

Curricular Requirements	Page(s)
CR1 Students and teachers use a recently published (within the last 10 years) college-level biology textbook.	1
CR2 The course is structured around the enduring understandings within the big ideas as described in the AP [®] Biology Curriculum Framework.	1
CR3a Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea.	1,2,3
CR3b Students connect the enduring understandings within Big Idea 2 (biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis) to at least one other big idea.	1,2
CR3c Students connect the enduring understandings within Big Idea 3 (living systems store, retrieve, transmit, and respond to information essential to life processes) to at least one other big idea.	1,2,3
CR3d Students connect the enduring understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.	1
CR4a The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	1,2
CR4b The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.	1,2
CR4c The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.	1,2
CR4d The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.	1
CR5 The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	4
CR6 The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.	4,5
CR7 Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.	5
CR8 The course provides opportunities for students to develop and record evidence of their verbal, written and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations.	6

Teaching Philosophy

All students need an opportunity to experience science as a process and not just learn biology as a collection of unrelated facts. This means that the course should emphasize how scientists use their observations and readings to ask questions that can lead to new experiments. These experiments build on the work of others and eventually lead to additional evidence on different topics. This investigative process will be used throughout this AP Biology course. It is important for students to become excited with discovery as they ask and answer their own questions about natural/biological phenomena that they see, read about, or experience in the laboratory and field. In addition, it is critical that students connect new concepts with what they know, with each connection they help themselves build a solid framework of biological knowledge and scientific know-how. This framework will help students to enter their future, prepared for whatever may lie ahead of them.

Textbook: Reece, Jane et al., *Campbell Biology*, 9th Edition. Benjamin Cummings, 2011. [CR1]

Course Organization

This course is structured around the four big ideas and the enduring understandings identified in the Curriculum Framework. [CR2] All essential knowledge will be taught and all learning objectives will be addressed through this curriculum. The course will focus on inquiry-based laboratory work and the use of the seven science practices in both lab and non-lab activities.

The four Big ideas are:

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

Big idea 2: Biological systems utilize free 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 possess complex properties.

Students will be given a copy of the big ideas and enduring understandings to self-monitor mastery of these major organizing tools. The big ideas and enduring understandings will also be posted in the room. As connections are made across big ideas, a line will join the related enduring understandings, visually building a web of relatedness as the course progresses. The learning objectives will be used as a guide to build the rest of the class discussions, not as a checklist to be marked off through the year, but as a way to help students learn a focused amount of biological content with the use of specific scientific process skills. Skills will be practiced every day, not necessarily all skills every day, but each day at least one skill will be used to introduce the biological content students study. [CR2], [CR3a], [CR3b], [CR3c], [CR3d], [CR4a], [CR4b], [CR4c] & [CR4d]

CR1: Students and teachers use a recently published (within the last 10 years) college-level biology textbook.

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

CR3a: Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea.

CR3b: Students connect the enduring understandings within Big Idea 2 (biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis) to at least one other big idea.

CR3d: Students connect the enduring understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.

Big Ideas

The big ideas are interrelated, and they will not be taught in isolation. The course will connect the enduring understandings from one big idea with those of the others wherever practical. Students will maintain a curricular map of the big ideas and enduring understanding showing connections as they are made by the students themselves.

Examples illustrating the types of connections to be made throughout the course:

Big idea 1 and 3: **[CR3a]**

EU 1.B: Organisms are linked by lines of descent from common ancestry.

EU 3.A: Heritable information provides for continuity of life.

- DNA and RNA are carriers of genetic information through transcription, translation and replication. (LO 1.15) Students will model information flow in a kinesthetic activity and discuss the similarities in the process among different domains. DNA replication ensures continuity of hereditary information. (LO 3.3) (This is an example of a student activity that will connect enduring understandings between different big ideas and is an example of what students will do throughout the course).

3B: Big idea 1, 2 and 4: **[CR3a] & [CR3b]**

EU 1.B: Organisms are linked by lines of descent from common ancestry.

EU 2.B: Growth, reproduction, and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.

EU 4.1: Interaction within biological systems lead to complex properties.

