells.
- Describe the five main types of leukocytes and note their functions.
- Describe the process of blood clotting.
- Define leukemia and describe the most common forms of treatment.
- Describe the nature of nonspecific human defenses against infection.
- Describe the events of the inflammatory response and explain how it helps to prevent the spread of disease.
- Describe the structure and functions of the lymphatic system.
- Describe the specific nature of an immune system response. Define antigen, antibody, passive immunity, and active immunity.
- Describe the development and functions of B and T lymphocytes.
- Describe the nature of antigens. Explain how an antigen and its antibody interact.
- Explain how clones of the appropriate B and T cells are produced to fight an infection.
- Compare the primary and secondary immune responses. Distinguish between the functions of plasma cells and memory cells.
- Relate the specific structure of an antibody to its functions.
- Describe the effector mechanisms triggered by antibodies binding to antigens.
- Describe the production of and uses for monoclonal antibodies.
- Describe the specific functions of cytotoxic T cells and helper T cells.
- Explain how the immune system helps to fight cancer.
- Explain how the immune system identifies the body’s own molecules and how this system creates problems for organ transplantations.
- Describe the ways animals eliminate nitrogenous wastes and the advantages and disadvantages of each method.
- Describe the general and specific structure of the human kidney. Explain how this organ promotes homeostasis.
- Describe the four major processes by which the human excretory system produces and eliminates urine.
- Describe the key events in the process by which the kidneys convert filtrate into urine.
- Explain how a dialysis machine works.
- Describe the many functions of the liver.
- Define a hormone and compare the mechanisms and functions of the endocrine and nervous systems.
- Compare the two general mechanisms by which hormones trigger changes in target cells.
- Describe the different types and functions of vertebrate endocrine organs.
- Describe the functions of and interrelationships between the hypothalamus and the anterior and posterior pituitary glands.
- Describe the functions of the thyroid gland. Describe the symptoms of hypothyroidism, hyperthyroidism, and a goiter.
- Explain how insulin and glucagon work to manage blood glucose levels. Explain what occurs in the different types of diabetes.
- Compare the functions of the hormones released by the adrenal medulla and the adrenal cortex.
- Describe the three major categories of sex hormones and note their functions.
- Fertilization results in a zygote and triggers embryonic development
- Cleavage produces a ball of cells from the zygote.
- Gastrulation produces a three-layered embryo and organs start to form after gastrulation.
- Changes in cell shape, cell migration, and programmed cell death give form to the developing animal.
- The embryo and placenta take shape during the first month of pregnancy
- Human development from conception to birth is divided into three trimesters
- Describe the structural and functional subdivisions of the nervous system.

- Describe the structure and functions of neurons.
- Explain how an action potential propagates itself along a neuron.
- Compare the structures, functions, and locations of electrical and chemical synapses.
- Describe the types of inputs a single neuron can receive and note the nature of the neuron's response.
- Describe the types and functions of neurotransmitters known in humans.
- Explain how drugs can alter chemical synapses.
- Explain how muscle cells contract and describe the role of calcium in a muscle contraction.
- Distinguish between aerobic and anaerobic exercise.
- Describe the three main types of skeletons, their advantages and disadvantages.
- Describe the structure of bone and the three types of joints.
- Describe how the Integumentary system protects the internal body from mechanical injury, infection, extreme temperatures, and drying out.
- Describe the systems that help exchange materials between an animal and its environment.
- Define the concept of homeostasis and understand that homeostasis depends on negative feedback.
- Explain how thermoregulation is an example of homeostasis.

