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**Textbooks** *Biology AP Edition, 8th Edition.* Campbell & Reece (2009)

**Classroom**  Room **#210** in the **SOUTH HIGH SCHOOL**

**Prerequisites**  Pre-AP Biology or Sophomore Biology; Chemistry or joint enrollment required

**Required Materials** Textbook, *Biology: AP Edition (8th edition)*

 3-ring binder

**Instructional** Cliffs Notes: AP Biology

**Resources** 5 Steps to a 5: AP Biology (McGraw-Hill)

Copies of these materials can be found in the classroom for in-class use

**Websites of Interest** AP Central: apcentral.collegeboard.com Book website: [www.campbellbiology.com](http://www.campbellbiology.com)

**Advanced Placement Biology Content**

This course in AP Biology is structured around the four Big Ideas, the Enduring Understandings within the big Ideas, and the Essential Knowledge within the Enduring Understandings.

**The Big Ideas:**

* **Big Idea 1**: The process of evolution drives the diversity and unity of life.
* **Big Idea 2**: Biological systems utilize fee energy and molecular building blocks to grow, to reproduce and to

 maintain dynamic homeostasis.

* **Big Idea 3**: Living systems store, retrieve, transmit and respond to information essential to life processes.
* **Big Idea 4**: Biological systems interact and these systems and their interactions posses complex properties.

**The Investigative Laboratory Component**

The course is structured around inquiry in the lab and the use of seven science practices throughout the course. Students will be given the opportunity to engage in student-directed laboratory investigations throughout the course of a minimum of 30% of instructional time. Students will be required to participate in a minimum of eight inquiry-based investigations (two per big idea) throughout the course) as described in *AP Biology Investigative Labs: an Inquiry Based Approach.* The science practices (SP) covered by each lab are listed in this document. These practices are:

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.

2. The student can use mathematics appropriately.

3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of

 the AP course.

4. The student can plan and implement data collection strategies appropriate to a particular scientific question.

5. The student can perform data analysis and evaluation of evidence.

6. The student can work with scientific explanations and theories.

7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across

 domains.

**Units of Instruction**

The course content has been divided into eight instructional units. Four units will be presented each semester. The Four Big Ideas will be interwoven within the unit(s).

The following pages contain a detailed summary of content covered in each unit.

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| --- | --- |
| **Unit 1 – Introduction and Biochemistry *Big Ideas 1, 2*** 1 – Introduction to AP Biology 2 – Chemistry of Life (self-study: summer) 3 – Water (self-study: summer) 4 – Carbon and Molecular Diversity (self-study: summer) 5 – MacromoleculesConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 2.A Growth, reproduction and maintenance of the organization of living systems requires free energy.
* 3.A Heritable information provides for continuity of life.
* 4.A Interactions within biological systems lead to complex properties.
 | **Suggested Labs**Introduction to Inquiry Labs, GraphingAnimal Behavior – red worms or pillbugsMacromolecules – testing and model makingEssay Writing, Rubric Setting and Practice Grading **Unit 1 Activities:**1. Lecture and discussion
2. Biochemistry homework assignment.
3. Students construct models of atoms (SP 1)
4. Students participate in a classroom demonstration of dehydration synthesis and hydrolysis of polymers. (SP 1)
5. Students perform water demonstrations to visualize cohesion, adhesion and capillary action. (SP 1)
6. **Animal Behavior Lab Inquiry:** Pillbugs are used to serve as an introduction to inquiry designed laboratory investigations; Students complete this laboratory write up within their laboratory notebook. (SP 3,4, 5, 6)
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| **Unit 2 – Cells and Cell Cycle *Big Ideas 1, 2, 3, 4*** 6 – Tour of a Cell (self-study) 7 – Membrane Structure and Function 12 – Cell Cycle 44 – Osmoregulation and Excretion Connection to enduring understandings:* 2.A Growth, reproduction and maintenance of the organization of living systems requires free energy.
* 2.B Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.
* 3.A Heritable information provides for continuity of life.
* 4.A Interactions within biological systems lead to complex properties.
* 4.B Competition and cooperation are important aspects of biological systems.
* 4.C Naturally occurring diversity among and between components within biological systems affect interactions with the environment.
 | **Suggested Labs**Cell observations with a MicroscopeOsmosis – dialysis tubing, potatoesMitosis**Unit 2 Activities:**1. Lecture and discussion
2. Students complete reading guides to reinforce chapter 6, 7 and 12.
3. Students complete a reading guide to reinforce chapter 44.
4. Cells and the Cell Cycle homework assignment.
5. Test your Understanding Activity: Students are given class time to prepare a written response to the following: *Explain your reasoning as to the outcome of experiments whose outcomes depend on the chemical characteristics of the four main types of macromolecules*.
6. Students construct a model of the cell membrane using construction paper, markers or other approved material, showing membrane structures and embedded proteins. Students present their membranes to the class and identify the function of each component part. (SP 1)
7. **Diffusion and Osmosis Lab Inquiry:** A demonstration using dialysis tubing will provide students the opportunity to observe diffusion; Students set up an experiment regarding osmosis and concentration gradients, after hypothesizing the outcome; data collection, calculations of percent change, graphing percent change in mass of dialysis bags of varying sucrose molarities placed in water. Analysis of data collected will follow and work is kept in laboratory notebook. (SP 1, 2, 3, 4, 5, 6)
8. Modeling the cell cycle. Students construct a model of the cell cycle , explaining the events in a poster. (SP 1)
9. **Mitosis/Cell Cycle Lab Inquiry:** Students will treat onion root cells with lectin to increase mitotic rate in cells. Students design a controlled experiment to test the effect of treated root squashes and use Chi Square to analyze data. A write up of the laboratory and outcome, including calculations and analysis of data will be reported in the laboratory notebook. (Big idea 3; SP 2, 3, 4, 5)
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| **Unit 3 – Cellular Energy *Big Ideas 1, 2, 4*** 8 – Introduction to Metabolism 9 – Cellular Respiration 10 – PhotosynthesisConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 1.D The origin of living systems is explained by natural processes.
* 2.B Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
* 4.A Interactions within biological systems lead to complex properties.
* 4.B Competition and cooperation are important biological systems.
 | **Suggested Labs**Enzymes Respiration – pea respirationPhotosynthesis **Unit 3 Activities:**1. Lecture and discussion.
2. Students complete reading guides to reinforce chapter 8, 9 and 10 content/material.
3. Bioenergetics homework assignment.
4. Table activity: How do C3, C4 and CAM plants compare in their photosynthesis mechanics?

