

AP[®] Biology

Syllabus 1

Philosophy

I enjoy teaching biology because I see it as an opportunity to encourage students to make a difference in this world. I see everything as connected to biology in some way, so I orient my teaching to help students make correct decisions about the environment and their health, and to see that their decisions can and will affect others. I also like to highlight the cultural differences in the naming of plants and animals, as well as in customs, because it includes everyone in my ethnically diverse class. [C7]

C7--Applications of biological knowledge and critical thinking to environmental and social concerns.

Course Overview

My AP Biology course has been influenced by the *PAK: Individualized Biology* workbooks by Dr. Marvin Druger. Although I no longer use these workbooks, I have adapted my program to follow a similar sequence to that of the workbooks. My main goals are for my students to have a good understanding of the concepts in biology and a grasp of its relevance to themselves and society. [C7] I also aim to promote self-learning among my students.

In order to cover so much information, I must be very organized and stick to the deadlines I have set. I provide my students with several planning tools:

- Course Schedule
- Monthly Calendars
- Reading and Lecture Guidelines.

The textbook for the course is the seventh edition of Neil A. Campbell and Jane B. Reece's *Biology*. Students also use the *AP Biology Lab Manual for Students*. The first semester begins with orientation and a discussion on how to use the Campbell/Reese textbook, emphasizing the "Ten Themes in the Study of Life," which are very similar to the "eight major themes" found in the official curricular requirements of AP Biology. [C6]

C6--The integration of the general topics of biology through the eight major themes as specified in the Course Description;
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Unit 1. Survey of Animals/Protists and Classification Concepts (2 weeks)

Readings

- Themes of biology, chapter 1 [C6]
- Animal survey and classification, selected readings from chapters 25.2–25.3, 24, 26.6, 28, 31, 32, 33, 34

Class Activities

- Review terms like *prokaryotic/eukaryotic* and *autotroph/heterotroph*, and terms used in classification and the formation of phylogenetic trees, like *symmetry*, and types of coelom
- Receive outline notes and guidance on the textbook readings and the major phyla
- Observe specimens and practice placing the organisms on the phylogenetic trees

Labs

- Hydra/Planaria behavior lab
- *Daphnia* (AP Lab 10, Exercise 10C)
- Microscope use and measurement (this lab can be found in most lab manuals)
- Itty-bitty city lab (this is described in the student activities section of this syllabus)

Unit 1 test on survey of animals/protists and classification concepts

Unit 2. Evolution and Past Diversity of Life (2 weeks)

Readings

- Evolution, chapters 22–25
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Historical background behind Darwin's theory; voyage of the *Beagle*
- Evidences for evolution
- Evolution in action today
- Modern synthesis, population genetics, Hardy-Weinberg law of genetic equilibrium, problems
- Natural selection, microevolution events, types of selection, preservation of variation

- Speciation, prezygotic and postzygotic mechanisms, allopatric and sympatric speciation
- Gradualism/punctuated equilibrium
- Fossil record, extinctions, dating of fossils [C2]

C2--Heredity and Evolution

Lab

- Population genetics and evolution (AP Lab 8)

Class Activity

- At the end of the unit watch the video *The Odyssey of Life: The Ultimate Journey*, which supports the concepts in the lecture and notes
- Class discussion: How does the present period of mass extinction compare to those of the past? [C6] & [C7]

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Unit 2 test on evolution

Unit 3. Ecology (2 weeks)

Readings

- Ecology, chapters 50, 52–55
- Receive outline notes and guidance on the textbook readings

C7--Applications of biological knowledge and critical thinking to environmental and social concerns.

Lecture Topics

- Biomes: aquatic and terrestrial biomes and the factors that influence them
- Community ecology, ecological succession, soil and its role in succession
- Ecosystem ecology, trophic structure, and productivity
- Population ecology [C3]

C3--Organisms and Populations

Independent Work

- Students use the Internet and chapter 50 in their textbooks to find the latitude, temperature range, rainfall, flora, fauna, and anything that is unique about their assigned biome. They provide their classmates with a one-half- to one-page handout and give a presentation that lasts for five minutes or less. In order to speed things along, and because I know students covered biomes in their first-year biology course, I make this a two-day assignment.
- Students are asked to find an example of the introduction of a non-native species to an environment. The one getting closest to our own biome wins a prize, and is asked to help lead a class discussion about how that organism has affected the local environment. [C6] & [C7]

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Lab

- Dissolved oxygen and aquatic primary productivity (AP Lab 12). Students have the weekend to complete a lab write-up (to be counted as a test grade) for this lab.