Honors Biology Course Outline	Laboratory Exercises & Supporting Activities
Unit 1. The Process of Science A. The Process of Science ▪ Goals and limits of scientific investigations ▪ Inductive and deductive reasoning: ▪ Discovery science and hypothesis-driven science B. Scientific Method ▪ Observation and questions ▪ Testable hypothesis ▪ Experimental design ▪ Independent, Dependent variables ▪ Controls ▪ Sample size ▪ Data collection and recording ▪ Data interpretation and analysis ▪ Drawing inferences C. Biology and Everyday Life ▪ Biology is essential to our lives ▪ Science and Technology ▪ Scientific publications	Ex. 1.1 The Black Box ▪ Explain and apply the scientific inquiry method. Ex. 1.2 Defining a Problem ▪ Identify questions that can be answered through scientific inquiry and explain what characterizes a good question. ▪ Identify usable hypotheses and explain what characterizes a good scientific hypothesis. Ex. 1.3 The Elements of an Experiment ▪ Define and give examples of dependent, independent, and standardized variables. ▪ Identify the variables in an experiment. ▪ Explain what control treatments are and why they are used. ▪ Explain what replication is and why it is important. Ex. 1.4 Designing an Experiment ▪ Critique the experimental design of a given proposed experiment. ▪ Design an experiment with a given method for measuring a dependent variable. Ex. 1.5 Application of Science Inquiry ▪ Evaluate research reported in the media using the criteria provided. Current Science Article I ▪ Research paper on current science topic. Video – *Collapse* ▪ Observational notes. ▪ Inferences as to why collapses occurred. Video - *History of Biology* ▪ Notes on important discoveries in Biology.
Unit 2. The Molecules and Cells A. The Chemical Basis of Life ▪ Atoms and Molecules: atomic structure; elements; covalent bonds; ionic bonds; matter; isotopes; electron configuration influence on chemical behavior; compounds in living organisms. ▪ The Properties of Water: hydrogen bonding; solute, solvent, and solution; acids and bases; the affect of hydrogen ion concentration; pH scale; buffers; acid precipitation and the environment ▪ Rearrangement of Atoms: chemical reaction; reactants and products B. Molecules of the Cell ▪ Organic Compounds and Their Polymers: organic compounds; hydrocarbons; carbon skeleton; isomers; four functional groups of organic molecules; monomers; polymers; dehydration synthesis and hydrolysis ▪ Carbohydrates: structures and functions; properties and types of carbohydrate molecules ▪ Lipids: structures and functions; properties and types of lipid molecules	Ex 2.1 Buffering Capacity ▪ Define a buffer, and explain why buffers are important to organisms. ▪ Interpret a titration curve to determine whether a solution has buffering capacity and, if so, over what pH range. ▪ Explain why some solutions have buffering capacity and others do not. Ex 3.1 Carbohydrates ▪ Define monosaccharide, disaccharide, and polysaccharide and give examples of each. ▪ Name the monosaccharide components of sucrose and starch. ▪ Describe the test that indicated the presence of most small sugars. ▪ Describe the test that indicates the presence of starch. ▪ Define hydrolysis and give an example of the hydrolysis of carbohydrates. Ex 3.2 Lipids ▪ Define lipid and give examples. ▪ Describe the test that indicates the presence of lipids. Ex 3.3 Proteins ▪ Define protein and give examples.

- Proteins: structures and functions; properties and types of proteins
- Nucleic Acids: compare the structures and functions of DNA and RNA

C. Tour of the Cell

- The Microscope: light microscope; scanning electron microscope; transmission electron microscope; distinguish between magnification and resolving power
- Prokaryotic and eukaryotic cells: cell theory; upper and lower limits to cell size; compartmentalization in eukaryotic cells; structures and functions of plant and animal cell parts
- Organelles and the Endomembrane System: structures and function of the nucleus; endomembrane system; rough and smooth endoplasmic reticulum; Golgi apparatus; lysosomes
- Energy-Converting Organelles: structures and functions of mitochondria and chloroplasts
- The Cytoskeleton and Related Structures: structures and functions of microfilaments; intermediate filaments and microtubules; how the structures of cilia and flagella relate to their functions
- Eukaryotic Cell Surfaces and Junctions: structures and functions of cell surfaces; intercellular junctions of plant and animal cells