(connection of big idea #2 to enduring understanding 1.A)1. Students will construct an enzyme foldable to use as a reference for enzyme activity. (SP 1)
2. **Pea Respiration Inquiry Lab:** Students will engage in the process of inquiry as they conduct an experiment to measure the rate of cell respiration in germinating peas at room temperature. Students will then design a controlled experiment to answer a question of their choice that they asked while discussing the experiment at room temperature. Students will collect and determine cell respiration rates and demonstrate an understanding of concepts involved by performing their laboratory write up in the laboratory notebook. (Big idea 2; SP 2, 3, 4, 5)
3. **Photosynthesis Lab:** Student-directed and inquiry based investigations about photosynthesis using the floating disc procedure. The laboratory write up will be included in the students’ laboratory notebook. (Big idea 2; SP 2, 3, 4)
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| **Unit 4 – Organism Form and Function *Big Ideas 1 , 2, 3, 4*** 11 – Cell Communication 45 – Hormones and the Endocrine  System 48 – Neurons, Synapses and Signaling 43 – Immune System 40 – Basic Principles of Animal Form  and Function (self-study)Connection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 1.B Organisms are linked by lines of descent from common ancestry.
* 2.A Growth, reproduction and maintenance of the organization of living systems requires free energy.
* 2.C Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
* 2.D Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment.
* 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
* 3.E Transmission of information results in changes within and between biological systems.
* 4.A Interactions within biological systems lead to complex properties.
* 4.B Competition and cooperation are important biological systems.
 | **Suggested Labs**Cell Communication – simulation Hormones Nerve signaling –website investigation**Unit 4 Activities:**1. Lecture and discussion.
2. Students complete reading guides over each chapter to reinforce content and material.
3. Cell communication homework assignment.
4. Animal form and function/immune system homework assignment.
5. Hormones and the Endocrine system/Nervous System homework assignment.
6. “Pathways with Friends”-Using instructional cards, students demonstrate the stages of cell signaling, as well as different types of cell signaling in animals. (SP 1)
7. Biological Inquiry (Campbell, 8th edition): A Workbook of Investigative Cases-Explore the immune response to pathogens with the case of “Pandemic Flu (Past and Possible)”.
8. The Nerve Impulse-animation ([www.highered.mcgraw-hill.com](http://www.highered.mcgraw-hill.com)). The class will view this animation and discuss; students will then be asked to take the included quiz as table groups; students will present their answers to the class. (SP 1, 3)
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| **Unit 5 – Genetic Basis of Life *Big Ideas 1, 3, 4*** 13 – Meiosis and Sexual Life Cycles  14 – Mendel and the Gene Idea 15 – Chromosome Basis of Inheritance 21 – Genomes and their EvolutionConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 3.A Heritable information provides for continuity of life.
* 3.B Expression of genetic information involves cellular and molecular mechanisms.
* 3.C The processing of genetic information is imperfect and is a source of genetic information.
* 4.C Naturally occurring diversity among and between components within biological systems affect interactions with the environment.
 | **Suggested Labs**Meiosis simulationFast Plants-grow in the labFruit Fly Genetics simulation, Chi Square test on Genetic CornHuman Genetic Diseases **Unit 5 Activities:**1. Lecture and discussion.
2. Students complete reading guides over each chapter to reinforce content and material.
3. Meiosis and the Sexual Life Cycles homework assignment.
4. Mendel and the Gene Idea homework.
5. Chromosome Basis of Inheritance homework.
6. Genomes and their Evolution homework.
7. PTC Taste Paper Strips Activity. Students will test members of the student population for the presence of the allele necessary to taste PTC.
8. M & M Chi Square Activity. Students will count the colors of small packages of M & M’s and apply the null hypothesis concept and Chi square analysis/calculations on the data. Students will use the % of each color supplied by the Mars Co.

