The Advanced Placement Program®

AP Biology— An Overview of Course Revisions

Section 1: An Introduction

CollegeBoard
inspiring minds™

Why We Are Changing AP Biology and Other AP Science Courses?

To Emphasize scientific inquiry and reasoning

To Respond to changes recommended by the National Research Council and the National Science Foundation

To Reduce the emphasis on broad content coverage and focus on depth of understanding

To Support teachers in their efforts to foster students' deep understanding of science

Goals of the *AP Biology* Revision

Working Directly With Experts From Colleges and High Schools, the College Board Has Created a Revised AP Biology Course That:

- Reduces and defines the breadth of the required content so that teachers have more time to develop students' deep conceptual understanding and to engage in inquiry-based lab experiences
- Allows teachers to select specific contexts for teaching key concepts in ways that are meaningful to their own strengths and preferences and to their students' interests
- Makes knowing what will be on the AP Biology Exam completely transparent

Goals of the *AP Biology* Revision
(continued)

Working Directly With Experts From Colleges and High Schools, the College Board Has Created a Revised AP Biology Course That:

- Supports the awarding of college credit/placement for qualifying student exam performance
- Provides students the opportunity to prepare for success in sequent college courses in biology

The New Course Was Created in Collaboration With College Faculty & AP Biology Teachers

Stacy Baker,
Staten Island Academy

Spencer Benson,
University of Maryland

Arnold Best,
Tri-Cities HS

A. Malcolm Campbell,
Davidson College

Robert Cannon,
University of North Carolina

Elizabeth Carzoli,
Castle Park HS

Liz Cowles,
Eastern Connecticut University

Robert Dennison,
Texas ISD

Janice Earle,
National Science Foundation

Kim Foglia,
Division Ave HS

Michael Gaines,
University of Miami

Pamela Gunter-Smith,
Drew University

J.K. Haynes,
Morehouse College

Doris R. Helms,
Clemson University

John R. Jungck,
Beloit College

Chasity Malatesta,
West Salem HS

Pat Marsteller,
Emory University

Sue Offner,
Lexington HS

Jim Pellegrino,
University of Illinois at Chicago

Jeanne Pemberton,
University of Arizona

Jack Kay,
Iolani HS

Sharon Radford,
The Paideia School

Mark Reckase,
Michigan State University

Peggy O'Neill Skinner,
The Bush School

Nancy Songer,
University of Michigan

Kathy Takayama,
Brown University

Gordon Uno,
University of Oklahoma

Brad Williamson,
University of Kansas

Betty Ann Wonderly,
Hockaday School

Bill Wood,
University of Colorado

Julianne Zedalis,
The Bishop's School

CollegeBoard
inspiring minds™

What Has Changed?

Current Course

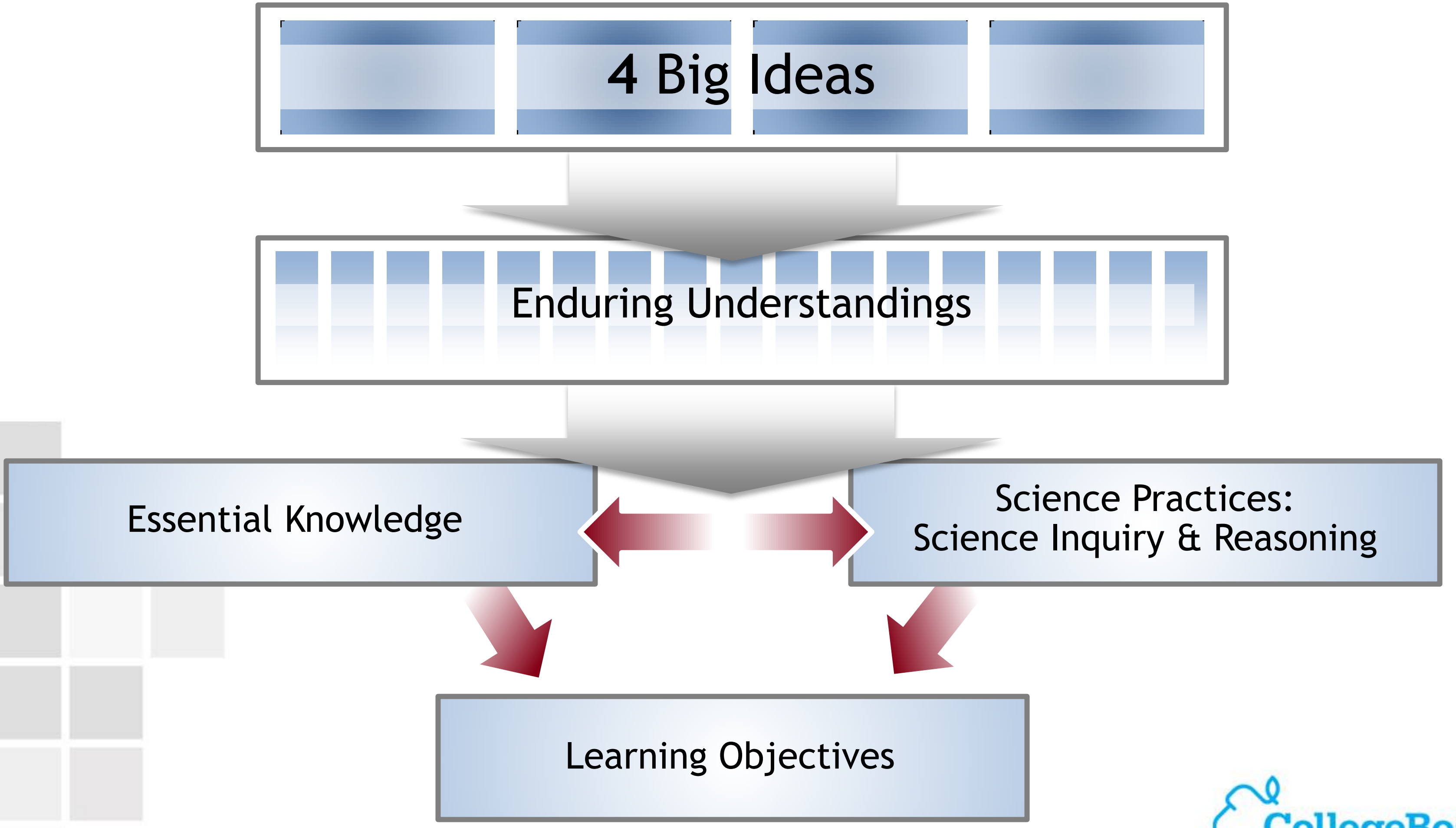
- Teachers have only a general topic outline in the AP Course Description and released exams to determine what to teach
- Teachers feel the need to march through all textbook chapters associated with the general topics because no specific guidance was given

What Has Changed?

Revised Course

- A detailed curriculum framework defines and articulates the scope of the course. Clear guidance is provided on what concepts, content and skills should be taught and will be assessed on the AP Exam
- “Exclusion Statements” — clear indications in curriculum as to what teachers don’t have to teach
- New emphasis on integrating inquiry and reasoning throughout the course and on quantitative skills

The New Curriculum Framework Supports and Furthers Conceptual Knowledge



AP Biology Curriculum Is Framed Around Four Big Ideas

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

Building Enduring Understandings

For each of the four Big Ideas, there is a set of Enduring Understandings which incorporates core concepts that students should retain from these learning experiences

BIG IDEA 1 — The process of evolution drives the diversity and unity of life.

- Enduring Understanding 1.A: Change in the genetic makeup of a population over time is evolution
- Enduring Understanding 1.B: Organisms are linked by lines of descent from common ancestry
- Enduring Understanding 1.C: Life continues to evolve within a changing environment
- Enduring Understanding 1.D: The origin of living systems is explained by natural processes

EXAMPLE

Building Essential Knowledge

Each Enduring Understanding is followed by statements of the Essential Knowledge students must develop in the course

BIG IDEA 1

The process of evolution drives the diversity and unity of life.

- Enduring Understanding 1.A: Change in the genetic makeup of a population over time is evolution
  - Essential Knowledge1.A.1: Natural selection is a major mechanism of evolution
    - a. According to Darwin's Theory of Natural Selection, competition for limited resources results in differential survival . Individuals with more favorable phenotypes are more likely to survive and produce more offspring, thus passing traits to subsequent generations
    - b. Evolutionary fitness is measured by reproductive success
    - c. Genetic variation and mutation play roles in natural selection. A diverse gene pool is important for the survival of a species in a changing environment

CollegeBoard inspiring minds™

Emphasis on Science Practices

The science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena

SCIENCE PRACTICES

- 1.0 The student can use representations and models to communicate scientific phenomena and solve scientific problems
- 2.0 The student can use mathematics appropriately
- 3.0 The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course
- 4.0 Student can plan and implement data collection strategies in relation to a particular scientific question
- 5.0 The student can perform data analysis and evaluation of evidence
- 6.0 The student can work with scientific explanations and theories
- 7.0 The student can connect and relate knowledge across various scales, concepts, and representations in and across domains

AP

EXAMPLE

Clearly Articulated Science Practices Underpin the Entire Course

SCIENCE PRACTICES 6.0

The student can work with scientific explanations and theories.

