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AP BIOLOGY

Course Content

Based on the Understanding by Design® (Wiggins and McTighe) model, this course framework provides a clear and detailed description of the course requirements necessary for student success. The framework specifies what students must know, be able to do, and understand, with a focus on the big ideas that encompass core principles, theories, and processes of the discipline. The framework also encourages instruction that prepares students for advanced work in STEM and life science–related majors.

Big Ideas

The big ideas serve as the foundation of the course and allow students to create meaningful connections among course concepts. Often, they are abstract concepts or themes that become threads that run throughout the course. Revisiting the big ideas and applying them in a variety of contexts allow students to develop deeper conceptual understandings. Following are the big ideas of the course and a brief description of each:

BIG IDEA 1: EVOLUTION (EVO)

The process of evolution drives the diversity and unity of life. Evolution is a change in the genetic makeup of a population over time, with natural selection as its major driving mechanism. Darwin's theory, which is supported by evidence from many scientific disciplines, states that inheritable variations occur in individuals in a population. Due to competition for limited resources, individuals with more favorable genetic variations are more likely to survive and produce more offspring, thus passing traits to future generations. A diverse gene pool is vital for the survival of species because environmental conditions change. The process of evolution explains the diversity and unity of life, but an explanation about the *origin* of life is less clear.

In addition to the process of natural selection, naturally occurring catastrophic and human-induced events as well as random environmental changes can result in alteration in the gene pools of populations. Scientific evidence supports that speciation and extinction have occurred throughout Earth's history and that life continues to evolve within a changing environment, thus explaining the diversity of life.

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BIG IDEA 2: ENERGETICS (ENE)

Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis. Cells and organisms must exchange matter with the environment. Organisms respond to changes in their environment at the molecular, cellular, physiological, and behavioral levels. Living systems require energy and matter to maintain order, grow, and reproduce. Organisms employ various strategies to capture, use, and store energy and other vital resources. Energy deficiencies are not only detrimental to individual organisms but they can cause disruptions at the population and ecosystem levels. Homeostatic mechanisms that are conserved or divergent across related organisms reflect either continuity due to common ancestry or evolutionary change in response to distinct selective pressures.

BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST)

Living systems store, retrieve, transmit, and respond to information essential to life processes. Genetic information provides for continuity of life, and, in most cases, this information is passed from parent to offspring via DNA. Nonheritable information transmission influences behavior within and between cells, organisms, and populations. These behaviors are directed by underlying genetic information, and responses to information are vital to natural selection and evolution. Genetic information is a repository of instructions necessary for the survival, growth, and reproduction of the organism. Genetic variation can be advantageous for the long-term survival and evolution of a species.

BIG IDEA 4: SYSTEMS INTERACTIONS (SYI)

Biological systems interact, and these systems and their interactions exhibit complex properties. All biological systems comprise parts that interact with one another. These interactions result in characteristics and emergent properties not found in the individual parts alone. All biological systems from the molecular level to the ecosystem level exhibit properties of biocomplexity and diversity. These two properties provide robustness to biological systems, enabling greater resiliency and flexibility to tolerate and respond to changes in the environment.

UNITS

The course content is organized into commonly taught units. The units have been arranged in a common sequence frequently found in many college courses and textbooks.

The eight units in AP Biology, and their weightings on the multiple-choice section of the AP Exam, are listed below.

Pacing recommendations at the unit level and on the Course at Glance provide suggestions for how you can teach the required course content and administer the Personal Progress Checks. The suggested class periods are based on a schedule in which the class meets five days a week for 45 minutes each day. While these recommendations have been made to aid in planning, teachers should of course adjust the pacing based on the needs of their students, alternate schedules (e.g., block scheduling), or their school's academic calendar.

TOPICS

Each unit is broken down into teachable segments called topics. The topic pages (starting on p. 34) contain all required content for each topic. Although most topics can be taught in one or two class periods, teachers should pace the course to suit the needs of their students and school.