(SP 2)1. Chromosomes bead kits will be used in class so students can simulate the process of meiosis and explain the concept of haploidy. (SP 1)
2. **Meiosis in Sordaria Laboratory:** Students will analyze the outcomes of Sordaria crosses, determine phenotypes due to crossing over or non-crossing over and will determine the percent of recombination. Students will compare their data with known map distances from genes to the centromere of a sample chromosome.

(SP 2, 5) |
| **Unit 6 – Gene Activity and Biotechnology *Big Ideas 1, 2, 3, 4***  16 – Molecular Basis of Heredity 17 – From Gene to Protein 18 – Regulation of Gene Expression 19 – Viruses (self-study) 20 – BiotechnologyConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 2.C Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
* 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
* 3.A Heritable information provides for continuity of life.
* 3.B Expression of genetic information involves cellular and molecular mechanisms.
* 3.C The processing of genetic information is imperfect and is a source of genetic information.
* 4.A Interactions within biological systems lead to complex properties.
 | **Suggested Labs**DNA IsolationTransformation using pGLORestriction Enzymes and Gel Electrophoresis**Unit 6 Activities:**1. Lecture and discussion.
2. Students will complete reading guides over each chapter to reinforce content and material.
3. Unit 6 Homework Assignment: includes chapters 16, 17, 18, and 20.
4. Modeling T n’ T. Students will complete a hands on demonstration of the steps/stages of transcription and translation using construction paper cut outs and manipulatives. Each partnership will explain the process to another group. (SP 1, 3, 4, 5, 6)
5. DNA Isolation Activity. Using DNA strands on paper, students will model the process of DNA digestion using paper enzymes. Students will isolate samples of DNA sequences to compare to DNA sequences provided for other organisms.

(SP 1, 3, 5)1. **Biotechnology Laboratory-Transformation**: Students will perform transformation using bacterial cells and manipulating them by introducing a plasmid containing a gene which can be expressed, producing protein products that make the cell glow. Students study plasmid structure and predict growth on different agar plates. They will examine bacterial growth over time and collect data. Students will then plan a controlled experiment that they believe could improve the efficiency of transformation. The laboratory write up will be contained within the students’ laboratory notebook. (Big idea 3; SP2, 3, 4, 5, 6)
2. **Biotechnology Laboratory-DNA Gel Electrophoresis:** Students will perform a laboratory to restrict DNA and use marker DNA along with “crime scene” and “suspect” DNA to predict which suspect matches the crime scene. Gel electrophoresis will be performed and students will use the quantitative data collected from their marker DNA to graph data. Students will use band migration distances and extrapolate band sizes by extrapolating from their graphs. The laboratory write up will be contained within the students’ laboratory notebook. (Big idea 3; SP 2, 3, 4, 5, 6)
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| **Unit 7 – Evolution and Phylogeny *Big Ideas 1, 3, 4*** 22 – Descent with Modification: Darwin 23 – Evolution of Populations 24 – Origin of Species 25 – History of Life on Earth 26 – Phylogeny and the Tree of Life 27 - Bacteria and ArchaeConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 1.B Organisms are linked by lines of descent from common ancestry.
* 1.C Life continues to evolve within a changing environment.
* 1.D The origin of living systems is explained by natural processes.
* 3.A Heritable information provides for continuity of life.
* 3.C The processing of genetic information is imperfect and is a source of genetic information.
* 4.C Naturally occurring diversity among and between components within biological systems affect interactions with the environment.
 | **Suggested Labs**Population GeneticsBlast Lab**Unit 7 Activities:**1. Lecture and discussion.
2. Students will complete reading guides over chapters within this unit.
3. “What Darwin Never Knew” (NOVA; PBS video):

Students will view this video to supplement classroom discussion and reinforce Charles Darwin’s evolution hypothesis. The video will serve as a tool to connect modern day molecular biology to Darwin’s theories and findings. (Connects big idea 1 to enduring understanding 3.C)1. PTC Paper Strip Testing. Students will test themselves and additional student populations for the presence of a gene that allows students to taste PTC. This activity will present Hardy-Weinberg Population Genetics to the students and will allow students to apply the Hardy-Weinberg equation to determine frequencies of phenotypes and alleles. (SP 2)
2. **BLAST Laboratory: Cladogram analysis and morphology**: Students will use the Basic Local Alignment Sequencing tool to analyze morphological details about a newly discovered fossil. Students will hypothesize the position of the fossil in a pre-constructed cladogram and test their hypothesis using BLAST. Students will answer questions regarding gene sequences using this tool. (Big idea 1; SP 1, 3, 4, 5)
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| **Unit 8 – Ecology *Big Ideas 1, 2, 3, 4*** 51 – Animal Behavior (self-study) 52 – Introduction to Ecology 53 – Population Ecology 54 – Community Ecology 55 – Ecosystems 56 – Conservation BiologyConnection to enduring understandings:* 1.A Change in the genetic makeup of a population over time is evolution.
* 1.C Life continues to evolve within a changing environment.
* 2.A Growth, reproduction and maintenance of the organization of living systems requires free energy.
* 2.C Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
* 2.D Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment.
* 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
* 3. E Transmission of information results in changes within and between biological systems.
* 4.A Interactions within biological systems lead to complex properties.
* 4.B Competition and cooperation are important aspects of biological systems.
* 4.C Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
 | **Suggested Labs**Transpiration – whole plant methodAquatic Production – ecosystem simulation**Unit 8 Activities:**1. Lecture and discussion.
2. Students will complete reading guides over each chapter.
3. Unit 8 Ecology homework assignment.
4. Biome activity. Students will choose a biome and will prepare a presentation that demonstrates their knowledge of biological processes and concepts. Students will present to their peers to demonstrate their knowledge. (Connects big idea 4 to enduring understanding 2.A; SP 7)
5. Computer investigation: How Does the Fungus Pilobolus Succeed as a Decomposer? ([www.campbellbiology.com](http://www.campbellbiology.com))(Connects big idea 4 to enduring understanding 1.A; SP 5, 6, 7)
6. **Fruit Fly Inquiry Laboratory:** Students will design controlled experiments to study one of many questions pertaining to animal behavior that were presented during unit 1. The laboratory write up will be contained within the students’ laboratory notebook. (Big idea 4; SP 1, 2, 3, 4, 5, 6, 7)
7. **Plant Transpiration Laboratory Demonstration:**

Each class will determine one factor that they would like to test to determine how said factor impacts the rate of transpiration in plants. Impatiens will be used and water loss will be calculated over a four day period. Students will share their qualitative and quantitative data with classmates. A laboratory report will be prepared. (SP 2, 3, 4, 5, 6)1. **Dissolved Oxygen and Primary Productivity Laboratory:**  Students will learn how to measure dissolved oxygen using the Winkler method. Students will explore respiration and photosynthesis in green algae samples as they study productivity (net primary, gross). Students will then choose a variable they wish to study and will design and conduct a controlled experiment to test said variable on primary productivity. The laboratory, including all required components, will be written in the laboratory notebook. (Big idea 4; SP 1, 2, 3, 4, 5, 6, 7)
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**Lab Schedule – by Big Idea and Content Unit**

Below is a table that correlates the labs by each Big Idea and Content Unit. A minimum of two will be covered in Inquiry format. The science practices covered in each lab are listed in *AP Biology Investigative Labs: an Inquiry Based Approach.*

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| --- | --- |
| **Big Idea 1: Evolution**Lab – Population GeneticsLab – DNA Comparisons by BLAST | **Content Unit**Unit 7Unit 7 |
| **Big Idea 2: Cellular Processes**Lab – Diffusion & OsmosisLab - Photosynthesis – computer probesLab – Cellular Respiration | **Content Unit**Unit 2Unit 3Unit 3 |
| **Big Idea 3: Genetics and Information Transfer**Lab – Cell Division: Mitosis and MeiosisLab - Bacterial TransformationLab – Restriction Enzyme Analysis of DNA | **Content Unit**Unit 2 and Unit 5Unit 6Unit 6 |
| **Big Idea 4: Interactions**Lab – Energy Dynamics – aquatic ecosystemsLab – Whole Plant TranspirationLab – Behavior – red worms or pillbugs; Fruit FlyLab – Enzymes – computer probes | **Content Unit**Unit 8Unit 8Unit 1/8Unit 3 |

Additional labs may be performed to facilitate students’ learning and understanding of science practices within a hands-on experience. Directed inquiry will be the most common method of lab instruction used. The course will provide opportunities for students to develop, record, and communicate the results of their laboratory investigations. Lab report format will include a formal lab report, and on occasion, PowerPoint presentations, poster board presentations, oral presentations, just to name a few.

Students will be required to maintain a laboratory notebook throughout the year. The notebook required is from Hayden McNeil; 70 page carbonless notebook, Physical Sciences.

**Expectations for AP Biology**

I assume that by enrolling in this class that you have an interest in the sciences and that you are self motivated. You are undertaking a rigorous course of study with the intended outcome of achieving college credit. I am not here to constantly remind you about finishing your assignments (you will have something to do every night). You will receive guidelines that will inform you of when you should have read certain chapters, when labs are scheduled, when write-ups are due, etc. It will require organization and planning on *your* part to meet your deadlines and to be prepared for tests and assignments that are due. This course is great preparation for what you will experience next year (or the year after) in college. Now is the time to develop the necessary habits.

If you have trouble staying organized, utilize your agenda and look at it daily. Science is best learned by doing; therefore, the laboratory component of this class will be quite intense and will take a significant amount of time. Some of the lab activities will require you to come in on the weekends and possibly before/after school in order to have adequate time to complete the activities.

A fundamental biological topic that is studied each unit is **evolution**. The concepts and ideals incorporated into the theories of evolution will offer in-depth questioning and conversations, such as:

* What is the adaptive value of \_\_\_\_\_\_\_\_\_?
* Why has \_\_\_\_\_\_\_\_\_\_\_\_\_ persisted over time?
* What is the role of the environment in \_\_\_\_\_\_\_\_\_\_\_\_\_? If the environment changes, what might happen over time?
* Does \_\_\_\_\_\_\_\_ improve the ability of the organism to survive and reproduce? How?

Summer Assignment

You will be **expected** to complete a summer assignment, due on the first day of school in August. The assignment is collected by students prior to summer vacation in May and a textbook is issued for the year at this time. The assignment consists of reading guides to facilitate understanding of the first unit of study, Chemistry. In addition, students will be required to answer three essay questions that will be turned in on the first day of school as well. An assessment will be given during the first week of class over the material. A detailed syllabus outlines these requirements and will be provided along with the text; it is also posted on my Weebly webpage.

Students often wonder, “Why do we study chemistry in a biology class?” It is simple: chemistry occurs in the absence of life (biology), but life ceases to exist in the absence of chemistry. Chemistry is the “foundation”, so to speak, for life on Earth.

Suggested Note-taking Methods

I will provide a handout for each chapter covered in class. This handout serves two purposes-one, to provide a detailed outline of the objectives for the chapter and how information will be presented. The outline has been used to build a PowerPoint presentation. The PowerPoint slides should be viewed as a guide for the content and each presentation will be posted to my e-Learning Website for your utilization. Second, the handout provides homework problems to be answered for the unit covered.

Homework

As mentioned above, a selection of short answer questions will be assigned for each chapter. The majority of the questions will be practice on the Level 1 items to help students in mastering these concepts. Students should focus on the **task words** (shown in bold font text) in the questions such as **discuss**, **explain**, **identify**, **compare and contrast** etc. when answering these questions. These same bold font task words will be used in essay questions on exams.

Many questions are designed to challenge the student and require students to think above and beyond the content that has been presented in class or provided in outlines and/or Power Points.

Absences

In addition to the attendance policy at this high school, attendance is extremely important in AP Biology. If excessive absences have been a problem in the past it will make success in this course more difficult, if not impossible. Material is covered very quickly and in much more detail than in prerequisite courses. Obviously your test will reflect much of what is covered in class, lecture, discussion and labs; it will not however be limited to those topics (make sure you are keeping up with the reading assignments). Being present will help to ensure that you receive and understand the highlights of the material, making it easier to concentrate on what you are responsible for outside of class.

Also, many of the labs will require several days of work (sometimes before or after school also), and in order to have a complete understanding of the lab, you should be present for the instructions and procedures. In short, be **present**, **prepared**, and actively **participate** each class period.

It is within your best interest to communicate when you will be missing class for any reason. You may e-mail me or let me know in person, and if the absence is unexpected (illness, etc.) you may discuss what class work was missed upon your return. Please note that it is your responsibility to utilize the AP Biology Binder to pick up assignments, lab manuals, and/or other pertinent handouts when absent. I will not hunt you down to provide you these materials. In addition, any classroom presentations that are missed due to an absence may be accessed from my e-Learning website. It would be helpful to download these at home and print them for personal use.

**Correlation of the textbook content to the Essential Knowledge items:**

This chart is modified and adapted from the “Advances in AP Biology” website using content examples specific to this instructor and course.

**Big Idea 1: The process of evolution drives the diversity and unity of Life**

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| --- | --- | --- |
| **Essential Knowledge** | **Chapters/Sections** | **Illustrative Examples Covered** |
| 1.a.1 natural selection is a major mechanism of evolution. | 22.223.2 | - Graphical analysis of allele frequencies in a population- Application of the Hardy-Weinberg equilibrium equation |
| 1.a.2 Natural selection acts on phenotypic variations in populations. | 23.1, 23.4 | - Peppered moth- Sickle cell Anemia- Pesticide resistance in insects- Artificial selection- Antibiotic resistance- Loss of genetic diversity in monoculture |
| 1.a.3: Evolutionary change is also driven by random processes. | 23.3 | - Allele loss by genetic drift, Founders Effect and Bottlenecking |
| 1.a.4 Biological evolution is supported by scientific evidence from many disciplines including mathematics. | 22.325.2 | - Field observations- Fossil record- Homology and Analogy- Biogeography- Analysis of phylogenetic trees- Construction of phylogenetic trees based on sequence data |
| 1.b.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. | 25.1, 25.3 | - Cytoskeleton similarities- Membrane-bound organelles (mitochondria and/or chloroplasts)- Linear chromosomes- Universal genetic code |
| 1.b.2 Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested. | 26.1 - 26.3 | - Number of heart chambers in animals- Opposable thumbs- Absence of legs in some sea mammals |
| 1.c.1 Speciation and extinction have occurred throughout the Earth’s history. | 24.3, 24.4, 25.4 | - Five major extinction events- Human impact on ecosystems and species extinction rates |
| 1.c.2 Speciation may occur when two populations become reproductively isolated from each other. | 24.1 | - Galapagos fauna examples- Salamander examples |
| 1.c.3 Populations of organisms continue to evolve. | 24.2, 44.1 | - Chemical resistance in many species- Observed directional phenotypic change in a population (Grants study)- A eukaryotic example that describes evolution of a structure or process. |
| 1.d.1 There are several hypothesis about the natural origin of life on Earth, each with supporting scientific evidence. | 4.1 25.1, 25.3 | - Abiogenesis of Life- Miller and Urey experiments- Volcanic vents- Comets and meteors |
| 1.d.2 Scientific evidences from many disciplines supports models of the origin of life.  | 25.126.6 | - Abiogenesis of Life- Miller and Urey experiments/Volcanic vents |

**Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.**

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| --- | --- | --- |
| **Essential knowledge** | **Chapters/sections** | **Illustrative examples covered** |
| 2.a.1 All living systems require constant input of free energy. | 8.1 - 8.39.1 - 9.510.1, 10.2, 10.340.1 - 40.451.553.2, 53.455.2, 55.3 | - Krebs cycle- Glycolysis- Electron Transport Chain- Fermentation-Light Reaction- Calvin cycle- Endothermy and Ectothermy- Seasonal reproduction in animals and plants- Life history strategy- Change in the producer level can affect the number and size of other trophic levels- change in energy resource levels such as sunlight can affect the number and size of the trophic levels |
| 2.a.2 Organisms capture and store free energy for use in biological processes. | 8 .39.1 – 9.510.1 – 10.3 | - ATP- NADH in respiration- NADP in photosynthesis |
| 2.a.3 Organisms must exchange matter with the environment to grow, reproduce and maintain organization. | 3.1 – 3.34.1, 4.26.2 | - Cohesion and Adhesion- High specific heat capacity- Universal solvent supports reactions- Heat of vaporization and Heat of fusion- Water’s thermal conductivity |
| 2.b.1 Cell membranes are selectively permeable due to their structure. | 7.1, 7.2 | - Fluid mosaic model of membranes- Diffusion- Aquaporins- NA+/K+ pump |
| 2.b.2 Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes. | 7.3 – 7.5 | - Simple diffusion- Glucose transport- NA+/K+ pump- H+ pump |
| 2.b.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions. | 6.2 – 6.5 | - Nuclear envelope- Endoplasmic reticulum- Mitochondria and Chloroplasts- Golgi bodies |
| 2.c.1 Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes. | 18.1, 18.240.244.445.2 | - Operons and Eukaryotic gene control mechanisms- Endothermy and Ectothermy- Kidney function- Glucose regulation- Calcium regulation |
| 2.c.2 Organisms respond to changes in their external environments. | 40.244.451.1 – 51.3 | - Endothermy and Ectothermy- Kidney function- Animal behavior examples |
| 2.d.1 All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions including exchange of matter and free energy. | 12.552.553.1 – 53.554.1 – 54.555.1 – 55.4 | - Cell density- Temperature and water availability- Sunlight- Symbiosis (mutualism, commensalism, parasitism)- Predator-prey relationships- Water and nutrient availability, temperature, salinity, and pH- Availability of nesting sites- Food chains and food webs- species diversity- Population density |
| 2.d.2 Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation to different environments. | 40.2, 40.344.2, 43.356.1 | - Gas exchange in aquatic and terrestrial plants- Digestive mechanisms in animals- Respiration systems of aquatic and terrestrial animals- Nitrogenous was production and elimination in aquatic and terrestrial animals- Excretory systems across the animal Kingdom- Thermoregulation in animals (countercurrent exchange mechanisms) |
| 2.d.3 Biological systems are affected by disruptions to their dynamic homeostasis. | 40.2, 40.343. 2- 44.456.1 | - Physiological responses to toxic substances- Dehydration- Immunological responses to pathogens, toxins and allergens- Invasive and/or eruptive species- Human impact- Natural disasters |
| 2.d.4 Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis. | 43.1 – 43.454.2 | - Invertebrate immune systems have nonspecific response mechanisms- Vertebrate immune systems have specific response mechanisms- Plants have a variety of defense mechanisms |
| 2.e.1 timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms. | 18.2 – 18.425.5 | - Morphogenesis of fingers and toes- Eukaryotic gene control mechanisms- HOX genes |
| 2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms. | 24.111.1 | - Release and reaction of pheromones- Visual displays in the reproductive cycle- Quorum sensing in bacteria |
| 2.e.3 Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection. | 51.1, 51.2, 54.1 | - Hibernation, estivation, migration and courtship behaviors- Niche and resource portioning |

**Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.**

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| **Essential knowledge** | **Chapters/sections** | **Illustrative examples covered** |
| 3.a.1 DNA and in some cases RNA, is the primary source of heritable information. | 17.316.1, 16.217.1 – 17.419.220.1, 20.2 | - Addition of a poly-A tail- Addition of a GTP cap- Excision of introns- Enzymatic reactions- Transport by proteins- Synthesis and degradation- Electrophoresis- Plasmid-based transformations- Restriction enzyme analysis of DNA- PCR- Genetically modified foods- Transgenic animals, cloned animals- Pharmaceuticals such as Humulin |
| 3.a.2 In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis, or meiosis plus fertilization. | 12.1 – 12.313.1 – 13.3 | - Mitosis-promoting factor (MPF)- Platelet-derived growth factor (PDGF)- Cancer results from disruptions in cell cycle control- Meiosis and sexual life cycles |
| 3.a.3 The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring. | 14.1 – 14.415.1 – 15.420.4 | - Sickle cell anemia- Tay-Sachs disease- Huntington’s disease- X-linked traits- Klinefelter’s syndrome- Trisomy 21/Down syndrome- Civic issues such as ownership of genetic information, privacy, historical contexts etc. |
| 3.a.4 the inheritance pattern of many traits cannot be explained by simple Mendelian genetics. | 15.1 – 15.5 | - Sex-linked genes reside on the X chromosome in humans- The Y chromosome is small and carries few genes- In mammals and flies, females and XX and males and XY; X-linked recessive traits are usually expressed in males- Some traits are sex limited or sex influenced- Maternal inheritance of mitochondria and chloroplasts |
| 3.b.1 Gene regulation results in differential gene expression leading to cell specialization. | 18.1 – 18.3 | - Promoters- Terminators- Enhancers |
| 3.b.2 A variety of intercellular and intracellular signal transmissions mediate gene expression. | 11.1, 11.418.1 – 18.4 | - Cytokines regulate gene expression to allow for cell replication and division- Levels of cAMP regulate metabolic gene expression in bacteria- Expression of the SRY gene triggers the male sexual development pathway in animals- Morphogens stimulate cell differentiation and development- Changes in p53 activity can result in cancer- HOX genes and their role in development |
| 3.c.1 Changes in genotype can result in changes in phenotype. | 15.416.217.523.4 | - Antibiotic resistance mutations- Pesticide resistance mutations- Griffith’s experiments in transformation- Sickle cell disorder and heterozygote advantage |
| 3.c.2 Biological systems have multiple processes that increase genetic variation. | 13.4 | - Sexual reproduction and random assortment of chromosomes- Random fertilization- Crossing over of chromosomes |
| 3.c.3 Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts. | 19.1, 19.2 | - Transduction in bacteria- Transposons present in DNA |
| 3.d.1 Cell communication processes share common features that reflect a shared evolutionary history. | 11.1, 11.2 | - Use of pheromones to trigger reproduction and developmental pathways- Response to external signals by cells- Cell signaling mechanism comparison across bacteria to eukaryotes |
| 3.d.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. | 11.1, 11.243.248 1 – 48.345.1 – 45. 3 | - Plasmodesmata between plant cells allow material to be transported from cell to cell- Immune cells interact by cell-cell contact such as with T-cells and killer T-cells- Neuron transmission across synapsis- Neurotransmitters- Insulin and glucagon- Pituitary hormones |
| 3.d.3 Signal transduction pathways link signal reception with cellular response. | 11.3 | - G-protein linked receptors- Ligand-gated ion channels- Receptor tyrosine kinases- Secondary messengers such as cAMP, Calcium ions, and IP3. |
| 3.d.4 changes in signal transduction pathways can alter cellular response. | 11.4 | - Diabetes, heart disease, cancer- Effects of neurotoxins, poisons, and pesticides- Drug interactions |
| 3.e.1 Individuals can act on information and communicate it to others. | 51.1 | - Fight or flight response- Predator warnings- Avoidance responses- Territorial marking in mammals- Bee dances, bird songs- Courtship and mating behaviors |
| 3.e.2 Animals have nervous systems that detect external and internal signals, transmit and integrate information and produce responses. | 48.1 – 48.4 | - Acetylcholine- Epinephrine- Dopamine- GABA- Neuro-hormone production- Neurotransmission and responses |

**Big Idea 4: Biological systems interact, and these systems and their interactions posses complex properties.**

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| **Essential knowledge** | **Chapters/sections** | **Illustrative examples covered** |
| 4.a.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule. | 5.1 – 5.5 | - Functions groups- Monomers and polymers- Levels of protein structure- Carbohydrates- Lipids |
| 4.a.2 The structure and function of subcellular components and their interactions, provide essential cellular processes. | 6.2 – 6.5 | - Organelle structure and function- Endomembrane system- Cytoskeleton (microtubules, microfilaments, and intermediate fibers) |
| 4.a.3 Interactions between external stimuli and regulated gene expression results in specialization of cells, tissues and organs. | 18.4 | - Promoters and gene expression- Enhancers and gene expression- Regulation of gene control mechanisms |
| 4.a.4 Organisms exhibit complex properties due to interactions between their constituent parts. | 44.1 – 44.348.451.1 – 55.4 | - Osmoregulation and Excretory system- Nerve signal transmission and response to external stimuli- Animal behavior examples |
| 4.a.5 Communities are composed of populations of organisms that interact in complex ways. | 53.1 – 53.654.1, 54.2 | - Predator/pre relationships- Symbiotic relationships- Niche resource partitioning |
| 4.a.6 Interactions among living systems and with their environment result in the movement of matter and energy. | 54.255.1 – 55.456.4 | - Food chains and food webs- Carbon cycle, nitrogen cycle- Biological magnification of DDT |
| 4.b.1 Interactions between molecules affect their structure and function. | 5.48.4, 8.5 | - Protein structure levels and folding- ATP cycling- Enzyme active sites and allosteric sites |
| 4.b.2 Cooperative interactions within organisms promote efficiency in the use of energy and matter. | 40.144.1 – 44.325.1 | - Exchange of gases- Circulation of fluids- Excretion of wastes as linked to environment- Bacterial community in and around deep sea vents |
| 4.b.3 Interactions between and within populations influence patterns of species distribution and abundance. | 54.1 – 54.3 | - Examples of uniform, clumped and random distributions- Loss of keystone species; sea urchins, kelp and sea otters- Theoretical versus realized niches such as in barnacles, fence lizards |
| 4.b.4 Distribution of local and global ecosystems changes over time. | 25.455.556.1 | - Meteor impact on dinosaurs- Continental drift and mass extinctions- El Nino- Dutch elm disease or Emerald Ash tree borer |
| 4.c.1 Variation in molecular units provides cells with a wider range of functions. | 5.1 – 5.543.321.5 | - Different types of phospholipids in cell membranes- Amino acid composition and protein function- Different types of hemoglobin- Different types of chlorophylls- Molecular diversity of antibodies in response to an antigen- Gene families and pseudogenes |
| 4.c.2 Environmental factors influence the expression of the genotype in an organism. | 14.3 | - Height and weight in humans- flower color based on soil pH- Sex determination in reptiles- Darker fur in cooler regions of the body in rabbits and cats |
| 4.c.3 The level of variation in a population affects population dynamics. | 23.1 – 23.3 | - Cheetahs, prairie chickens, condors - Old order Amish- Bottle necking events |
| 4.c.4 the diversity of species within an ecosystem may influence the stability of the ecosystem. | 54.256.1 | - Keystone species, sea urchins, kelp and sea otters- Clear cutting forestry practices |

**Commitment**

I assume that by enrolling in this class that you have an interest in the sciences and that you are self motivated. You are undertaking a rigorous course of study with the intended outcome of achieving college credit. I am not here to constantly remind you about finishing your assignments (you will have something to do every night). You will receive guidelines that will inform you of when you should have read certain chapters, when labs are scheduled, when write-ups are due, etc. It will require organization and planning on *your* part to meet your deadlines and to be prepared for tests and assignments that are due. This course is great preparation for what you will experience next year (or the year after) in college. Now is the time to develop the necessary habits.

**Grading** The grade distribution for this course is as follows:

 Tests 70%

Labs 20%

Homework 10%

Due dates will be announced at the time an assignment or lab report is given. Students are responsible for meeting those assigned deadlines.

**Formal Lab Write Up**

Labs are an integral part of this course. Therefore, be prepared to spend **~30% of class time** devoted to laboratory investigations.

The first one I will lead you through. After that, you are on your own. You are required to provide detailed reports of the labs that we complete in AP biology. Labs are a critical piece of the AP biology curriculum. It is important that you are present and actively participating in these lab investigations, as the information and data obtained will be applicable to content and will be presented in some capacity on unit exams.

**LAB REPORTING REQUIREMENTS:** You will be provided a detailed requirement(s) “packet” to keep and reference throughout the school year.

The pre-lab (title and date, introduction, materials and procedure) will need to be done before the lab on **ALL** labs. *Come to class PREPARED for your lab.*

* **Title and Date**: official AP title of the lab with the start date of the lab in class
* **Abstract**: list lab objectives and relevant terminology
* **Introduction:** background information, purpose of lab, hypothesis stated “IF…then…” form
* **Materials/Procedures:** list materials and equipment used in lab with specific amounts and sizes;

write a brief, numbered procedure to show your understanding of the instructions with illustrations if appropriate (do not copy the procedure from the handout verbatim)

* **Results/Data**: construct tables, histograms, graphs to present the data that has been collected; title and label all tables and charts, graphs completely
* **Discussion and Conclusions**: summarize the results of the lab and any conclusions regarding those results; compare and contrast results with objectives; explain any unexpected results or errors and **why** those results may have been obtained.
* **Lab Questions**: answer all questions from the lab handout and include all equations and calculations

Upon the completion of a lab, students will be required to complete a lab assessment and/or essay using the lab report, which will ultimately determine your lab “grade”. Each lab will be worth ~20 points.

**Expectations:** 1. Do as you are asked.

 2. Be considerate and courteous to fellow learners.

 \* This includes NOT speaking when the teacher or others are addressing the class.

 3. Pick up after yourself and leave the class in the orderly fashion in which you found it.

 4. Participate enthusiastically in learning.

 \* No sleeping will be permitted.

 5. The **teacher** closes class each day. Remain engaged until you are dismissed, please.

**Late Work:**

This course is designed to challenge students academically while also preparing students for life as a college student. Therefore, NO LATE WORK will be accepted. Failing to turn in your assignments will result in a 0 in the gradebook.

**Redo Protocol for AP Biology:**

As stated above, due to the rigorous nature of this course, students will not be eligible to retake tests and/or assessments. Our summative assessments (tests) are “curved” as the AP Biology exam will be. However, per the Ray-Pec High School Redo Protocol, I will accept three late/missing assignments throughout the semester for full credit.

The rules and procedures outlined in the Ray-Pec High School Student Handbook will be followed at all times.

I look forward to working with you throughout this year in AP biology. Please do not hesitate to visit with me concerning any reservations or celebrations that you may have.

Best wishes!

**Jennifer Talley**

 Jennifer D. Talley