Unit 3 test on ecology

Unit 4. Animal Behavior (1 week)

Topics and Readings

- Students read chapter 51 and watch videos on behavior like *Konrad Lorenz: Science of Animal Behavior* or National Geographic's *Search for the Great Apes*.

Lecture Topics

- Instead of a formal lecture, this week we discuss concepts of behavior.

Independent Work

- Students use their textbook and the Internet to answer assigned questions about famous animal behaviorists and concepts. This activity provides the background for the pill bug lab (AP Lab 11, Exercise 11A). (See the student activities section of this syllabus for a description of the famous animal behaviorist assignment.)

Labs

- Animal behavior (AP Lab 11). Because this lab has all the components of the scientific method, I give it a higher weighting than a test grade.
- "Be a Behaviorist for a Day" field trip to Monkey Jungle in Miami. Monkey Jungle is a 30-acre preserve with about 400 primates (go to www.monkeyjungle.com for information about this facility). Students have the weekend to complete a lab write-up (to be counted as a test grade) for this lab.

Unit 5. Cell and Cell Functions (3 weeks)

Readings

- Architecture of cells (includes bacteria and viruses), chapters 7, 27, 18
- How substances get into cells, chapter 8
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Architecture of prokaryotic cells to eukaryotic cells: comparing structures
- Cell wall of bacteria and plants
- Organelles; emphasis on mitochondria and chloroplasts [C1]
- Membrane structure and function, transport across the membrane
- Bacteria reproduction and nutritional modes
- Bacteria: classification and their roles, both harmful and beneficial
- Viruses: basic virus structure, reproduction
- AIDS and other important viruses
- Viroids, prions, emerging viruses

C1--Molecules and Cells

Labs

- Diffusion and osmosis (AP Lab 1)
- Examination of different cell types (this lab can be found in most lab manuals)
- Gram-staining techniques and the effect of antibiotics on bacteria (this lab can be found in most lab manuals)

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Class Activity

- Close with a video on bacteria/viruses (I choose something that can show the uses of this diverse group)
- Class discussion – What characteristics of cells provides evidence of a common origin? [C6]

Unit 5 test on cells and cell function, bacteria, and viruses

Unit 6. Biochemistry (2 weeks)

Readings

- Chemical basis of life, protein and enzymes, chapters 2–5
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Elementary principles of inorganic chemistry (e.g., atoms, molecules, etc.)
- Role of water and carbon and the functional groups
- Macromolecules: carbohydrates, lipids, proteins, nucleic acids
- Proteins and enzymes
- The closing lecture is a demonstration of the food tests used to identify the different organic compounds (they have all done this in their previous biology course) [C1]

C1--Molecules and Cells

Independent Work

- The origins of life (chapter 26). I spend about a day tracing the historical development of ideas concerning the origin of life and current views of the origin of life and the experimental evidence that supports these views. Students learn more about the origins of life by reading the chapter in their textbook and answering the guided questions I provide. This independent class work appears 10 weeks into the first semester because it is at this point that students have an understanding of organic molecules and can appreciate the molecular evolution concepts that are used to explain the origin of life.

Lab

- Enzyme catalysis (AP Lab 2)

Unit 6 test on biochemistry and the origin of life

Unit 7. Biotechnology (2 weeks)

Readings

- Biotechnology, chapters 19 and 20
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- DNA historical background, experimental evidence
- DNA structure
- DNA replication in detail, experimental evidence
- Protein synthesis, transcription, and translation
- Mutations
- Biotechnology techniques: cloning, PCR, principles of electrophoresis, RFLP analysis

Lab

- DNA extraction, transformation, and electrophoresis (AP Lab 6)

Class Activity

Class Discussion – Should insurance and other health care related companies have the right to screen and discriminate based on the presence or absence of potentially disorder-producing or disease-causing genes in their clients? **[C6] & [C7]**

Unit 7 test on biotechnology

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Unit 8. Reproduction (1 week)

Note: Reproduction is divided into two parts. Unit 8 covers mitosis and meiosis, because these processes set the stage for understanding embryology and development. Mitosis and meiosis are tested on the first semester exam. Unit 9 covers human reproduction and embryology.