D. The Working Cell

- Energy and the Cell: kinetic, potential, and chemical energy; heat; first and second laws of thermodynamics; endergonic and exergonic reactions in cells; energy coupling; ATP
- Enzymes: role of enzymes in chemical reactions; structure of enzyme-substrate interaction; cellular environments affects on enzyme activity; competitive and noncompetitive inhibitors; certain pesticides and antibiotics work by inhibiting enzymes
- Membrane Structure and Function: organize the chemical activities of a cell; phospholipid molecules; structure of cell membranes; membrane proteins; active and passive transport; diffusion and osmosis; plant and animal cells response to hypertonic, hypotonic and isotonic solutions; facilitated diffusion; exocytosis, endocytosis, phagocytosis and pinocytosis; receptor mediated endocytosis, hypercholesterolemia
- Cellular Respiration: chemical equation; role of mitochondria in harvesting energy for cellular work
- Photosynthesis: chemical equation; role of chloroplast in harvesting energy for cellular work

- Explain why the structure of a protein is important for its function.
- Describe the test that indicates the presence of protein.

Ex 3.4 Macromolecules In Food

- Explain how the components of butter are distributed in two fractions by the process of clarification.
- Interpret the results of tests that indicate the presence of sugar, starch, lipid, and protein in unknown samples.

Ex 3.5 DNA Extraction

- Describe how DNA can be extracted from cells.
- Form a hypothesis about the outcome of the experiment.
- Use a positive and negative control to interpret the results of experimental unknown.

Ex 4.1 The Compound Microscope

- Determine total magnification of the lenses on your microscope.
- Explain the difference between magnification and resolving power.
- Identify the parts of the compound microscope and give the function of each part.
- Describe the procedure you would follow to locate and focus on a specimen using the scanning, low-power, or high-power objective.
- Define field of view and describe how the field of view changes with magnification.
- Define depth of focus and explain how it changes with magnification and how to adjust for it when viewing specimens.

Ex 4.2 Observing Cells

- Explain what stains are and why they are often used with biological materials.
- Make a slide of an animal cell and plant cell.
- Draw an animal and plant cell and identify cell structures.

Ex 4.3 Cell Size & Diffusion

- Calculate surface-area-to-volume ratio.
- Explain the significance of the surface-area-to-volume ratio in terms of movement of materials in a cell.
- Explain how a model can be used to help illustrate the relationship between the surface area of a cell and its volume.

Ex 4.4 Chemistry of Combustion, Respiration & Photosynthesis

- Compare the equations of combustion, respiration, and photosynthesis.
- Understand structural formula and chemical bonding.
- Duplicate the chemical activities of photosynthesis and respiration with molecule sets.
- Write balanced equations for photosynthesis and respiration.

Ex 5.1 Enzyme Catalysis

- Measure the effects of changes in temperature, pH, salinity, enzyme concentration, and substrate concentration on the rate of an enzyme-catalyzed reaction.
- Explain how environmental factors affect the rate of enzyme-catalyzed reactions.

Ex 5.2 Diffusion and Osmosis

- Investigate the processes of diffusion and osmosis in a model of a membrane system.
- Investigate the effect of solute concentration on water

