

FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

BIOLOGY HL

Date: April 2014

Course Length: 2 Years

Proposed Grade Level(s): 11th and 12th

Subject Area/Credits: Science IB / 5 per Semester

Grading: A-F

Prerequisite: “C” or better in Honors Biology or Biology

Intent to Pursue College Prep Status through the UC System: ☒ Yes ☐ No

COURSE DESCRIPTION:

An emphasis of this course is a practical approach through experimental work, with a required project that mirrors the work of real scientists by encouraging collaboration between schools across the regions. A biology students’ approach to study should be characterized by the specific IB learner profile attributes – inquirers, thinkers and communicators. There are four basic biological concepts that run throughout the course:

- Structure and function; this relationship is probably one of the most important in a study of biology and operates at all levels of complexity. Students should appreciate that structures permit some functions while, at the same time, limiting others.
- Universality versus diversity; at the factual level, it soon becomes obvious to students that some molecules (for example, enzymes, amino acids, nucleic acids and ATP) are ubiquitous and so are processes and structures. However, these universal features exist in a biological world of enormous diversity. Species exist in a range of habitats and show adaptations that relate structure to function. At another level, students can grasp the idea of a living world in which universality means that a diverse range of organisms (including ourselves) are connected and interdependent.
- Equilibrium within systems; checks and balances exist both within living organisms and within ecosystems. The state of dynamic equilibrium is essential for the continuity of life.
- Evolution; the concept of evolution draws together the other themes. It can be regarded as change leading to diversity within constraints and this leads to adaptations of structure and function.

These four concepts serve as themes that unify the various topics that make up the three sections of the course: the core, the additional higher level (AHL) material and the options.

GENERAL GOALS/ESSENTIAL QUESTIONS:

The primary goal of IB Biology HL is to prepare students to take the IB exams at the end of their senior year. In order to do this, students will need detailed knowledge of the unit topics listed below, as well as a sophisticated skill set that allows them to think, act, and write like a scientist.

CCSS READING COMPONENT:

Students will read from various text sources including science texts, science journals, science news articles and a variety of science web materials. Students will cite strong and thorough textual evidence to support analysis of what the text says.

Students will integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address biology questions or solve biology problems. Students will gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

Students will draw evidence from literary and/or informational texts to support analysis, reflection, and research on a variety of biology topics.

CCSS WRITING COMPONENT:

Students will complete investigations that are complex and commensurate with the level of the IB HL Biology course. These will require a purposeful research question and scientific rationale. Students will write a thorough lab report with a detailed background, methodology, analysis, and conclusion.

During the course, students will complete writing assignments and other investigations where students will state scientific claims and support them with evidence.

CCSS SPEAKING AND LISTENING COMPONENTS:

Students will initiate and participate effectively in collaborative discussions including one-on-one, in groups and teacher led.

Students engage in peer teaching, presentations of research findings, class discussions.

Students will complete independent investigations. Students will complete a collaborative project with students in IB SL Chemistry investigating a scientific or technological problem where students will plan, implementing (action) and evaluate the project. The students will decide on the project to be completed.

DETAILED UNITS OF INSTRUCTION:

Students will study all of the core topics, all of the additional higher level topics and one of the four options. The order of the topics, advanced higher level topics and the option will be left to the discretion of the teacher. The option chosen will be left to the discretion of the teacher. In addition to the topics studied, students will complete 60 hours of a practical scheme of work (science investigations); a group 4 project will be completed with SL Chemistry students; and an independent investigation which will be evaluated both internally and externally.

Core topics:

Cell biology

- Introduction to cells
- Ultrastructure of cells
- Membrane structure
- Membrane transport
- The origin of cells
- Cell division

Molecular biology

- Molecules to metabolism
- Water
- Carbohydrates and lipids

- Proteins
- Enzymes
- Structure of DNA and RNA
- DNA replication, transcription and translation
- Cell respiration
- Photosynthesis

Genetics

- Genes
- Chromosomes
- Meiosis
- Inheritance
- Genetic modification and biotechnology

Ecology

- Species, communities and ecosystems
- Energy flow
- Carbon cycling
- Climate change

Evolution and Biodiversity

- Evidence for evolution
- Natural selection
- Classification of biodiversity
- Cladistics

Human Physiology

- Digestion and absorption
- The blood system
- Defense against infectious disease
- Gas exchange
- Neurons and synapses
- Hormones, homeostasis and reproduction

Additional Higher Level Topics:

Nucleic Acids

- DNA structure and replication
- Transcription and gene expression
- Translation

Metabolism, cell respiration and photosynthesis

- Metabolism
- Cell respiration
- Photosynthesis

Plant Biology

- Transport in the xylem of plants
- Transport in the phloem of plants
- Growth in plants
- Reproduction in plants

Genetics and Evolution

- Meiosis
- Inheritance
- Gene pools and speciation

Animal Physiology

Antibody production and vaccination
Movement
The kidney and osmoregulation
Sexual reproduction

Options:

Neurobiology and Behaviour

Neural development
The human brain
Perception of stimuli
Innate and learned behaviour
Neuropharmacology
Ethology

Biotechnology and Bioinformatics

Microbiology: organisms in industry
Biotechnology in agriculture
Environmental protection
Medicine
Bioinformatics

Ecology and Conservation

Species and communities
Communities and ecosystems
Impacts of humans on ecosystems
Conservation of biodiversity
Population ecology
Nitrogen and phosphorus cycles

Human Physiology

Human nutrition
Digestion
Functions of the liver
The heart
Hormones and metabolism
Transport of respiratory gases

TEXTBOOKS AND RESOURCE MATERIALS:

- Oxford IB Diploma Programme Biology (Allott and Mindorff, 2014) with Kerboodle online resources.
- Campbell Biology AP ed. 10th ed. (Reece Et al. 2014) with Mastering Biology, Pearson etext, and a 6 yr renewal or Campbell Biology in Focus AP Ed. (Reece et al 2014) with Mastering Biology, Pearson etext, and a 6 yr renewal
- Practicing Biology, A Student workbook, for Campbell Biology (Campbell/Reece).
- Student Study Guide for Campbell Biology (Martha Taylor).
- Investigating Biology, Laboratory manual (Judith Morgan) including Teacher Instruction Edition and teacher preparation manual.
- Biological Inquiry – A Workbook of Investigative Cases for Campbell Biology (Waterman & Stanley).
- Test Prep workbook for Campbell Biology (Holtzclaw & Holtclaw).

- Biozone IB Biology Student workbook (Richard Alan, Biozone International Ltd) including supporting teacher materials.
- AP Biology Investigative Labs- An Inquiry Based Approach (College Board, 2012).
- IB Course Companion (Andrew Allott , Oxford including teacher materials.
- IB Study Guide (Andrew Allott, Oxford).

Supplemental reading:

- Survival of the Sickest, Sharon Moalem
- Your Inner Fish, Neil Shubin
- Complications- A Surgeons Notes on Imperfect Science, Atul Gawande
- Riddled with Life, Marlene Zuk
- The Immortal Life of Henrietta Lacks, Rebecca Skloot
- The Hot Zone, Richard Preston

COMMON CORE STANDARDS to be ADDRESSED:

IB courses promote student-led, inquiry based lessons. While teachers are there to provide contextual knowledge, much of the deeper analytical work is done by students. Students will gain the skills of a scientist allowing them to conduct independent research, independently analyze newly learned scientific information, and have a contextual understanding of science . IB DP HL Biology will give students a strong foundation from which to become life-long learners.

1. HS-LS1 From Molecules to Organisms: Structures and Processes

- 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.

1. HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

- 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 the 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 the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

1. HS-LS3 Heredity: Inheritance and Variation of Traits

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.

1. HS-LS4 Biological Evolution: Unity and Diversity

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.*

California Common Core Standards

Common Core State Standards Connections:

ELA/Literacy –

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

WHST.9-12.1 Write arguments focused on discipline-specific content.

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.9-12.5 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.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Mathematics –

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

HSF-BF.A.1 Write a function that describes a relationship between two quantities.

Mathematics -

HSS-ID.A.1 Represent data with plots on the real number line.

HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

HSS-IC.B.6 Evaluate reports based on data.

DISTRICT ESLRs to be ADDRESSED:

Students will be:

- **Self-Directed Learners:**

Students will complete independent investigations. Students will complete a collaborative project with students in SL chemistry investigating a scientific or technological problem where students will plan, implement (action) and evaluate the project. The students will decide on the project to be completed. At the end of the project they will present their findings

- **Effective Communicators:**

Students will complete investigations that are complex and commensurate with the level of the IB HL Biology course. These will require a purposeful research question and scientific rationale. Students will write a thorough lab report with a detailed background, methodology, analysis, and conclusion.

Students engage in collaborative discussions; presentations of research findings.

- **Quality Producers/Performers:**

Students will complete independent investigations. Students will complete a collaborative project with students in SL Chemistry investigating a scientific or technological problem where students will plan, implement (action) and evaluate the project. The students will decide on the project to be completed. At the end of the project they will present their findings

Students will complete multiple forms of high level papers and an investigation that will be evaluated for an IB diploma

- **Constructive Thinkers:**

Students will participate in many inquiry based lessons. They will analyze and evaluate scientific data. They will design their own science investigations.

- **Collaborative Workers:**

Students will participate in collaborative groups both in the HL Biology course and with the SL Chemistry course. Students will complete a project with SL Chemistry students.

- **Responsible Citizens:**

The course will support their work in Community Action Service which requires students to serve within their community and reminds them about the importance of their role in the global society.

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