Readings

- Reproduction: mitosis and meiosis, chapters 12 and 13
- Receive outline notes and guidance on the textbook readings

C7 --Applications of biological knowledge and critical thinking to environmental and social concerns.
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Lecture Topics

- Significance of mitosis and meiosis
- Cell cycle
- Mitosis in plants and animals
- Meiosis in plants and animals
- Chromosomal abnormalities due to non-disjunction
- Cancer

Lab

- Mitosis and meiosis (AP Lab 3)

First semester exam

Winter Break (the second semester begins after the break)

Unit 9. Reproduction and Embryology (2 weeks)

Note: The human system is included here because it fits into this sequence of teaching and makes a nice closure by bringing in the significance of mitosis and meiosis to reproduction.

Readings

- Reproduction: human reproduction and embryology, chapters 45 and 46.
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Basic embryological terms
- Comparison of development stages in echinoderm, frog, chicken, and human
- Extra embryonic membranes in chicken and human, and their importance
- Human anatomy, male and female
- Menstrual cycle
- Human development to birth

Lab

- Chick embryology lab. This lab gives me a chance to discuss amniotic eggs and their significance to evolution. I incubate about two-dozen eggs, opening them for the first four days to show students the stages of development and leaving the rest to hatch so students can enjoy the baby chicks. This lab runs into genetics.

Class Activity

- Students watch the video *Chick Embryology*.
- Guest (physician and local public health official) leads discussion on sexually transmitted diseases. [C6] & [C7]

Unit 9 test on reproduction and embryology

Unit 10. Genetics (2 weeks)

Readings

- Genetics, chapters 14 and 15
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Mendelian genetics, probability, segregation, independent assortment
- Non-Mendelian patterns, codominance, pleiotropy, epistasis, polygeny
- Human genetics, pedigree analysis
- Sex linkage, autosomal linkage, linkage maps
- *Drosophila* genetics, setting up a cross
- Chi-square
- Eukaryotic chromosome
- Control of gene expression, Lac Operon

Class Activity and Assignment

- Students solve several problems from the ends of chapters 14 and 15 for homework. We go over the problems in class, with students writing the hardest ones on the board. Students teaching students is a very effective teaching strategy; my role is to help only when difficulty arises. These problems give them good practice.
- The unit closes with a research assignment on different inherited diseases (a description of this assignment can be found in the student activities section of this syllabus).

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Lab

- *Drosophila* (AP Lab 7). Students have the weekend to complete a lab write-up (to be counted as a test grade) for this lab.

Unit 10 test on genetics

Unit 11. Photosynthesis and Respiration (2 weeks)

Readings

- Photosynthesis and respiration, chapters 10 and 9
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Angiosperm leaf anatomy
- Chloroplast structure and function
- Light reactions/light-dependent reactions
- Light-independent reactions/Calvin cycle
- C₃ and C₄ cycles
- Overview of aerobic and anaerobic respiration
- Mitochondrion structure
- Glycolysis/Krebs cycle
- Chemiosmosis in respiration and photosynthesis
- The role of photosynthesis and respiration in global warming [C6] & [C7]

Labs

- Plant pigments and photosynthesis (AP Lab 4). Students have the weekend to complete a lab write-up (to be counted as a test grade) for this lab. Sometimes I have them write a lab report for the cell respiration lab instead.
- Cell respiration (AP Lab 5)

Unit 11 test on photosynthesis and respiration

Unit 12. The Plants (2 weeks)

Readings

- The plants, chapters 29, 30, 35, 36, 27, 38, 39
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Alternation of generations
- Angiosperm structure and growth

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- Angiosperm reproduction and growth
- Plant control systems

Lab

- Transpiration (AP Lab 9)

Class Activity

- This topic has a “look, see, feel format,” and I bring in specimens of flowers and do a simple lab to show the floral anatomy when I am teaching plant reproduction.
- Students usually do some basic planting activities like stem cuttings and planting a seed. They generally enjoy this because they are city kids and know very little about how things grow.
- Videos like *Sexual Encounters of the Floral Kind* close the unit.