Units	Exam Weighting
Unit 1: Chemistry of Life	**8–11%**
Unit 2: Cell Structure and Function	**10–13%**
Unit 3: Cellular Energetics	**12–16%**
Unit 4: Cell Communication and Cell Cycle	**10–15%**
Unit 5: Heredity	**8–11%**
Unit 6: Gene Expression and Regulation	**12–16%**
Unit 7: Natural Selection	**13–20%**
Unit 8: Ecology	**10–15%**

Exam Overview

The AP Biology Exam assesses student understanding of the science practices and learning objectives outlined in the course framework. The exam is 3 hours long and includes 60 multiple-choice questions and 6 free-response questions. A four-function, scientific, or graphing calculator is allowed on both sections of the exam. The details of the exam, including exam weighting and timing, can be found below:

Section	Question Type	Number of Questions	Exam Weighting	Timing
I	**Multiple-choice questions**	**60**	**50%**	**90 minutes**
II	**Free-response questions**	**6**	**50%**	**90 minutes**
	Question 1: Interpreting and Evaluating Experimental Results (8–10 pts)			
	Question 2: Interpreting and Evaluating Experimental Results with Graphing (8–10 pts)			
	Question 3: Scientific Investigation (4 pts)			
	Question 4: Conceptual Analysis (4 pts)			
	Question 5: Analyze Model or Visual Representation (4 pts)			
	Question 6: Analyze Data (4 pts)			

The exam assesses content from each of four big ideas for the course:

1. Evolution
2. Energetics
3. Information Storage and Transmission
4. Systems Interactions

The exam also assesses each of the eight units of the course with the following exam weightings on the multiple-choice section of the AP Exam:

Unit	Exam Weighting
1: Chemistry of Life	**8–11%**
2: Cell Structure and Function	**10–13%**
3: Cellular Energetics	**12–16%**
4: Cell Communication and Cell Cycle	**10–15%**
5: Heredity	**8–11%**
6: Gene Expression and Regulation	**12–16%**
7: Natural Selection	**13–20%**
8: Ecology	**10–15%**

How Student Learning Is Assessed on the AP Exam

All six AP Biology science practices are assessed on every AP Exam in the multiple-choice and free-response sections as detailed below.

Science Practice	Multiple-Choice Section	Free-Response Section
1: Concept Explanation	Individual and/or set-based multiple-choice questions assess students' ability to explain biological concepts, processes, and models presented in written format. Students will need to describe and explain these concepts, processes, and models in both conceptual and applied contexts.	Free-response questions 1, 2, 3, 4, and 5 include one or two points per question that assess Science Practice 1.
2: Visual Representations	Individual and/or set-based multiple-choice questions will assess students' ability to analyze visual representations of biological concepts and processes. Students will need to describe characteristics of a biological concept, process, or model represented visually, as well as explain relationships between these different characteristics. Additionally, students will need to explain how biological concepts or processes represented visually relate to larger biological principles, concepts, processes, or theories.	Free-response question 5 focuses primarily on Science Practice 2.
3: Questions and Methods	Individual and/or set-based multiple-choice questions will assess students' ability to determine scientific questions and methods. Students will need to identify or pose a testable question, state the null and alternative hypotheses or predict the results of an experiment, identify experimental procedures, and/or propose new investigations.	Free-response questions 1 and 3 focus on Science Practice 3, with approximately half of the points for each question assessing this practice.

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Science Practice	Multiple-Choice Section	Free-Response Section
4: Representing and Describing Data	Individual and/or set-based multiple-choice questions will assess students' ability to describe data from a table or graph. Students will need to identify specific data points, describe trends or patterns, and describe relationships between variables	Free-response questions 2 and 6 focus on Science Practice 4, with approximately half of the points for each question assessing this practice. Free-response question 1 also assesses this practice in one or two points.
5: Statistical Tests and Data Analysis	Individual and/or set-based multiple-choice questions will assess students' ability to perform statistical tests and mathematical calculations to analyze and interpret data. Students will need to perform mathematical calculations, use confidence intervals, perform chi-square hypothesis testing, and use data to evaluate a hypothesis or prediction.	Free-response question 1 or 2 assess students' ability to perform a mathematical calculation. Free-response question 6 assesses students' ability to use data to evaluate a hypothesis or prediction.
6: Argumentation	Individual and/or set-based multiple-choice questions will assess students' ability to develop and justify scientific arguments using evidence. Students will need to make scientific claims, support claims with evidence, and provide reasoning to justify claims. Additionally, students will need to explain relationships between experimental results and larger biological concepts, processes, or theories. Finally, students will need to predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	Free-response questions 1, 2, 3, 4, and 6 include one, two, or occasionally three points per question that assess Science Practice 6.