	potential as it related to living plant tissues. Campbell Biology CD-ROM ▪ Activity ~ *Comparing Prokaryotic and Eukaryotic Cells* ▪ Activity ~ *Prokaryotic Cell Structure and Function* ▪ Activity ~ *Animal Cell Structure and Function* ▪ Activity ~ *Plant Cell Structure and Function* Current Science Article II ▪ Research paper on current science topic. Video – *The Microscopic World*
Unit 3. Cellular Reproduction and Genetics A. Cellular Basis of Reproduction and Inheritance ▪ Cell Division and Reproduction: asexual versus sexual reproduction; Virchow's principle regarding cellular reproduction; binary fission ▪ Eukaryotic Cell Cycle and Mitosis: Prokaryotic and Eukaryotic chromosomes; stages and significance of the cell cycle; phases of mitosis and describe the events characteristics of each phase; cytokinesis in animals and plants; anchorage, cell density, and growth factors control influence the cell cycle; cancerous cells; benign and malignant tumors; strategies behind some common cancer treatments ▪ Meiosis and Crossing Over: somatic cells and gametes; diploid and haploid cells; autosomes and sex chromosomes; phases of meiosis I and meiosis II and describe events and characteristics of each phase; key differences between mitosis and meiosis; genetic variation in sexually reproducing organisms through independent orientation, crossing over, and random fertilization ▪ Alterations of Chromosome Number and Structure: karyotyping; causes and symptoms of Down syndrome; nondisjunction; consequences of abnormal number of sex chromosomes B. Patterns of Inheritance ▪ Mendel's Principles: rejection of pangenesis theory and blending hypothesis; Mendel's work with peas; true-breeding organisms; hybrids; the P generation, the F1generation, the F2 generation; genotypes and phenotypes; dominant allele vs. recessive allele; heterozygous vs. homozygous; Punnett square; monohybrid and dihybrid crosses; alleles; homologous chromosomes; Mendel's principle of independent assortment; testcrosses used to determine organism's genotype; probability rules of addition and multiplication; family pedigrees and inheritance of traits; recessive and dominant disorders; advantages and disadvantages of amniocentesis, chorionic villus sampling and ultrasound imaging ▪ Variation on Mendel's Principles: inheritance patterns of incomplete dominance; multiple	Ex 8.1 Mitosis & Meiosis ▪ Examine and compare the phases of mitosis in animal and plant cells. ▪ Determine the relative time cells spend in each phase of mitosis. ▪ Prepare microscope slides of mitotic cells using allium root tips. ▪ Follow the processes of mitosis and meiosis in the life cycle of Sordaria. ▪ Examine the arrangement of Sordaria ascospores microscopically to determine the frequency of crossing-over ▪ Calculate the distance, in map units, between a specific gene and the chromosome centromere. Ex 8.2 Model of Meiosis ▪ List in correct order and describe the steps of meiosis. ▪ Understand the role chromosomes play in the process of reproduction. ▪ Describe the effects of Independent Orientation on genetic variation. ▪ Describe the effects of Crossing Over of genetic variation. ▪ Discussion the advantages and disadvantages of using models to help explain biological events like meiosis. Ex 8.4 Human Karyotyping ▪ Describe how human karyotypes are typically prepared. ▪ Use concepts such as homologous chromosomes, centromeres, and DNA banding to help you simulate building karyotypes. ▪ Understand how human karyotypes are used to identify chromosomal problems. ▪ Recognize the differences between normal human karyotypes and those that have chromosomal abnormalities. Ex 9.1 Probability and Genetics ▪ Determine the probability for the results of tossing a single coin. ▪ Determine the probability for the results of tossing two coins at the same time. ▪ Understand and calculate percent deviation. ▪ Identify examples demonstrating the rules of probability. Ex 9.2 Genetics of Corn Kernels ▪ Use a model to illustrate Mendel's principle of segregation. ▪ Construct Punnett squares to show the results of genetic crosses. ▪ Calculate actual phenotype ratios in two stains of corn.

