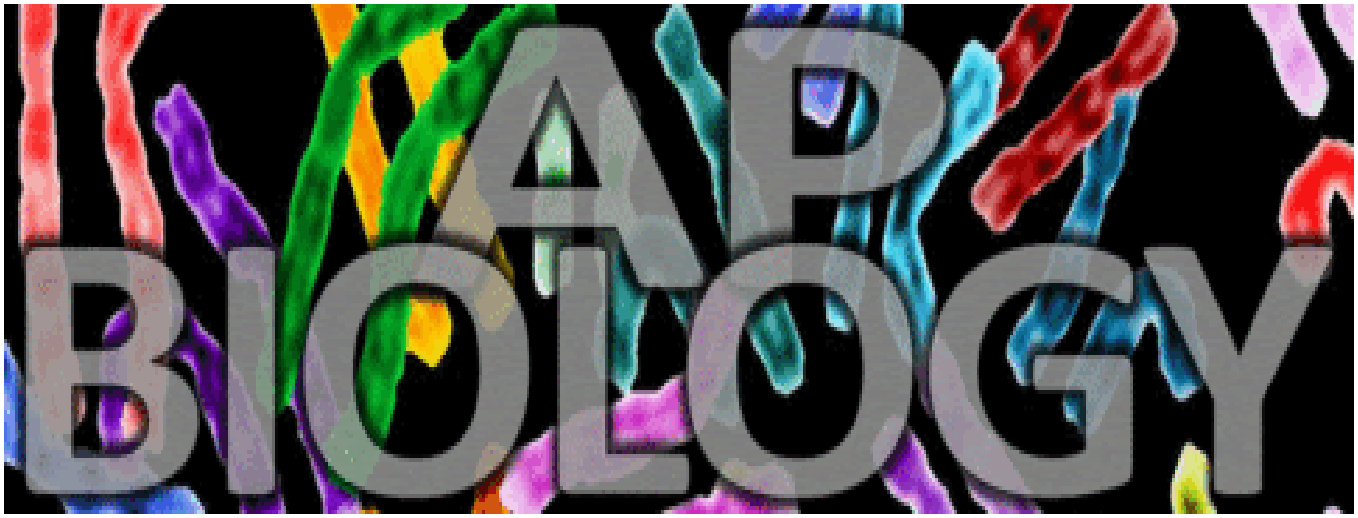
AP/ACP Biology COURSE SYLLABUS

Course Title: Advanced Placement Biology School Year: 2019-20	**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.	5-9
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.	4, 6- 10
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.	4, 10
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.	4, 10-11
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.	4, 10-11
CR4a The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	4, 10-11
CR4b The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.	10-12
CR4c The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.	12
CR4d The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.	12
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.	10-12
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.	12
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.	11-12
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.	11- 12



Advanced Placement College Biology Course Syllabus

Textbook: Biology (Ninth Edition) by Campbell and Reece

Course Overview:

The Advanced College Placement Biology curriculum is equivalent to a college course usually taken by biology majors during their first year of college. Students obtain weighted credit by successfully completing the AP Biology exam at the end of the course. The course differs significantly from a first year high school Biology course with respect to the kind of textbook used, the range and depth of the topics covered the kind of laboratory work done by students, and the time and effort required by the students. The primary emphasis of the course is on developing an understanding of concepts; a grasp of science as a process rather than as an accumulation of facts; personal experience in scientific inquiry; recognition of unifying themes that integrate the major topics of biology; and the application of biological knowledge and critical thinking to environmental and social concerns.

Topics covered in the course include chemistry of life, cells and cell energetics, heredity, molecular genetics, evolution, diversity of organisms, structure and function of both plants and animals, and ecology. The course is broken down into three areas of study: 25% molecules and cells, 25% genetics and evolution, and 50% organisms and populations. In addition, students will conduct all twelve of the College Board AP Biology laboratories

Benefits of taking the course for UMSL credit

Students who take this course for credit at the University of Missouri Saint Louis enjoy, money saying on college tuition, qualify to apply for scholarship, some may use it as a transferable college credit**. Grade for this course will be averaged over 2 semesters of the regular school year in order to get college credit. There will be one grade for both lecture and lab. Course number and description for 2019-2020 are listed below.**

Biology 1012: General Biology (3) [MS] - Emphasis on fundamental principles of biology. Biology 1012 can be applied toward fulfillment of the general education requirement in science. Biology 1012 does not satisfy the prerequisite requirements in other courses in biology at the 2000 level or above. Students who plan to pursue a career in medicine or one of the medical-oriented professions should enroll in Biology 1811 rather than Biology 1012.