Section I: Multiple-Choice

The first section of the AP Biology Exam includes 60 multiple-choice questions appearing either as individual questions or in sets of typically four to five questions per set. All six AP Biology science practices are assessed in the multiple-choice section with the following exam weightings:

Science Practice	Exam Weighting
1: Concept Explanation	**25–33%**
2: Visual Representations	**16–24%**
3: Questions and Methods	**8–14%**
4: Representing and Describing Data	**8–14%**
5: Statistical Tests and Data Analysis	**8–14%**
6: Argumentation	**20–26%**

Section II: Free-Response

The second section of the AP Biology Exam includes two long questions, and four short-answer questions. Each of the four short-answer questions will focus on a different big idea and a different unit of instruction.

Free-response question 1: Interpreting and Evaluating Experimental Results is an 8 to 10-point question that presents students with an authentic scenario accompanied by data in a table and/or graph. This question assesses student ability to do the following in four question parts:

- Part A (1 to 2 points): Describe and explain biological concepts, processes, or models.
- Part B (3 to 4 points): Identify experimental design procedures.
- Part C (1 to 3 points): Analyze data.
- Part D (2 to 4 points): Make and justify predictions.

Free-response 2: Interpreting and Evaluating Experimental Results with Graphing is an 8 to 10-point question that presents students with an authentic scenario accompanied by data in a table. This question assesses students' ability to do the following in four question parts:

- Part A (1 to 2 points): Describe and explain biological concepts, processes, or models.
- Part B (4 points): Construct a graph, plot or chart and use confidence intervals or error bars.
- Part C (1 to 3 points): Analyze data.
- Part D (1 to 3 points): Make and justify predictions.

Free-response question 3: Scientific Investigation is a 4-point question that presents students with a description of a lab investigation scenario. This question assesses students' ability to do the following in four question parts:

- Part A (1 point): Describe biological concepts or processes.
- Part B (1 point): Identify experimental procedures.
- Part C (1 point): Predict results.
- Part D (1 point): Justify predictions.

Free-response question 4: Conceptual Analysis is a 4-point question that presents students with an authentic scenario describing a biological phenomenon with a disruption. This question assesses students' ability to do the following in four question parts:

- Part A (1 point): Describe biological concepts or processes.
- Part B (1 point): Explain biological concepts or processes.
- Part C (1 point): Predict the causes or effects of a change in a biological system.
- Part D (1 point): Justify predictions.

Free-response question 5: Analyze Model or Visual Representation is a 4-point question that presents students with a description of an authentic scenario accompanied by a visual model or representation. This question assesses students' ability to do the following in four question parts:

- Part A (1 point): Describe characteristics of a biological concept, process, or model represented visually.
- Part B (1 point): Explain relationships between different characteristics of a biological concept or process represented visually.
- Part C (1 point): Represent relationships within a biological model.
- Part D (1 point): Explain how a biological concept or process represented visually relates to a larger biological principle, concept, process, or theory.

Free-response question 6: Analyze Data is a 4-point question that presents students with data in a graph, table, or other visual representation. This question assesses students' ability to do the following in four question parts:

- Part A (1 point): Describe data.
- Part B (1 point): Describe data.
- Part C (1 point): Use data to evaluate a hypothesis or prediction.
- Part D (1 point): Explain how experimental results relate to biological principles, concepts, processes, or theories.