alleles and pleiotrophy; distinguish between carrier testing, diagnostic testing, prenatal testing, newborn screening, and predictive testing; many genes influence a single characteristic ▪ The Chromosomal Basis of Inheritance: linked genes are inherited differently; Morgan's studies of crossing over; linkage maps ▪ Sex Chromosomes and Sex-Linked Genes: sex is genetically determined in humans; significance of the SRY gene; patterns of sex-linked inheritance C. Molecular Biology of the Gene ▪ The Structure of the Genetic Material: experiments of Griffith, Hershey and Chase; compare the structure of DNA and RNA ▪ DNA Replication: structure of DNA; process of DNA replication; DNA polymerases and ligase ▪ The Flow of Genetic Information from DNA to RNA to Protein: locations and products of transcription and translation; major types of mutations and their possible consequences ▪ Viruses: lytic and lysogenic reproductive cycles; prophage; plant viruses; new viruses evolve; AIDS virus reproduction D. Control of Gene Expression ▪ Cellular Differentiation: patterns of gene expression; cloning of eukaryotes; adult stem cells; gene regulation in eukaryotes; embryonic development; genetic basis of cancer ▪ Human Genome Project: importance of sequencing genomes, telomeres	Ex 10.1 DNA Model Building and Replication of DNA ▪ Use a model to review the molecular make-up of DNA ▪ Use a model to simulate DNA replication. Ex 10.2 RNA and Protein Synthesis ▪ Use a model to review the molecular make-up of RNA ▪ Use a model to simulate transcription and translation of RNA. ▪ Use a model to simulate protein synthesis. Campbell Biology CD-ROM ▪ Activity ~ *The Cell Cycle* ▪ Activity ~ *The Hershey-Chase Experiment* ▪ Activity ~ *DNA and RNA Structure* ▪ Activity ~ *DNA Double Helix* ▪ Activity ~ *Transcription* ▪ Activity ~ *Translation* ▪ Activity ~ *The Human Genome Project: Human Chromosome 17* ▪ Thinking as a Scientist ~ *How much time do cells spend in each phase of mitosis?* ▪ Thinking as a Scientist ~ *How can the frequency of crossing over be estimated?* Current Science Article III ▪ Research paper on current science topic.
Unit 4. Evolution A. Populations ▪ Evidence of Evolution: evolutionary adaptations; descent with modification; fossils and the fossil record; biogeography; comparative anatomy of homologous structures; comparative embryology; molecular biology ▪ Darwin's Theory and the Modern Synthesis: artificial and natural selection; populations and population genetics; modern synthesis; species concept; gene pool; microevolution; Hardy-Weinberg equilibrium; genetic drift, bottleneck effect, founder effect and gene flow; mutations are rare events ▪ Variation and Natural Selection: polymorphic populations; geographic variation; genetic variation; gene diversity; nucleotide diversity of DNA sequences; sexual recombination, independents assortment, crossing over and random fertilization; "hidden" recessive alleles, heterozygote advantage; neutral variation; reduced variation in endangered species; Darwinian fitness; stabilizing, directional and diversifying selection; sexual dimorphism; antibiotic resistance in bacteria B. Origin of Species ▪ Concepts of Species: speciation; taxonomy; biological species concept; ring species;	Ex. 13.1 Population Genetics and Evolution ▪ Simulate random mating patterns and utilize the Hardy-Weinberg principle to determine allele frequencies. ▪ The effect natural selection has on allelic frequencies. ▪ How natural selection reduces the frequency of recessive traits. ▪ How the Hardy-Weinberg law of genetic equilibrium can help determine whether evolution is occurring. Ex 13.2 Human Heredity ▪ Form a pedigree of their immediate family ability to taste PTC. ▪ Determine, from their PTC pedigree and classmates pedigrees whether the gene for tasting PTC is autosomal dominant or recessive. ▪ Calculate, using class data, the frequency of the recessive gene, the dominant gene, and the genotypes in a population. ▪ Predict, using the Hardy-Weinberg equation, the frequency of the genotypes in a large population. Ex 14.1 Speciation ▪ Plot field data to create a species distribution map. ▪ Analyze and discuss the distribution of *Ensatina eschscholtzii* in California. ▪ Discuss the biological species concept, as well as other species concepts, and know how they are used to define a species. Ex 14.2 Variation