- 6.1 The student can justify claims with evidence
- 6.2 The student can construct explanations of phenomena based on evidence
- 6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced.
- 6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models.
- 6.5 The student can evaluate alternative scientific explanations

CollegeBoard inspiring minds™

An Example of Integrating the Concept, Content, and the Science Practice

Content	**Essential Knowledge 1.B.2** Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested
Science + Practice	**Science Practice 5.3** The student connect phenomena and models across spatial and temporal scales
Learning Objective	**Learning Objective (1.B.2 & 5.3)** The student is able to evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a simple cladogram to determine evolutionary history and speciation

The New Course Emphasizes Inquiry-Based and Student-Directed Labs

Topic	*Previously*	*Now*
Primary Question	A primary question framed the lab	Students generate their own questions for investigation
Alignment to Big Ideas	Not as clearly tied to the curriculum	Labs are clearly tied to Big Ideas, enduring understandings, science practices, and the learning objectives
Experiments	Experiments were teacher-directed	Students design and conduct their own experiments, based on investigative questions they pose for themselves
Variables	Students are told which variables to investigate	Students choose which variables to investigate
Steps	Each lab provided clear steps to follow	Students design their own experimental procedures
Tables and Graphs	Tables and graphs were provided for the students to fill in	Students construct their own tables and graphs for presentations
Providing Conclusions	Students were given specific questions to answer	Students determine how to provide their conclusion

AP Biology New Exam Design

Section Information: Item Types & Weight	*Question Types and Distribution*	*Timing*
Multiple Choice + Grid-ins (50% of exam weight)	55 multiple choice 5 grid-in questions (New type: mathematical manipulation/calculation. Students will write and bubble in numerated answer)	90m
Five Minutes Required Reading Time in Advance of the Free Response Section		
Free Response (50% of exam weight)	2 multi-part questions, 1 of which connects to the lab experience (25% of exam weight)	20-25 min per question
	7 single-part questions (25% of exam weight)	3-10 min per question

CollegeBoard
inspiring minds™

Example of a Multiple Choice Question Integrating Concept, Content and Science Practice

Two flasks with identical medium containing nutrients and glucose are inoculated with yeast cells that are capable of both anaerobic and aerobic respiration. Culture 1 is then sealed to prevent fresh air from reaching the culture; culture 2 is loosely capped to permit air to reach the culture. Both flasks are periodically shaken.

Which of the following best predicts which culture will contain more yeast cells after one week, and most accurately justifies that prediction?

A. **Culture 1,** because fresh air is toxic to yeast cells and will inhibit their growth

B. **Culture 1,** because fermentation is a more efficient metabolic process than cellular respiration

C. **Culture 2,** because fresh air provides essential nitrogen nutrients to the culture

D. **Culture 2,** because oxidative cellular respiration is a more efficient metabolic process than fermentation

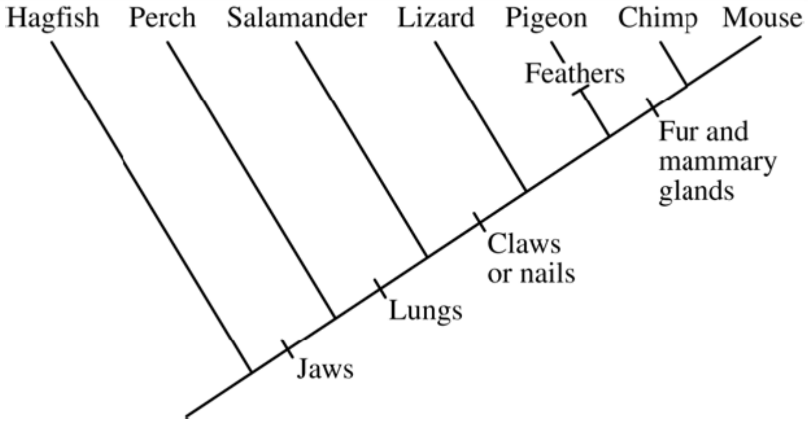
The answer is on the next slide →

Answer: D

Culture 2 will contain more yeast cells after one week. Culture 1 must eventually undergo anaerobic respiration due to a lack of oxygen. Anaerobic respiration is less efficient in ATP production which results in decreased cellular processes and cellular reproduction.

Example of a Multiple Choice Question Integrating Concept, Content and Science Practice

Animal	*Jaws*	*Lungs*	*Claws Nails*	*Feathers*	*Fur/Mammary Glands*
Lizard	X	X	X		
Mouse	X	X	X		X
Hagfish					
Chimp	X	X	X		X
Perch	X				
Pigeon	X	X	X	X	
Salamander	X	X	X		



And Here Is the Exam Question…

Assume that the cladogram shows the correct ancestral relationships between the organisms listed. Which of the following describes an error in the data table?

A. Perch have swim bladders, and therefore the table should indicate the presence of lungs.

B. Salamanders should not show claws or nails in the data table.

C. Pigeons produce a nutritious milk-like substance for their young, and therefore the data table should indicate the presence of mammary glands.

D. Hagfish are the animals least like chimps, but since they are fish, the data table should indicate the presence of jaws.

The answer is on the next slide →

Answer: B

The cladogram shows that the presence of claws or nails is a shared derived character among the lizard, pigeon, chimp and mouse, and is not found in the salamander.

EXAMPLE

Short Single-Part Question

BIG IDEA 1

Currently, all living organisms are classified into one of three domains: Bacteria, Archaea, and Eukarya.

In a sentence or two, provide two pieces of evidence that justify a common origin for the three domains.

BIG IDEA 2

Oxygen can diffuse into cells by passing between plasma membrane lipids.

In a sentence or two, explain why ions, such as Na^+, cannot pass between membrane lipids.

The answers are on the next slide →

Answer 1:

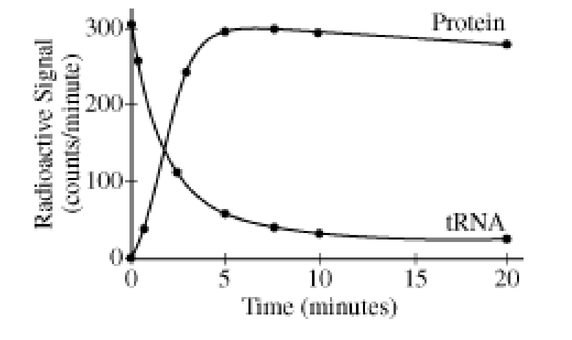
All living organisms are composed of cells that use nucleic acid as their genetic material, and have ribosomes for protein synthesis.

Answer 2:

Ions and polar molecules are hydrophilic, and therefore cannot pass through the hydrophobic core of the cell membrane without a transport protein or channel.

Another Single-Response Question…

BIG IDEA 3



The role of tRNA in the process of translation was investigated by the addition of tRNA with attached radioactive leucine to an in vitro translation system that included mRNA and ribosomes. The results are shown by the graph.

Describe in one or two sentences how this figure justifies the claim that the role of tRNA is to carry amino acids that are then transferred from the tRNA to growing polypeptide chains.

The answer is on the next slide →

Answer:

One can infer the transfer of the radioactive leucine from tRNA to protein because the radioactive leucine signal in tRNA decreases as the signal in protein increase.

EXAMPLE

Single-Part Questions

BIG IDEA 4

The rate of an enzyme-catalyzed reaction was measured at various temperatures based on the amount of product, in micromoles, produced per square meter of reaction surface per second. The table below shows the data collected.

In two or three sentences, indicate the nature of the relationship between enzyme structure/function and temperature that explains the data shown in the table.

REACTION RATES AT DIFFERENT TEMPERATURES				
Temperature	10 C	25 C	40 C	85 C
Reaction rate (*m*mol/m²/s)	0.2	1.0	3.5	0.0

The answer is on the next slide →

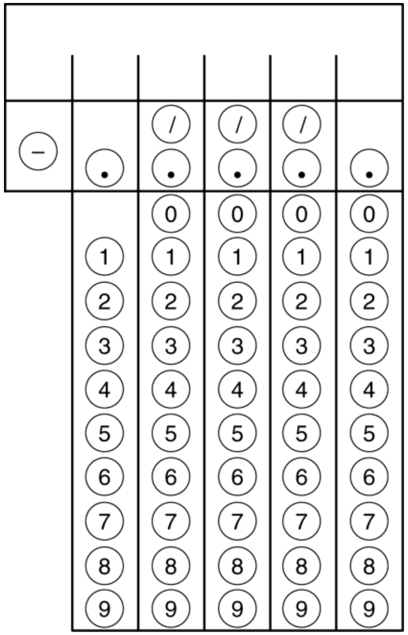
Answer:

The reaction rate increases as the temperature increases from 10^0C to 40^0C. However, the reaction rate is zero at 85^0C, suggesting that the enzyme can no longer function as a catalyst at this temperature. The enzyme's functional conformation is stabilized by hydrogen bonds, which can be broken by excessive heat, rendering the enzyme nonfunctional.

Grid-In Question Requiring Calculator Use

The data below demonstrate the frequency of tasters and non-tasters in an isolated population at Hardy-Weinberg equilibrium. The allele for non-tasters is recessive

Tasters	*Non-tasters*
8235	**4328**



How many of the tasters in the population are heterozygous for tasting?

The answer is on the next slide →

Answer:

An acceptable answer would be any number in the range of 6030– 6156, depending on how students rounded the variables in the Hardy-Weinberg equation.

Lab Free Response Question

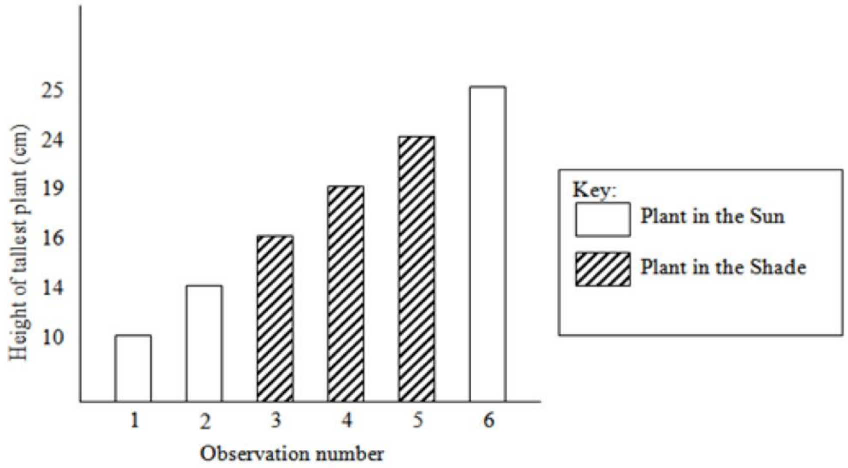
1. An experiment to determine the effect of sunlight on plant growth involved growing six plants, three in a sunny window and three in the shady corner of the classroom. The height of each plant was measured, and the results are shown in the chart below.

Effect of Sunlight on Plant Height in cm							
Observation #:		1	2	3	4	5	6
Plant #	Treatment	Starting Height	Height on Tuesday AM	Height on Wednesday PM	Height on Friday AM	Height on Monday AM	Height on Monday PM
1	Light	2	6	8	12	16	20
2	Light	4	8	18	19	22	25
3	Light	10	14	15	16	17	18
4	Shade	9	13	16	19	24	24
5	Shade	5	10	15	19	21	21
6	Shade	4	9	11	18	19	19

Lab Free Response Question

(continued)

A student's representation of the data is shown in the graph above. When asked to draw a conclusion from the data, the student wrote, "I can conclude that whether a plant is in sun or shade makes very little difference, as the data shows that for three days the sunny plant grew the best, and for three days the shady plant grew the best, and all plants grew at the same steady rate."



A. Describe what is wrong with the student's graph and conclusion based on the purpose of the experiment.

B. Using the data in the table, construct a graph that shows the relationship between plant growth and exposure to sunlight.

C. Describe three potential sources of error in the design of the experiment.

D. Design an experiment to better test the hypothesis that "plants grown in the sun grow faster than plants in the shade."

The answer is on the next slide →

Lab question overview:

The lab investigation focuses on the “big idea” that organisms use available energy to grow, reproduce and maintain homeostasis. The experimental design and analysis, including intentional errors, provides students with the opportunity to apply the following skills: analyzing data, converting data from one form to another, refining scientific methods and questions, and designing plans to collect data and test hypotheses.

How the Curriculum Framework helps you focus and constrain breadth

- **Illustrative Examples** are suggested contexts for instructional purposes. The specific examples will not be assessed on the AP Biology exam. What is required is an understanding of the contexts/concepts that are illustrated

- **Exclusion Statements** define the type and level of content which is excluded from the AP Biology course and exam

- **Concept and Content Connections** indicate where an overlap, further clarification or application of concepts and content exist

Breadth Reduction in the Curriculum Framework

1.C.1 SPECIATION

Speciation and extinction have occurred throughout the Earth's history.

A. Speciation rates can vary, especially when adaptive radiation occurs when new habitats become available.

B. Species extinction rates are rapid at times of ecological stress

Students should be able to demonstrate understanding of the above concept by using an Illustrative example **such as:**

- Five major extinctions
- Human impact on ecosystems and species extinction rates

They do **NOT** need to know the names and dates of these extinctions

Learning Objective (Pairing of Content + Science Practice)

CollegeBoard inspiring minds™

Examples of Reduction of Breadth

Campbell and Reece, *Biology, 7th* ***ed***.

Material in 20+ chapters does not need to be covered or needs much less coverage (See table below for examples of how content has been reduced)

Type of Content Reduction	*Examples of Chapters*
I. Content is ***prerequisite*** or ***eliminated***	Chapter 2: Chemical Context of Life (***Prerequisite***) Chapter 35: Plant Structure (***Eliminated***)
II. Content is substantially reduced *Only certain content is ***required*** and is specified in the AP Biology Curriculum Framework	Chapters 40-49: Animal Form and Function ("Organ of the Day" approach will no longer be needed.) *Only ***required*** systems are immune, nervous, and endocrine, as specified in the AP Biology Curriculum Framework. Chapters 8-10: Energy, Respiration, and Photosynthesis *The ***required*** content is specified in the AP Biology Curriculum Framework
III. Content is primarily comprised of ***illustrative examples*** and is not ***required***.	Chapters 27-34: Prokaryotes to Vertebrates ("March of the Phyla") *Content includes ***illustrative examples*** taught to support concepts and is not ***required***.

Reductions to the AP Biology Course Content Make Course Delivery Manageable

AP Teacher	School Starts/Ends	Class Periods	Amount of Instructional Time Devoted to Each Big Idea
Julianne Zedalis The Bishop's School, La Jolla, CA Number of AP Biology Students: 20	Mid August End of May	50 minutes twice a week for class Two double periods for labs of 100 minutes each week	Big Idea 1: 17% Big Idea 2: 32% Big Idea 3: 31 % Big Idea 4: 20%

AP Teacher	School Starts/Ends	Class Periods	Amount of Instructional Time Devoted to Each Big Idea
Sharon Radford The Padeia School, Atlanta, GA Number of AP Biology Students: 18	Mid August End of May	50 minute classes five times per week	Big Idea 1: 17% Big Idea 2: 29% Big Idea 3: 29% Big Idea 4: 25%

AP Teacher	School Starts/Ends	Class Periods	Amount of Instructional Time Devoted to Each Big Idea
Elizabeth Carzoli Castle Park High School, Chula Vista, CA Number of AP Biology Students: 27	Early September End of June	55 minute classes five times per week	Big Idea 1: 17% Big Idea 2: 31% Big Idea 3: 27 % Big Idea 4: 25%

Preparing for the New Course

- Visit Advances in AP for:
  - A free download of the AP Biology Curriculum Framework
  - Ongoing updates about the upcoming course and exam changes
  - Answers to any questions that you may have
  - Information about the new labs and other resources to support AP Biology.

Preparing for the New Course

- Professional development opportunities will help you transition your current content and activities to the new course
  - In spring 2011, online tutorials will be available
  - The 2011 AP Summer Institute will focus on the new labs
- The new lab manual will provide strategies for making your own labs inquiry based
- AP will share teacher-created pacing guides showing examples of how to teach the new course within an academic year and allocate instructional time to meet all of the learning objectives

Thank you!

On behalf of the Advanced Placement Program, thank you very much for your time to learn more about the upcoming changes to AP Biology.

We look forward to partnering with you as you build students' success in biology in your classroom and for the future!