Biology 1013: General Biology Laboratory (2) [MS] - Prerequisite: Biology 1012 (may be taken concurrently). Laboratory course to accompany Biology 1012. Biology 1013 can be used to fulfill the general education requirements in a laboratory science. Biology 1012 does not meet the prerequisite requirements for other courses in biology.

Objectives

- Understand the methods used in scientific research.
- Be familiar with mathematical procedures used in the biological sciences.
- Understand chemical principles, and how they apply to living systems.
- Understand the importance of water to living organisms.
- Describe cellular structures, and how they function in a cell.
- Understand the energy processes that occur in a living cell.
- Understand the similarities and differences between RNA and DNA, and their role in the genetic process.

Goals:

1. To familiarize students with the terminology and concepts of Biology using a theme-oriented approach that emphasizes concepts and science as a process over knowledge of facts.
2. To enhance problem-solving skills of students using hands-on labs, readings, collections, independent projects, and class discussions.
3. To strengthen students' communication skills with the use of written assignments, essays, abstracts, and lab reports.
4. To prepare students for further study in the Biological Sciences.

Timeline subject to change and rearrangement

First Semester

Subject	Weeks of Instruction	% of AP Test
Chemistry of Life	5.0	7%
Mechanics of evolution	6.5	8%
Biological Diversity	6.5	8%
Ecology	8.0	10%
Second Semester		
Cells	6.5	18%
Genes	6.5	17%
Plant Form & Function	3.5	12%
Animal Form & Function	7.0	20%

Prerequisites:

Pre-AP Biology, Honors biology, Chemistry (may take concurrently), and Algebra I are required with a grade of 80% (B) for each semester in these courses. Students may also enroll with teacher recommendation.

Course Requirements:

Students should maintain a "C", each of the first five weeks of the grading cycle, in order to remain in the course. Students who are not able to maintain this level will be transferred into biology

Textbook & Study Resources:

Biology 9th th ed. By Campbell, Reece, & Mitchell, Edition. 2011. Pearson Education , Inc., Publishing as Pearson Benjamin Cummings..

Student Study Guide for Campbell Biology, 9th Edition. 2011. Benjamin/Cummings Publishing Co., Inc.

Required Materials:

- 3D-ring binder with dividers
- Standard size, loose leaf notebook paper
- Composition notebook
- Pencils with erasers

- Colored pencils
- Graph paper
- Black ink pens
- Computer with access to the internet

Grading Scale:

Credit is based on Carnegie units; therefore, a year course is valued as one (1) unit.

Grading Scale	Grade Points
90 -100 A	A = 4
80 - 89 B	B = 3
70 - 79 C	C = 2
60 - 69 D	D = 1
0 - 59 F	F = 0

Quarter grades will be calculated as follows

Essays	15%
Labs	20%
Projects/Research paper	15%
Quizzes	20%
Test	30%

- **total 100% equal to final grade**
- **grades will be kept as a running total not broken down by quarters**
- **semester grade will be 80% from 2 quarters and 20% final exam**
- **UMSL grade will be a composite grade with the lab grade included in the overall grade for the course.**

This class is available for dual credit through University of Missouri St. Louis

Projects:

1. Students are responsible for completing a Science research project to be submitted To the Greater St Louis Science Fair during the spring semester
2. **Students are responsible for writing a 3 page essay in a scientific issue every month**.
3. **Each semester, students will write a research paper.**
4. Students are required to complete twelve (12) labs set forth by The College Board Advanced Placement Program. Students are expected to read each lab carefully before

coming to the laboratory and are responsible for following all correct laboratory and safety procedures. Students should also use the lab aid, LabBench, to make sure they understand all lab procedures before beginning a lab exercise.

5. Due to the large amount of time required for laboratory set-up, it is essential that you are always present on lab days. Some labs will use Lab Quest sensors and probes to obtain quantitative data. Additional labs will be included such as bioremediation of oil and industrial pollutants, gram staining techniques, and dissection of the fetal pig. Within one week of completing the lab, students will turn in lab reports in the format provided by the instructor.
6. Scientific issues essays and semester research paper topics must include but are not limited to the following topics: CRISPR-Cas9 genome editing technology, the Winogradsky Column and what it demonstrates, and any topics concerning Global Climate Change especially ocean acidification implications and greenhouse gas generation by prokaryotes.
7. Students will also be tested on the required reading of "The Survival of the Sickest" the surprising connection between disease and longevity by Dr. Sharon Moalem.

Make-Up Work

Only students that have an excused absence will be permitted to make-up work. All unexcused absences will result in a zero for the missed assignment.