- Electron Transport Chain (ETC) and chemiosmosis kinesthetic activity. Students build an inner mitochondrial membrane out of a variety of materials and identify the membrane as a feature allowing separation within the cell. Students explain and justify how this separation is achieved in prokaryotes to generate a proton gradient, and they will present the evolutionary connections across domains through a BLAST search for proteins in the ETC. **[CR4a] & [CR4b]**

3C: Big idea 1 and 3: **[CR3a] & [CR3c]**

EU 1.A: Change in the genetic makeup of a population over time is evolution.

EU 3.A: Heritable information provides for continuity of life.

- Students will participate in a Hardy-Weinberg activity where they calculate allelic frequency change. These alleles will be connected to DNA and related back to the evolutionary history of the organisms being studied. In a second part of this activity, students will investigate the role of environmental change in the changing genetic make-up of a population. **[CR4a] & [CR4c]**

CR3a: Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea.

CR4a: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.

CR4b: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

CR4c: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

3D: Big idea 1 and 4: **[CR3a] & [CR3c]**

EU 4.B: Competition and cooperation are important aspects of biological systems.

EU 1.C: Life continues to evolve within a changing environment. Students will track the changing flowering phenology of particular species of flowering plants across a wide territory (such as North America or Europe) or the changing flight patterns of migratory insects or birds in relation to global climate change.

- Students are provided with opportunities to meet the learning objectives within each of the big ideas. These opportunities must occur outside of the laboratory investigations.
- The science practices and the learning objectives are used throughout the course. All activities and class work will be connected to at least one learning objective that will be clearly communicated to students so they can see the science practices and learning objectives as the framework around which the learning of the course takes place. The science practices and learning objectives will also be addressed in classroom activities and projects external to the formal lab investigations. Representative examples of activities are below:

4A: Students will participate in a Hardy-Weinberg simulation as a class activity.

Within this activity, students will make predictions and test them using mathematical models to study population genetics. (LO 1.6)

- Students will choose several organisms to investigate some aspect of their evolutionary relatedness. Students will narrow down an appropriate, under-explored question about the organism of their choice through research, and develop testable hypotheses. Students will share research results. (LO 1.16)
- Students will examine evidence regarding speciation of major groups of plants and major extinctions on Earth. Students will plan, design, and carry out data collection plans to evaluate these scientific claims. (LO 1.21)

4B: Students will compare cells in different domains with regard to internal membranes and their function. Students will extend this analysis to an examination and application of scientific explanations in endosymbiont theory. (LO 2.13)

- Students will make short movies showing the relationship between molecular events and global cycles such as between photosynthesis/respiration and global carbon cycles. (LO 2.9)

4C: Students will work with models demonstrating the immune system, digestive system, action potential, action at the nephron, working of the sarcomere, and cellular communication, which allow students to problem solve as they change conditions within the model. Students will model the effect of change (for example disease or drugs) and communicate the results predicted due to the change. (LO 3.36)

- Students will select and read an article in a scientific journal on a medical procedure, device, drug trial, or similar event. Students will statistically analyze and evaluate the data and report on the findings. (LO 3.37)

CR3a: Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea.

CR3c: Students connect the enduring understandings within Big Idea 3 (living systems store, retrieve, transmit, and respond to information essential to life processes) to at least one other big idea.

4D: Students will identify, explain and justify how intracellular structures interact with each other, such as rough endoplasmic reticulum and the Golgi apparatus, or mitochondria and chloroplasts in plants, or the DNA inside the nucleus and the ribosomes outside the nucleus. (LO 4.18)

Social and Ethical Concerns [CR5]

It is vitally important that students connect their classroom knowledge to socially important issues. The course will allow students to learn about and discuss many issues in a variety of formats. Issues will be discussed in a class setting, both live and electronically through such programs as a Moodle forum, and students may research and report on a current topic that has social or ethical issues associated with it. Since the goal will be to discuss a timely event, the list below should be seen as illustrative as new issues continually appear.