geographic barriers; morphological, genealogical and ecological species concept; reproductive barriers: prezygotic (temporal isolation, habitat isolation, behavioral isolation, mechanical isolation and gametic isolation) and postzygotic (hybrid inviability, hybrid sterility and hybrid breakdown) ▪ Mechanisms of Speciation: allopatric speciation; microevolutionary processes: mutation, genetic drift, and natural selection: geographic isolation; adaptive radiation (Darwin's finches of the Galapagos Island chain); sympatric speciation; polyploidy; reproductive barriers; gradualist model and punctuated equilibrium model of speciation	▪ Collect and plot data gathered on the variation of size in a sample population. ▪ Construct both a line and frequency distribution graph. ▪ Analyze data with mathematical treatments. ▪ Explain the concept of variation within a population. Ex 14.3 Natural Selection ~ A Simulation ▪ Successfully conduct a simulation of natural selection. ▪ Construct bar graphs and analyze collected data for trends related to natural selection. ▪ Explain the interrelationship between predators, the coloration of their prey and habitat. ▪ Give an example of natural selection in action today. Campbell Biology CD-ROM ▪ Activity ~ *Darwin and the Galapagos Islands* ▪ Activity ~ *Genetic Variation from Sexual Recombination* ▪ Activity ~ *Exploring Speciation on Islands* Current Science Article IV ▪ Research paper on current science topic. Video – *History of Evolutionary Thought*
Unit 5. Ecology A. The Biosphere ▪ Ecology: characteristics of the biosphere; organisms; populations; community; habitats; ecosystems; abiotic (solar energy, water, temperature and wind) and biotic components ▪ Aquatic biomes: ocean evaporation; photosynthesis of marine algae; estuaries and wetlands; intertidal zone and continental shelf; pelagic and benthic zones; phytoplankton and zooplanktion; photic and aphotic zones; coral reefs; freshwater biomes:lakes, ponds, rivers, and streams ▪ Terrestrial biomes: tropical forest, savannas, deserts, chaparral, temperate grasslands, temperate deciduous forests, coniferous forests, taiga, and tundra B. Population Dynamics ▪ Population structure and dynamics: populations and population density; mark-recapture method; dispersion patterns: clumped, uniform and random; mathematical equations of population growth (intrinsic rate of increase); exponential growth model, G = *rN*; population-limiting factors; logistic growth model; carrying capacity (K), G = *rN* [(K–N)/K]; limits to population growth; density dependent and independent factors; "boom-and-bust" cycles ▪ Life histories and their evolution: life tables; survivorship curves: Type I, Type II and Type III; life histories; *r*-selection and *K*-selection ▪ The human population: exponentially growth; ecological footprint; demographic transition; age structures; renewable resource management; maximum sustained yield C. Communities and Ecosystems ▪ Structural features of communities: communities; biodiversity; community stability; interspecific	Ex 35.1 Population Change ~ A Model ▪ Use a mathematical model to predict population change in hypothetical populations. ▪ Graph population growth of hypothetical populations on arithmetic and semi logarithmic graph paper and analyze. Ex 35.2 Population Change ~ Field Data ▪ Graph population data for several natural populations and determine reasons for population fluctuations. Current Science Article V ▪ Research paper on current science topic. Campbell Biology CD-ROM ▪ Activity ~ *Aquatic Biomes* ▪ Activity ~ *Terrestrial Biomes* ▪ Activity ~ *Techniques for Estimating Population Density and Size* ▪ Activity ~ *Investigating Survivorship Curves* ▪ Activity ~ *Human Population Growth* ▪ Activity ~ *Energy Flow and Chemical Cycling* ▪ Activity ~ *Food Webs* ▪ Activity ~ *Energy Pyramids* Video ~ *Human Population Growth*

competition; niche; competitive exclusion principle; resource partitioning; predation (force of evolution); coevolution; Batesian mimicry, Mullerian mimicry; keystone species; symbiotic relationship; predator, prey and parasitism; commensalisms and mutualism; disturbances in communities; ecological succession; primary and secondary succession ▪ Ecosystems structure and dynamics: ecosystem; energy flow and chemical cycling; food web and food chain; producers, primary consumers, secondary consumers, tertiary consumers, quaternary consumers, decomposer; biomass; primary production; abiotic reservoirs: water cycle, carbon cycle, nitrogen cycle, and phosphorus cycle ▪ Ecosystem alteration: zoned reserves	
Unit 6. Animals: Form and Function A. Unifying Concepts of Animals Structure and Function ▪ Structural Organization in an Animal: cells, tissues, organs, and organ systems ▪ Digestion systems: nutrition and the human digestive system ▪ Respiratory systems: mechanisms of gas exchange; transports of gases in the body ▪ Circulatory systems: mammalian cardiovascular system; structure and function of blood ▪ Lymphatic and Immune systems: nonspecific defenses against infection and specific immunity ▪ Excretory systems: structure and function ▪ Endocrine systems: structure and function ▪ Reproductive systems: embryonic development; human development ▪ Nervous systems: structure and function; nerve signals and their transmission ▪ Muscular systems: skeletal muscles provide movement; muscle cells; calcium's role in muscle contraction; aerobic and anaerobic exercise. ▪ Skeletal systems: bones and cartilage provide support and protection; movement; types of skeletons; structure of bone; types of joints ▪ Integumentary systems: skin, hair and nails; protect the internal body B. Homeostasis: ▪ negative feedback; thermoregulation; excretion; liver function; hormones	Ex 20.1 Measuring Cardiovascular Function in Humans ▪ Determine pulse rate for an individual. ▪ Determine blood pressure for an individual. ▪ Describe the cardiac cycle and how it relates to heart sounds and blood pressure. ▪ Explain how and why hypertension, atherosclerosis, and arteriosclerosis affect circulation. ▪ Design an original experiment to investigate some factor that affects pulse rate and/or blood pressure. Campbell Biology CD-ROM ▪ Activity ~ *Correlating Structure and Function of Cells* ▪ Activity ~ *Levels of Life* ▪ Activity ~ *Regulation: Negative and Positive Feedback* Seminar ▪ Students are given a topic from Unit 6 that they are responsible for researching and teaching to the class. Each topic is accompanied with specific objectives that will be addressed in the student's oral presentation. Current Science Article VI ▪ Research paper on current science topic.