1. The student's name must appear on the excused absences report within two days of absence.
2. Missed test and quizzes must be scheduled immediately upon return to school.
3. Tests and quizzes must be made up before school and/or during advisory period, per approval by teacher.
4. It's the student's responsibility to check Google Classroom for any missed work, get notes from a classmate, and to get any handouts from the teacher.
5. As a general rule, there will be no retesting in the event of poor performance on a summative assessment. However, circumstances may occasionally dictate the necessity of some form of test correction for partial credit. This is completely at the discretion of the teacher and will be evaluated on an individual basis. If you feel that circumstances warrant consideration, you must request accommodations and complete any corrections prior to the beginning of the following class period. Once the test has been reviewed by the class, no accommodations will be granted.

Make-up work is due no later than two class period days after returning to school. For extended excused absences and/or illnesses, you will be given time equal to the time you were absent to turn the work in. As unexpected events occur in everyone's life, it is understandable that there may be a time in which a student is unable to complete an assignment due to reasons beyond their control. In this event, a student may arrange with the teacher times before and/or after school to review missed material

AP Exam Preparation:

All students should prepare to take the Advanced Placement test given in May; therefore, throughout the course students will use past AP Biology essay questions to improve their skills in writing answers to scientific, free-response questions. Also, all major exams will follow the AP testing format of 60% multiple choice and 40% essay questions.

It is strongly recommended that students utilize the AP Biology test prep book issued to them. There are many other varieties of AP Biology study guides, and they all can be found at a local bookstore. Take the practice tests in these books so that you can become familiar with what to expect. When trying to find an AP Biology test prep book, choose one that also lets you see sample essays. Some books just focus on the multiple choice, and you need to be exposed to both parts of the exam.

Format of the AP Biology Exam:

Section I: Multiple Choice

1 hour and 30 minutes

Part A — 63 Multiple Choice Questions

Part B — 6 Grid-In Questions

The grid-in questions focus on the integration of science and mathematical skills. For these responses, you will need to calculate the correct answer for each question and enter it in a grid on that section of the answer sheet.

Total scores on the multiple-choice section are based on the number of questions answered correctly. Points are not deducted for incorrect answers and no points are awarded for unanswered questions.

Section II: Free Response

8 Questions (2 long and 6 short); 1 hour and 30 minutes, which includes a 10 minute reading period

Essay Section Hints:

1. The essay questions are graded equally.
2. One question is on molecules and cells.
3. One question is on genetics and evolution.
4. Two questions are on organisms and populations.
5. One or more of the questions will be lab-based.
6. Write in essay form! There is room on the test for you to create an outline to guide your answer if you'd like but outlines are not graded. That being said, perfect essay

writing is not expected. There aren't deductions for grammar or spelling mishaps (provided the spelling is close enough to determine the word you are trying to write).
7. Diagrams are helpful! If you use a diagram, be sure to refer to it in your essay.
8. Points are not deducted from your essay score if you give an incorrect statement. (You just don't receive points for incorrect statements). But be careful not to contradict yourself, because this can cause you to not receive points.

Study Tips:

1. A biology textbook cannot be read the way you would read a novel! Begin by pre-reading the chapter; glance at the section headings, charts and tables in order to organize the material in your mind and stimulate your curiosity. This will make it easier to read the chapter and extract more information from it.
2. Be an active, not passive reader, by stopping frequently (at least every paragraph) and consider what you have just read. What is the concept being discussed? Put it in your own words (out loud or by writing it down); by doing so you are reprocessing and using the information presented in the text. Place a few key notes in you notebook; make sure these notes include all new terms and illustrative examples.
3. Become a note taker and not a note copier! Simply writing down what is written on the board is passive learning (it's a start, but is not as effective as it could be). To get the most out of taking lecture notes, do it in a systematic manner. Before class read the textbook material to be covered in lecture. You will then use class time more efficiently because you will learn more from the lecture, and you will be able to take better notes having been introduced to many of the concepts in the text. During lecture do not attempt to write down every word that is said; that approach is futile and unnecessary. Instead, focus on the major ideas.
4. Summarize information by making your own diagrams and tables which will allow you to rehearse and test yourself on the material.
5. Relate new information to other, related information.
6. Study with a friend in the class and at home! Take turns explaining the material to each other. Set up on-going study groups and meet at each other's home each week.
7. There is too much new material in a biology class to be able to learn two weeks' worth of material the night before an exam! Review your text material and lecture notes daily so that you can avoid cramming at test time. Daily studying and rehearsal helps get information into long-term memory.
8. Make the most of your time in lab by arriving fully prepared. AP Biology labs are too long and involved to try to perform without having thoroughly read over them the day before.

Learner Objectives will be guided by the big ideas in science Course Organization

This course is structured around the four big ideas and the enduring understandings identified in the Curriculum Framework. 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.

Websites:

Websites for student use for review/homework/lab-prep are an irreplaceable tool for instructional purposes and student understanding. The following is a partial list of some of the sites that will be used on a daily/weekly basis.

The Biology Project - University of Arizona
Online Campbell Biology Book
Campell Log in site for students with password
Prentice Hall - The Biology Place
Biocoach PBS.ORG
Sunamasinc.com
ncbi.gov
DNAFTB.ORG
TALKORIGINS.ORG
LEARN.GENETICS.UTAH.EDU
Cells Alive

The four Big Ideas and Course Breakdown:

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

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

1. Natural selection is a major mechanism of evolution
2. Natural selections acts on phenotypic variations in populations
3. Evolutionary change is also driven by random processes
4. Biological evolution is supported by scientific evidence from many disciplines, including mathematics)

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

1. Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today
2. Phylogenetic trees and cladograms are graphical representations of evolutionary history that can be tested

EU 1C – Life continues to evolve within a changing environment

1. Speciation and extinction have occurred through the Earth's history
2. Speciation may occur when two populations become reproductively isolated from each other
3. Populations of organisms continue to evolve

EU 1D – the origin of living systems is explained by natural processes

1. There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence)
2. Scientific evidence from many different disciplines supports models of the origin of life

Big Idea 1 will be further investigated by the required reading of "Survival of the Sickest" by Dr. Sharon Moalem

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

EU 2A – Growth, reproduction, and maintenance of the organization of living systems require free energy and matter

1. All living system require constant input of free energy
2. Organisms capture and store free energy for use in biological processes
3. Organisms must exchange matter with the environment to grow, reproduce, and maintain organization

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

1. Cell membranes are selectively permeable due to their structure

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

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

EU 2C – organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis
1. Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes

2. Organisms respond to changes in their external environments

EU 2D – Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment
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. Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments)

3. Biological systems are affected by disruptions to their dynamic homeostasis

4. Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis

EU 2E – many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
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. Timing and coordination of physiological events are regulated by multiple mechanisms

3. Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection

Big idea 2 will be further investigated by the research and/or essay writing on the use and implications of the Winogradsky Column.

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

EU 3A – Heritable information provides for continuity of life
1. DNA and in some cases RNA, is the primary source of heritable information

2. In eukaryotes, heritable information is passes to the next generation in processes that include the cell cycle and mitosis or meiosis plus fertilization

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

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

EU 3B – Expression of genetic information involves cellular and molecular mechanisms
1. Gene regulation results in differential gene expression, leading to cell specialization
2. A variety of intercellular and intracellular signal transmissions mediate gene expression

EU 3C – The processing of genetic information is imperfect and is a source of genetic variation
1. Changes in genotype can result in changes in phenotype
2. Biological systems have multiple processes that increase genetic variation
3. Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts

EU 3D – Cells communicate by generating, transmitting, and receiving chemical signals
1. Cell communication processes share common features that reflect a shared evolutionary history
2. Cells communicate with each other through direct contact with other cells or from ad distance via chemical signaling
3. Signal transduction pathways link signal reception with cellular response
4. Changes in signal transduction pathways can alter cellular response

EU 3E – Transmission of information results in changes within and between biological systems
1. Individuals can act on information and communicate it to others
2. Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses

Big idea 3 will be further investigated by researching the CRISPR -Cas 9 genome editing technique

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

EU 4A – Interactions with biological systems lead to complex properties
1. The subcomponents of biological molecules and their sequence determine the properties of that molecule
2. The structure and function of subcellular components and their interactions provide essential cellular processes
3. Interactions between external stimuli and regulated gene expression result in specialization of cell, tissues, and organs
4. Organisms exhibit complex properties due to interactions between their constituent parts
5. Communities are composed of populations of organisms that interact in complex ways

6. Interactions among living systems and with their environment result in the movement of matter and energy

EU 4B – Competition and cooperation are important aspects of biological systems
1. Interactions between molecules affect their structure and function
2. Cooperative interactions within organisms promote efficiency in the use of energy and matter
3. Interactions between and within populations influence patterns of species distribution and abundance
4. Distribution of local and global ecosystems changes over time

EU 4C – Naturally occurring diversity among and between components within biological systems affects interactions with the environment
1. Variation in molecular units provides cells with a wider range of functions
2. Environmental factors influence the expression of the genotype in an organism
3. The level of variation in a population affects population dynamics
4. The diversity of species within an ecosystem may influence the stability of the ecosystem

Big idea 4 will be further investigated by reading and research on Global Climate Change topics including but not limited to ocean acidification and greenhouse gas production by prokaryotes

Science Practices (SP):

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:

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories
7. 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. Students will chose 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. 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

8. 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. Students will make short movies showing the relationship between molecular events and global cycles such as between photosynthesis/respiration and global carbon cycles.
9. 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. 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.
10. 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.