- Stem Cell Research (Big idea 3)
- Global Warming (Big idea 4)
- Antibiotic Resistance and the Problems with Improper Antibiotic Use (Big idea 1)
- Genetically Modified Food (Big idea 3)
- The Use of Genetic Information (Big idea 3)

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

Application of the Science Practices in the Laboratory Program [CR6]

Students will be able to apply the science practices throughout their laboratory work; a matrix describing their application is below. Many of the science practices will be used in all of the student-directed laboratory and field investigations, however, some science practices will be emphasized to a greater degree than others in each particular investigation. Those that are emphasized are indicated by an “X” in the matrix. [CR6]

	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7
BLAST	X				X		
Hardy-Weinberg	X	X			X		
Artificial Selection (Big Idea 1)	X	X			X		X
Cellular Respiration (Big Idea 2)	X	X	X			X	X

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.

	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7
Photosynthesis (Big idea 2)	X	X	X	X		X	X
Diffusion & Osmosis (Big Idea 2)		X		X	X		
Cell Division: (Mitosis and Meiosis) (Big Idea 3)	X				X	X	X
Biotechnology Lab #1: Bacterial Transformation (Big Idea 3)	X		X		X	X	X
Biotechnology Lab #2: Restriction Enzyme Analysis (Big Idea 3)			X			X	
Energy Dynamics (Big Idea 4)	X	X	X	X	X	X	X
Fruit Fly Behavior (Big Idea 4)	X		X	X	X	X	X
Transpiration (Big Idea 4)	X	X		X		X	X
Enzyme Activity					X	X	X

The Laboratory Program

The students will be engaged in investigative laboratory work for a minimum of 25% of instructional time. **[CR7]** These labs will be inquiry based, student-directed investigations. There will be at least two laboratory experiences per big idea selected from the list below from the *AP Biology Investigative Lab Manual: An inquiry-based approach (2012)*. **[CR6]** These labs will be spread throughout the school year and will be conducted during at least one out of every four class meetings during the year. The descriptions below summarize the student inquiry portion of the investigation. Additional prescribed activities supplement the student inquiry.

CR7: Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.

Big idea 1: Evolution

BLAST Activity: Students use NCBI to compare DNA and protein sequences for organisms to test student-generated hypotheses on their relatedness.

Hardy-Weinberg: Spreadsheet development to investigate factors affecting Hardy-Weinberg Equilibrium.

Artificial Selection: Students will grow organisms such as Fast Plants and select for specific traits over several generations.

Big idea 2: Cellular Processes; Energy and Matter

Cellular Respiration: Students investigate some aspect of cellular respiration in organisms.

Photosynthesis Students investigate photosynthetic rate under a variety of student selected conditions.

Diffusion/Osmosis: Students investigate diffusion and osmosis in model systems and in plant tissue.

Big idea 3: Genetics and Information Transfer

Cell Division: Mitosis and Meiosis. Students compare mitotic rate after exposure to lectin or other substances presumed to affect mitotic rate.

Bacterial Transformation: Students investigate bacterial transformation.

Restriction Enzyme Analysis: Students investigate restriction enzyme analysis.

Big idea 4: Interactions

Energy Dynamics: Students develop and analyze model systems that describe energy flow.

Fruit Fly Behavior: Students investigate chemotaxis in fruit flies.

Transpiration: Students investigate the movement of water through plants in a model system.

Enzyme Investigation: In an open inquiry lab, students will investigate and quantify factors that affect enzyme action.

Communication

Students will maintain a laboratory notebook and a portfolio throughout the course. In addition to the laboratory notebook, students will communicate to others in formats such as group presentations, PowerPoint presentations, poster sessions, and written reports. Communication tools are not only for the laboratory experiences, but represent examples of the collaboration, reflection, and articulation seen in the course as a whole. Students will use this collection of their work over time and reflect on the changes they can see in the quality or substance of their work through the year as they prepare to move into college courses and research experiences in the future. A key feature in the portfolio will be the requirement for student self-reflection in terms of the science practice skills that they have developed throughout the year. **[CR8]**

CR8: The course provides opportunities for students to develop and record evidence of their verbal, written and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations.