

## PACING GUIDE

### ADVANCED PLACEMENT BIOLOGY

#### **BIG IDEAS:**

- 1: The process of evolution drives the diversity and unity of life.**
- 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.**
- 3: Living systems store, retrieve, transmit and respond to information essential to life processes.**
- 4: Biological systems interact, and these systems and their interactions possess complex properties.**

INTRODUCTION: First day expectations and course overview (Big Ideas, Science Practices)

Discussion "Science as a Process."

[http://www.gccaz.edu/biology/glacier/scientific\\_method/index.swf](http://www.gccaz.edu/biology/glacier/scientific_method/index.swf) (3 DAYS)

#### UNIT 1: ECOLOGY (13 DAYS)

CHAPTERS: 51-Animal Behavior, 52-An Introduction to Ecology and the Biosphere, 53-Population Ecology, 54-Community Ecology, 55-Ecosystems and Restoration Ecology, 56-Conservation Biology and Global Change.

READING ASSIGNMENTS: 51.1-51.4, 52.1-52.2, 53.1-53.6, 54.1-54.5, 55.1-55.5, 56.1, 56.4, 56.5.

#### ESSENTIAL KNOWLEDGE:

- 2.a.1 All living systems require constant input of free energy.
- 2.d.1 All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.
- 2.d.2 Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.
- 2.d.3 Biological systems are affected by disruptions to their dynamic homeostasis.
- 2.e.3 Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.
- 3.e.1 Individuals can act on information and communicate it to others.
- 4.a.5 Communities are composed of populations of organisms that interact in complex ways.
- 4.a.6 Interactions among living systems and with their environment result in the movement of matter and energy.

4.b.3 Interactions between and within populations influence patterns of species distribution and abundance.  
4.b.4 Distribution of local and global ecosystems changes over time.  
4.c.4 The diversity of species within an ecosystem may influence the stability of the ecosystem.

**INSTRUCTIONAL ACTIVITIES:** Dissolved Oxygen Lab and prelab, Fertilizer “Design It” lab, Behavior (taxis and Kinesis) “Design It” lab with pill bugs, “Obituary” activity, Interpreting Scientific Paper 56.13, What Caused the Drastic Decline of the Illinois Greater Prairie Chicken Population? Article 7

**ASSESSMENTS:** Formative and summative quizzes, unit test w/essay, scientific paper, organized notebook, lab reports, and case study. **[CR7], [CR8]**

## UNIT 2: BIOCHEMISTRY (6 DAYS)

**CHAPTERS:** 3-Water and Life, 4-Carbon and the Molecular Diversity of Life, 5-The Structure and Function of Large Biological Molecules.

**READING ASSIGNMENTS:** 3.1-3.3, 4.1, 4.2, 5.1-5.5

**ESSENTIAL KNOWLEDGE:**

2.a.3 Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

4.a.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

4.b.1 Interactions between molecules affect their structure and function.

4.c.1 Variation in molecular units provides cells with a wider range of functions.

**INSTRUCTIONAL ACTIVITIES:** Water essay, properties of water demonstration, “Testing For Unknown Carbohydrate Lab”, Phospholipid modeling.

**ASSESSMENTS:** Organic chemistry quizzes (summative and formative), unit test w/essay, formative water essay using grading rubric, organized notebook, lab report, and finished model. **[CR7], [CR8]**

## UNIT 3: CELLS (21 DAYS)

**CHAPTERS:** 6-A Tour of the Cell, 7-Membrane Structure and Function, 11-Cell Communication, 12-The Cell Cycle, 19-Viruses, 27-Bacteria and Archaea



READING ASSIGNMENTS: 6.2-6.5, 7.1-7.5, 11.1-11.4, 12.1-12.3, , 19.1-19.2, 27.1-27.2.

ESSENTIAL KNOWLEDGE:

2.a.3 Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

2.b.1 Cell membranes are selectively due to their structure.

2.b.2 Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

2.b.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

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.

2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms.

3.a.1 DNA and in some cases RNA is the primary source of heritable information.

3.a.2 In Eukaryotes, heritable information is passed to the next generation via process that include the cell cycle and mitosis or meiosis plus fertilization.

3.b.1 Gene regulation results in differential gene expression, leading to cell specialization.

3.b.2 A variety of intercellular and intracellular signal transmissions mediate gene expression.

3.c.2 Biological systems have multiple processes that increase genetic variation.

3.c.3 Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts.

3.d.1 Cell communication processes share common features that reflect a shared evolutionary history.

3.d.2 Cells communicate with each other through direct contact with other via chemical signaling.

3.d.3 Signal transduction pathways link signal reception with cellular response.

3.d.4 Changes in signal transduction pathways can alter cellular response.

4.a.2 The structure and function of subcellular components, and their interactions, provide essential cellular processes.

4.a.3 Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.

4.b.2 Cooperative interactions within organisms promote efficiency in the use of energy and matter.