Unit 12 test on the plants

Spring Break

Unit 13. Animal Structure and Function (3–4 weeks)

Note: At this point in the course I am very short of time, so I provide notes and questions on each section to guide students on the depth of study and spend class time discussing what they have learned. I focus on teaching the heart and circulation, respiratory, and immune systems because I find doing so links everything together. I usually spend about a week on these concepts.

Readings

- All systems (human and animal), chapters 40–49
- Receive outline notes and guidance on the textbook readings

Lecture Topics

- Basic principles of anatomy, with an emphasis on mammalian systems
- Digestive system structure and function
- Heart and circulatory system
- Respiratory system
- Immune system
- Osmoregulation and the excretory system
- Endocrine system: homeostasis, sugar and calcium control, review of sexual hormones

- Nervous system: plan of the nervous system, neuron structure, reflex arc, transmission of nerve impulse
- Muscular system: voluntary and involuntary muscles, muscular contraction
- Review of human reproduction and embryology

Class Activity

Class Discussion – Design an experiment to determine why there is an inverse relationship between body size and metabolism. [C6]

Labs

- Measuring blood pressure (AP Lab 10, Exercise 10A)
- Fitness test (AP Lab 10, Exercise 10B)

Unit 13 test on human systems

Unit 14. Review (1-2 weeks)

- Review for AP Exam
- Complete any of the 12 AP Biology labs that remain unfinished.
- **Class Activity** – The class is divided into eight groups, with each group corresponding to one of the major themes in the AP Biology Course Description. I assign each group the task of providing one example of how their major theme relates to each of the units covered in the course. Over several days, one person per day from each group is then selected to present their examples. [C6]

Teaching Strategies

Most of my class time is spent in either lecture and class discussion or in lab activities. The lectures are supported by the excellent visuals (video, internet, overhead transparencies) for most of the topics in the textbook.

Most of my lectures are based on the factors used in making phylogenetic trees (e.g., the basics of embryology, symmetry, origin of the eukaryotic cell, etc.). [C5] I support this with practice multiple-choice questions from AP Central, the Released Exams, and test preparation books to help students focus on what is important in the chapter sections I assign.

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C5--recognition of evolution as the foundation of modern biological models and thought;

C8--The course includes a laboratory component that fulfills all of the objectives of the recommended AP Biology labs as listed in the Course Description. Students must spend a minimum of 25% of instructional time engaged in hands-on laboratory work. Note: Online course providers utilizing virtual labs (simulations rather than hands-on) should submit their laboratory materials for the audit. If these lab materials are determined to develop the

Lab Component

I cover all of the labs in the *AP Biology Lab Manual for Students*, either exactly or modified to fulfill my course objectives. This requires about one day out of four devoted to lab work. [C8]

I really like behavior so I introduce many of the concepts by doing lab activities like Hydra and Planaria labs. These are excellent subjects for teaching orientation behavior. They also give me an opportunity to lead a discussion on how these simple responses play a part in their survival and selection of habitat.

I manage to squeeze in one field trip each year. “Be a Behaviorist for a Day” is a lab that I designed that shows that behavior studies can be done even with limited time in the curriculum. After reading the textbook’s behavior chapter and watching some videos for background, we go to Monkey Jungle, a local primate preserve, where students observe primate behavior using an ethogram. Afterwards they write a full lab report. This is a highly successful unit because the learning is different. It teaches students a lot about behavior and the way behavioral scientists work.

On the day of the lab, if a lot of equipment is involved, I organize students into lab groups of no more than four and discuss the setup so they understand the equipment they will be using. I find this preliminary step is important because many of my students come to the AP Biology course with limited lab experience. Microscope labs are done individually.

Most of the time I have students end their labs by answering the questions in the lab manual or writing a brief evaluation (i.e., writing an analysis, conclusion, limitations, and recommendations) of the lab. When a full lab report is required, I instruct students to include the following elements in it: title, introduction/background information, purpose (the specific topic being investigated), procedure, data/results, analysis, conclusion, limitation, and recommendations. I give them the weekend to complete their lab reports, and I stress quality over length. [C4]

C4-- an understanding of science as a process rather than an accumulation of facts

Student Evaluation

I use quizzes, homework, unit tests, major projects, lab reports, and research papers to evaluate my students’ learning.