V. Texts & Supplemental Instructional Materials

- Benjamin Cummings: *Biology Concepts & Connections* 4th Edition (2003) Campbell, Reece, Mitchell, Taylor
- Benjamin Cummings: *Laboratory Investigations for Biology* 2nd Edition (2003) Dickey
- Campbell Biology CD-ROM and Web Site

VI. Instructional Methods and/or Strategies

- Laboratory Investigation
- Lecture and Discussion
- Research - library and Internet
- Project-based learning
- Group Work
- Readings
- CD-ROMs
- Videos

VII. Assessment Methods

- Laboratory Reports (40%)
- Written Exams and Quizzes (30%)
- Homework Assignments (10%)
- Current Science Research Papers (5%)
- Classroom Participation (5%)
- Comprehensive Final Exam ~ including laboratory concepts (10%)

Ernest Righetti High School has set goals through our Expected School wide Learning Results, ESLR's. Both teachers and administrators at Ernest Righetti High School set these goals. All students are expected to achieve these goals before graduation. As a result, the assessment criteria for the Honors Biology course take into account for these gals and students are held accountable to achieve these goals.

These goals are:

- Students will demonstrate effective communication skills in both reading and writing.
  - Students will use reading skills to build meaning, and gather information from a variety of grade level materials.
  - Students will write text with a clear purpose, supporting evidence, using accurate punctuation, and sentence structure.
- Students will demonstrate essential mathematical skills in:
  - Statistics, Data Analysis & Probability
  - Algebra and Functions
  - Mathematical Reasoning
  - Number sense
  - Measurement & Geometry
  - Algebra 1
- Student will demonstrate critical thinking skills.
  - Can identify, define and develop solutions to problems.
  - Organize, analyze, interpret, and evaluate information.
  - Utilize acquired skills in new situations.
- Students will demonstrate goal setting skills:
  - Assessment and Research
- Students will demonstrate the ability to work cooperatively with culturally diverse groups.
  - Student involvement in divers groups.

C. HONORS COURSES ONLY

How this honors course is different from the standard course.

This Honors Biology course differs from the standard Biology course in three major ways.

- First of all, the honors course is accelerated. Students are required to complete a summer assignment. Successful completion of this work introduces the student to Unit 1 and Unit 2 (A & B) of the course. This material is then used as a foundation for the first four weeks of the course, which is entirely laboratory based. The summer assignment also serves to set the tone for the class. Students are aware that the Honors Biology course will challenge them academically and if they are to be successful they must be self-motivated.
- Secondly, the course includes laboratory experiments, some of which are recommended AP Biology Laboratories, which are not used in the standard Biology course. Laboratory topics are explored in depth and involve data analysis and research. Laboratory experiments stress the importance of detailed observation, accurate recording, experimental design, and data interpretation.
- And lastly, the course textbook, *Biology Concepts & Connections*: Campbell, Reece, Mitchell, and Taylor, is a college introductory biology text. This textbook is the corner stone of the course. The concepts and principles of biology as presented in this text serve to raise the academic bar in the Honors Biology course well above the standard Biology course.

Course requested by: Ernest Righetti High School Science Department

Funding Source: School funds

Contact Person: Rebecca Wingerden, Ernest Righetti Science Department