INSTRUCTIONAL ACTIVITIES: "Modeling Limits to Cell Size", "Off to the Cell Races Design Challenge", Cancer Case Study, (Biological Inquiry Ch 10) Investigation 4 Diffusion and Osmosis (new), "Diffusion and Osmosis Design Challenge", TED talk cell communication, Investigation 7 Cell Division Mitosis and Meiosis (*Sordaria*), "Bacteria and Cyanobacteria" Lab, "Root ,Stem and Leaf Cell" Lab, <http://wehity/> (apoptosis and signal transduction), Exercise 3A.2 in Lab Three Mitosis and Meiosis, [http://www.ted.com/talks/lang/eng/bonnie\\_bassler\\_on\\_how\\_bacteria\\_communicate.html](http://www.ted.com/talks/lang/eng/bonnie_bassler_on_how_bacteria_communicate.html)

**ASSESSMENTS:** Formative and summative quizzes, unit test w/essay, lab reports, scientific paper, organized notebook, essays, water potential and diffusion problems. **[CR7], [CR8]**

#### UNIT 4: ENZYMES AND METABOLISM (24 DAYS)

**CHAPTERS:** 8-An Introduction to Metabolism, 9-Cellular Respiration and Fermentation, 10-Photosynthesis.

**READING ASSIGNMENTS:** 8.1-8.5, 9.1-9.5, 10.1-10.3.

**ESSENTIAL KNOWLEDGE:**

- 2.a.1 All living systems require constant input of free energy.
- 2.a.2 Organisms capture and store free energy for use in biological processes.
- 4.b.1 Interactions between molecules affect their structure and function.

**INSTRUCTIONAL ACTIVITIES:** Investigation 10 Energy Dynamics (new), “Design It Enzyme” Lab, Investigation 6 Cellular Respiration (new using LabQuest), Investigation 5 Photosynthesis (new), chromatography lab, absorbance spectrum lab, “Design It Photosynthesis” pH probes/Labquest and Duckweed.

**ASSESSMENTS:** Formative and summative quizzes, unit test w/essay, lab reports, scientific paper, organized notebook. **[CR7], [CR8]**

#### UNIT 5: MOLECULAR GENETICS (26 DAYS)

**CHAPTERS:** 13-Meiosis and Sexual Life Cycles, 16-The Molecular Basis of Inheritance, 17-From Gene to Protein, 18-Regulation of Gene Expression, 20-Biotechnology, 21-Genomes and Their Evolution.

**READING ASSIGNMENTS:** 13.1-13.4, 16.1, 16.2, 18.1-18.4, 17.1-17.6, 20.1, 20.2, 21.2, 21.5.

**ESSENTIAL KNOWLEDGE:**

- 3.a.1 DNA, in some cases RNA is the primary source of heritable information.
- 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.
- 3.b.1 Gene regulation results in differential gene expression, leading to cell specialization.
- 3.b.2 A variety of intercellular and intracellular signal transmissions mediate gene expression.
- 3.c.1 Changes in genotype can result in changes in phenotype.
- 3.c.2 Biological systems have multiple processes that increase genetic variation.
- 4.a.3 Interactions between external stimuli and regulated gene expression result in specializations of cells, tissues and organs.

4.c.1 Variation in molecular units provides cells with a wider range of functions.

**INSTRUCTIONAL ACTIVITIES:** Investigation 7 Cell Division Mitosis and Meiosis *Sordaria* Lab (new), modeling DNA replication, modeling protein synthesis, Investigation 8 Biotechnology Bacterial Transformation (new), Investigation 9 Biotechnology Restriction Enzyme Analysis of DNA (new), Paper Plasmids, Investigative Case: Silencing the Hedgehog Pathway Ch 10, epigenetics video, epigenetic case study.

**ASSESSMENTS:** Formative and summative quizzes, unit test w/essay, lab reports, organized notebook, investigative case, models of DNA replication, Gene to Protein model and paper plasmid model. **[CR7], [CR8]**

## UNIT 6: HEREDITY (12 DAYS)

**CHAPTERS:** 14-and the Gene Idea, 15-The Chromosomal Basis of Inheritance.

**READING ASSIGNMENTS:** 14.1-14.4, 15.1-15.5

### ESSENTIAL KNOWLEDGE:

3.a.3 The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.

3.a.4 The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.

3.c.1 Changes in genotype can result in changes in phenotype.

4.c.2 Environmental factors influence the expression of the genotype in an organism.

4.c.4 The diversity of species within an ecosystem may influence the stability of the ecosystem.

**INSTRUCTIONAL ACTIVITIES:** Genetics problems, Sex-linked fruit fly cross F1s, chi-square analysis, Investigation 12 Fruit Fly Behavior(new).

**ASSESSMENTS:** Formative and summative quizzes, unit test w/essay and problems, genetics problems and organized notebook

## UNIT 7: EVOLUTION (20 DAYS)

**CHAPTERS:** 22-Descent with Modification: A Darwinian View of Life, 23-The Evolution of Populations, 24-The Origin of Species, 25-The History of Life on Earth, 26-Phylogeny and the Tree of Life.

**READING ASSIGNMENTS:** 22.2, 22.3, 23.1-23.4, 24.1-24.4, 25.1-25.6, 26.1-26.3, 26.6.

### ESSENTIAL KNOWLEDGE:

1.a.1 Natural selection is a major mechanism of evolution.