Social and Ethical Concerns

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)

The Laboratory experience

The laboratory experience is extremely important in the AP Biology course and is used to emphasize that biology and science is a process, which involves development and testing of a hypothesis, collection, analysis, and presentation of data with a clear discussion of the results. To ensure the lab component of the course is met, on average, one day out of every four is devoted to laboratory work. Students are required to come in to the laboratory prepared and ready to complete the day's procedure. Lab reports are then completed at home. During the course, students will complete the recommended laboratories in the AP Biology Investigative Labs: An Inquiry-Based Approach. The topics covered in these labs are:

1. Investigation 1 Artificial Selection
2. Investigation 2: Mathematical Modeling; Hardy-Weinberg
3. Investigation 3: Comparing DNA Sequences to Understand Evolutionary Relationship with BLAST
4. Investigation 4: Diffusion and Osmosis
5. Investigation 5: Photosynthesis
6. Investigation 6: Cellular Respiration
7. Investigation 7: Cell Division: Mitosis and Meiosis
8. Investigation 8: Biotechnology: Bacterial Transformation
9. Investigation 9: Biotechnology: Restriction Enzyme Analysis
10. Investigation 10: Energy Dynamics
11. Investigation 11: Transpiration
12. Investigation 12: Fruit Fly Behavior
13. Investigation 13: Enzyme Activity

Lab	*Time Estimate*	*Level of Inquiry*	*Quantitative Skills*
Big Idea 1: Evolution			
Artificial Selection	7 weeks	Guided, then open	Counting, measuring, graphing, statistical analysis
Mathematical modeling	1.5 classes	Guided, then open	Mendelian genetics equations, H-W equation, Excel and spreadsheet operations
Comparing DNA sequences using BLAST	1.5 classes	Guided, then open	Statistical analysis, mathematical modeling, and bioinformatics
Big Idea 2: Cellular Processes: Energy and Communication			
Diffusion and Osmosis	2.5 classes	Structured, then guided	Measuring volumes, calculating surface area- to-volume ratios, calculating rate, calculating water potential, graphing

Photosynthesis	2 classes	Structured, then open	Calculating rate, preparing solutions, preparing serial dilutions, measuring light intensity, developing and applying indices to represent the relationship between two quantitative values, using reciprocals to modify graphical representations, utilizing medians, graphing
Cellular Respiration	2 classes	Guided then open	Calculating rate, measuring temperature and volume, graphing

FORMAL LAB REPORT FORMAT.

The following is a guide for all formal lab reports in this course. Students do not need to limit themselves to this outline. If additional information is warranted then please add it. Students will write a report based on the format below. Students will follow enduring understandings as they relate to each of the big ideas.

Title

- The title should indicate what the lab is all about. Centered at the top of the page.

Introduction & Background

- Include what is already known – with citations
- Indicate what you hope to learn (purpose of the lab)
- List of components of experimental design: Independent variable, dependent variable, control factors, constants.
- Clearly identify your hypothesis
- **Caveat:** This introduction section will take some research. Do not "wing it" by making up information from your head!!

Materials

- List the materials used in the lab

Procedure

- A brief description of the procedure to show how the lab was conducted
- Describe methods for controlling variables
- Describe methods for collecting data
- Note any departure from the instructions given

Results (present the data)

- Construct all data tables and charts to present the data collected
- Must include titles and labels for all tables and charts

Analysis (process the data)

- Construct all graphs needed to show results
    - Correct type (bar, line, pie)
    - Title
    - Appropriate Units
    - Labeled Axis
    - Legend
- Labeled diagrams or photos

Conclusion & Discussion

- State a valid conclusion and explain **WHY** you think the results turned out the way they did.
- Explain any unexpected results and why those results may have been obtained.
- Evaluate the data to determine if it supports your hypothesis using specific reference to the data.

Sources (each under an individual section)

- References – Works cited within your lab report in the introduction or conclusion/discussion.

- Appendix – Put any formulas used for calculating data presented or references in the lab report.