1.a.2 Natural selection acts on phenotypic variations in populations.

- 1.a.3 Evolutionary change is also driven by random processes.
- 1.a.4 Biological evolution is supported by scientific evidence from many disciplines, including mathematics.
- 1.b.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- 1.b.2 Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.
- 1.c.1 Speciation and extinction have occurred throughout the earth's history.
- 1.c.2 Speciation may occur when two populations become reproductively isolated from each other.
- 1.c.3 Populations of organism continue to evolve.
- 1.d.1 There are several hypothesis about the natural origin of life on earth, each with supporting scientific evidence.
- 1.d.2 Scientific evidence from many different disciplines supports models of the origin of life.
- 2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms.
- 3.c.1 Changes in genotype can result in changes in phenotype.
- 4.c.3 The level of variation in a population affects population dynamics.
- 4.c.4 The diversity of species within an ecosystem may influence the stability of the ecosystem.

**INSTRUCTIONAL ACTIVITIES:** Evolution script, Hardy-Weinberg problems, Hardy- Weinberg lab, Investigation 1 Artificial Selection (new), Investigation 3 Comparing DNA Sequences to Understanding Evolutionary Relationships with BLAST (new), practice AP essay questions- phylogentic trees, Fly Evolution and fitness lab (White and Wild)

**ASSESSMENTS:** Formative and summative quizzes, unit test w essay and problems, lab reports, organized notebook, evolution script, practice essays and practice phylogenetic trees.

## UNIT 8: PLANT AND ANIMAL STRUCTURE AND FUNCTION (24 DAYS)

**CHAPTERS:** 38-Angiosperm Reproduction and Biotechnology, 39-Plant Responses to Internal and External Signals, 40-Basic Principles of Animal Form and Function, 43-The Immune System, 45-Hormones and the Endocrine System, 47-Animal Development, 48-Neurons, Synapses, and Signaling, 49-Nervous System.

**READING ASSIGNMENTS:** 38.1, 39.1-39.3, 39.5, 40.1, 40.2, 40.3, 40.4, 43.1-43.4, 45.1, 45.2, 47.3, 48.1-48.4,49.2.

### ESSENTIAL KNOWLEDGE:

- 2.a.1 All living systems require constant input of free energy.
- 2.c.1 Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- 2.c.2 Organisms respond to changes in their external environments.

<p>2.d.2 Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.</p> <p>2.d.3 Biological systems are affected by disruptions to their dynamic homeostasis.</p> <p>2.d.4 Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.</p> <p>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.</p> <p>2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms.</p> <p>2.e.3 Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.</p> <p>3.e.2 Animals have nervous systems that detect external and internal signals, transmit and integrate information and produce responses.</p> <p>4.a.4 Organisms exhibit complex properties due to interactions between their constituent parts</p>
<p>INSTRUCTIONAL ACTIVITIES: “Grocery Store” Lab, Investigation 11 Transpiration (new), “Anatomy of the Human Brain” Lab, Animal Diversity I and Animal Diversity II, HHMI videos nervous system.</p>
<p>ASSESSMENTS: , Formative and summative quizzes, unit test w essay, lab reports, scientific paper, organized notebook and portfolio, [CR7], [CR8].</p>

EXAM REVIEW (13 DAYS)

UNIT 9: PIG DISSECTION: AFTER THE AP EXAM!!!! (10 DAYS)

<p>CHAPTERS: Pig Dissection Manual.</p>
<p>READING ASSIGNMENTS: None</p>
<p>INSTRUCTIONAL ACTIVITIES: Dissection of skeletal, muscular, circulatory, digestive and respiratory systems.</p>
<p>ASSESSMENTS: Bone, muscle (dorsal and ventral), circulatory, digestive, and respiratory system quizzes.</p>

8 DAYS OF NON-INSTRUCTIONAL TIME. EXAMPLES INCLUDE SEMESTER EXAMS, HOW TO WRITE A PAPER DAY, EXTRA LAB DAYS, SCIENTIST IN RESIDENCE  
TOTAL 180 DAYS

#### BIG IDEAS WITH ENDURING UNDERSTANDINGS

Big Idea 1: The process of evolution drives the diversity and unity of life.

- 1A: A change in the genetic makeup of a population over time is evolution.

- 1B: Organisms are linked by lines of decent from common ancestry.
- 1C: Life continues to evolve within a changing environment.
- 1D: The origin of living systems is explained by natural processes.

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

- 2A: Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 2B: Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from external environments.
- 2C: Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
- 2D: Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.
- 2E: Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.

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

- 3A: Heritable information provides for continuity of life.
- 3B: Expression of genetic information involves cellular and molecular mechanisms.
- 3C: The processing of genetic information is imperfect and is a source of genetic variation.
- 3D: Cells communicate by generating, transmitting and receiving chemical signals.
- 3E: Transmission of information results in changes within and between biological systems.

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

- 4A: Interactions within biological systems lead to complex properties.
- 4B: Competition and cooperation are important aspects of biological systems.
- 4C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.