Course Description
Advanced Placement Biology is designed to offer students a solid foundation in college level introductory biology, based on the belief that many students are ready for college work while still in high school. Student should be prepared for complex science texts and reading, including a minimum of 30 min to 1 hour or work outside class each day (about 5-8 hours a week). As a college level course, the amount of material covered as well as the complexity of the topics will be high. An ongoing expectation, therefore, is to learn the material as it is presented and come to class each day understanding the previous day’s material. Students must be certain that they are willing to accept this challenge and be committed to keep up with the work. Upon completion of the course students should be able have the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology.

Course Objectives
The College Board has organized the AP Biology course around the Curriculum Framework which are broken into four big ideas that our course will be based on [CR2]: (See course curriculum outline for full details.)

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.


Additional Texts: OpenStax College, Biology. Rice University.. 30 May 2013
AP Biology Investigative Labs: An Inquiry-Based Approach, The College Board, 2012
Other sites: LabBench, McGraw Hill textbook website, NSF Case Studies,

Website: The school website for this class is a vital tool for helping students succeed. All homework is posted online, along with notes, handouts, due dates, labs, and helpful links and videos. Please subscribe to the homework emails!

The AP Biology Test Date: Monday, May 14th @ 8:00 a.m.

Recommended Materials
- Pen or Pencil
- Three ring binder with biology section
- Lined, lose leaf paper
- RED pen, for correcting
- Highlighter
- QOD Notebook (spiral or other) that can be left in class to be graded
- Calculator
Class Policies, Expectations and Rules

• Arrive to class on time with your materials out and ready, starting any work posted on the board.
• No food or drink other than water for class meetings. *(Drink with sealable lids)*
• Restrooms should be used during passing periods and breaks. Teachers should only allow students to leave class to use the restroom in the event of an emergency (or by medical note). A pass must be used to leave the room for any reason.
• Technology (including phones!) may only be used to look up material relevant to this course or input assignments into the device to use it as a planner. It requires teacher permission in advance of use. Phones used without permission will be confiscated until after school.
• Students who do not follow instructions or create dangerous situation during labs will not be able to participate in the lab any will lose the points.

Absences/ Late work/ Make up work:

• NO LATE WORK IS ACCEPTED. This is to prepare you for college.
• If a student is absent or sick, it is their responsibility to get class notes and handout from online or a classmate. Asking the teaching can be done before or after class. *The student is responsible for checking online or asking the teacher for make up work! I can always be reached through email.*
• Normal work due the day of an absence is due the next day the student is at school. Project and lab due dates are *not flexible!* If a student is gone, they can email the assignment and then bring a hard copy the first day the student is back at school (no matter the classes on that day)
• Make up work for *excused* absences should be done within 3 days of the day missed. Students have 1 week to make up tests or quizzes. If you know you will be gone, get the work ahead of time. If an absence is not cleared, credit cannot be earned for that assignment.
• The AP test assumes student have knowledge of certain labs. Labs cannot always be made up. Student *must be present for labs,* and will have warning when there are lab days.
• Work for *unexcused absences* will not be graded. After 5 unexcused absences, earn a failing grade.
• Arrangements for absences due to school activities or shows must be made before the show date. If in doubt, contact your teacher! *Extensions will not be given on the due date so plan ahead!*

Late Rules: being tardy is unacceptable!

• If a student is tardy, they will lose one point per day for the “question of the day” notebook done at the beginning of the period.
• If is student is late to a lab, they will lose one letter grade for that lab, as lab instruction is done at the beginning of class. If a student is more that 30 minutes late, they cannot participate and will receive a 0 for that lab.

Assessments and Grading Policy

Grades are earned, not given. Students are responsible for knowing and maintaining their grade! As this is a science class, labs and activities are worth a large part of student’s grades. A student’s grade includes homework, labs, test, quizzes, notebook/participation and a final.

| HW/Projects | 15% |
| Tests/ Quizzes: | 35% |
| Labs/ Activities: | 25% |
| Classwork/ Participation: | 10% |
| Final | 15% |

| Grading Rubric for HW questions (6-10 points per chapter) |
|---|---|---|
| **10 Point Scale** | **6 Point Scale** | **Criteria** |
| 10 | 6 | All questions answered, detailed answers with accurate information, answers put in own words, not just copied, extensive reading of txt is clear |
All questions answered, good answers with accurate information, answers put in own words, not just copied, 1 mistake or may lack necessary detail.

80% of questions answered, partially correct or missing 2-3 pieces of information, reworded, but not always reworded well.

60% of questions answered, partially correct or missing information for almost half of the required information, poor rewording

40% of questions answered, partially correct or missing information for almost half of the required information, poor rewording

Less than 30% complete or inaccurate information, not hand written, not rewarded

0% Not submitted, or not submitted by due date

• All individual assignment rubrics will be posted on Mrs. Davisson’s website
• As your teacher, I will commit to grading all smaller assignments and posting all grades on the AERIES.net grade book within one week (5 school days) from the date the work is submitted. For larger assignments I will commit to grading the assignments and posting all grades on the AERIES.net grade book within two weeks (10 class days) from the date the work is submitted.

Effect of Unexcused Absences on Grades
• At LACHSA, a teacher may issue a failing grade to a student if they have unexcused absences for more than ten percent of the course periods in a given semester as follows:
  ▪ Five unexcused absences in a semester is excessive. When a student earns five unexcused absences, a teacher must notify the parent/guardian that if a student earns a sixth unexcused absence, a failing grade may be issued for the semester.

Test/Assessment Make Up Policy
If a student has an excused absence the day of an assessment or test, they are expected to attend the Assessment make up on Friday morning from 8am to 9:30am. Please make sure you know that the assessment make up will cover similar content to the assessment given in class, but it will not be the same assessment. For shorter quiz’s or assessment, student should plan to attend office hours (academics) or check in with their teacher (arts) to make up the work.

LACHSA Grading Scale

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<thead>
<tr>
<th>Mark</th>
<th>Citizenship</th>
<th>Work Habits</th>
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<tbody>
<tr>
<td>A+</td>
<td>97 - 100%</td>
<td>90 - 92.9%</td>
</tr>
<tr>
<td>B+</td>
<td>87 - 89.9%</td>
<td>80 - 82.9%</td>
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<tr>
<td>C+</td>
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<td>67 - 69.9%</td>
<td>60 - 62.9%</td>
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<td>F</td>
<td>59.9% and below</td>
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Note to Students
* Students can earn no less than the corresponding letter grade in each numerical category
* The University Of California does not recognize courses with D’s for A-G credit
* Grades will not be rounded.

Work Habits and Citizenship Grade
Progress Report grades will be issued every 4.5 weeks and will be available for review on the Parent Portal. In addition to a letter grade, a grade for citizenship and work habits will be included on the student's progress report for each course of enrolment. These grades should be reviewed by parents and students in an effort to identify areas for improvement that will likely also improve a student's overall letter grade in the course. Students earning Unsatisfactory Citizenship or Work Habits marks may not be able to participate in extracurricular activities (including field trips) and may be placed on probation. Parents/Guardians are recommended to reach out directly to teachers to discuss any Unsatisfactory remarks.
### Class Work and Homework Policy

- Class work will be assigned daily. It is posted on the board and online. Please email if you notice any discrepancies.
- Please see class website at lachsa.net for exact grading scale, assignments and assignment due dates.

### Late Work Policy

**Late work will not be accepted** unless the office has excused the absence within 24 hours of the absence. In accordance with the LACHSA Attendance Policy, all homework or book work for scheduled arts or academic field trips and performances must be completed **prior to trip or performance** for credit unless other arrangements have been made with the teacher ahead of time. If you are absent from class, it is your responsibility to ensure your absence is cleared in the main office and your assignments are turned in. You will not be able to earn credit for absent work unless your absence is cleared by the main office as an excused absence. In accordance with the LACHSA policy, for any excused absence, students will have one week from the day they return from their absence to submit any make up work. If students feel they need more time to complete make up work they should discuss this with their teachers before the end of the one week deadline.

### Academic Integrity

Integrity is highly valued at LACHSA. Truth is the ultimate goal in democratic education. Honesty is essential to successful education. Cheating is the most destructive action in the academic world. Cheating undermines the academic process, shatters student integrity and destroys the trust necessary to teacher/student relationships. The cynical or unprepared student who seeks a dishonest advantage over fellow students is not only self-defeating, but affects others if not confronted and stopped.

Our Academic Honesty Policy addresses issues of cheating, plagiarism, theft, alteration of materials and test avoidance. All students and parents sign the policy at the beginning of the school year to demonstrate their commitment to honesty and integrity. LACHSA students and staff will uphold the highest moral and ethical standards. Theft of (or unauthorized use of) student possession will not be tolerated. Theft is a criminal matter and will be treated as such. Our campus is a place for safety and respect for all. Promptly report all incidents to a staff member so that we may deal with each problem in a quick, consistent and rational manner.

### Acts of Academic Dishonesty which will not be tolerated at LACHSA are:

- **Cheating On Tests:** Any intentional giving or use of external assistance relating to an examination, test or quiz without permission of the teacher. Parents will be contacted by the instructor or the student during class time or at the conclusion of the class.
- **Unauthorized use of technology devices during a test or assessment.**
- **Unauthorized Collaboration:** Intentional collaboration (copying) an assignment between a student and another person is considered dishonest. Both or all students involved will be subject to lowered academic and citizenship grades, and parents will be contacted.
- **Plagiarism:** All students are expected to complete their own work and assignments. Plagiarism constitutes any intentional use of another’s ideas, words or works as one’s own. Plagiarism includes the misuse of material and the work of another student. It also includes downloading information directly from the internet and computer and turning it in as a report. Plagiarism can result in earning a failing grade on the assignment, lowering of a citizenship grade, and relinquishing of technology privileges.
Additionally, any student guilty of plagiarism may receive a zero grade on the assignment. The zero will not be dropped and that grade will be averaged in for the grading period.

- Theft or Alteration of Materials: A student guilty of stealing or altering test materials, calculators, books, computer tapes/disks, or other course materials from teachers, the Library/Media Center/media center, office or another student will be subject to being dropped from the class with an “F/U” for the semester and suspension from school.

- Test Avoidance: If a student develops a pattern of test avoidance, the parents will be notified. At the teacher’s discretion, any further absences may result in a forfeit of the make-up policy.

- Pressure for Unsubstantiated Grade Change: Student and parent requests or demands for a raise in a course grade will not be considered, unless such request is based on clerical error.

**Accessing the Class Website:**

You can access the class website by following these steps:

1. Log on to [http://lachsa.net](http://lachsa.net) (notice no www)
2. On the top of the page click on “Academics” or “Arts”
3. Then click on “Classes/Homework” or “Homework”
4. Then click on the subject you are trying to look up assignments for
5. Click on your Teacher name and then the period of your class

**Fall Semester Major Assessments and Projects (Pacing Plan)**

* see below for full college board approved course outline

**Online Grading – Parent Portal – AERIES.net**

**ALL Academic and arts faculty** will post student grades on their AERIES.net grade book after each assignment has been turned in and graded. As your teacher, I will commit to grading all short/small assignments and posting the grade to the AERIES.net grade book within one week (5 school days). For all larger assignments I will grade the assignment and post the grade to the AERIES.net grade book within two weeks (10 school days). It is the responsibility of the student and parent to verify that these grades are accurate. If there are any discrepancies with the grades, please inform your teacher. You can access these daily grades by choosing “Grades” and then “Gradebook” on your parent portal account. Then click on the class for which you want to see the assignment grade breakdown.

**ALL Academic and Arts grades** will be posted every 4.5 weeks. These overall grades will be posted on the Parent Portal for **ALL** classes in the form of a progress report. Click on “Grades” then “Grades” to see your overall grades every 4.5 weeks.

Information on how to create a parent portal account was given out during registration. Please contact lachsa_info@lacoe.edu if you need assistance with your portal account reactivation.

**Extra Instructional Help and Tutoring Hours**

With such a busy schedule, LACHSA students often need a little extra help, need to borrow a textbook to finish an assignment.

**Office Hours:** Tuesday and Wednesday mornings (7:15 – 8am) for all Academic classes

**By phone:** 323-343-6372 **Email is preferred:** davisson_sarah@lacoe.edu

I check my email daily. **Please make sure student and parent emails are up to date in Aries, as that will be used for all contact.** (Access on website though “Parent” or “Student” tab, then “Parent Portal”)


AP Biology Course Outline and Pacing Plan

Instructional Context

This course will include class work, discussions, homework, projects, labs and test that students need to keep up with. Class discussions may be based reading, labs, or animations from various sources (textbook, internet, etc.) to help the students visualize what they have learned. Quizzes are interspersed throughout the unit and inform how instruction may need to be adjusted to improve student learning.

The two main goals of AP Biology are to help students develop a conceptual framework for modern biology and to help students gain an appreciation of science as a process. The ongoing information explosion in biology makes these goals even more challenging. Students are encouraged to focus on understanding important relationships, processes, mechanisms, and potential extensions and applications of concepts.

The course provides opportunities to connect scientific knowledge to major social issues to help students become scientifically literate citizens. [CR 5]

Technology is used extensively throughout the course, and students are required to utilize the teacher webpage and homework site, participate in online simulations, interactive web based learning, and the development other educational artifacts such as concept maps or presentation that illustrate their understanding of topics. [CR 8]

Student will keep a notebook with all in class activities, including case studies, article summaries, and notes on labs, planning, and data collection [CR8]. Case studies and annotating article, both teacher and student generated, will allow opportunities to interact with the material outside the lab and textbook [CR4a-d]

The Investigative Laboratory Component

The course is also structured around inquiry in the lab and the use of the seven science practices throughout the course.

Hands-on labs will constitute at least 25% of instructional time [CR 7]. Students will have the opportunity to complete at least two lab experiences in each of the four big ideas. [CR 6] Many of these labs are inquiry based, and emphasize collaboration, development of hypotheses, data collection, analysis and presentation. Students will create detailed lab reports for each lab, based on the scientific method, which will document their investigations. Results will often be posted or shared with other students to compare their hypothesis, data, and results with others. [CR 8]

Science Practices {SP} * see science practice matrix for list of student directed labs and practices addressed

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. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

*Students are required do formal lab reports, and/ or write short summaries of observations [CR8]
### Unit 1: First Week Introduction (summer assignment, 2 week) [CR2]

<table>
<thead>
<tr>
<th>Resources</th>
<th>Ch 1, 44 in Mader, NSF Case Study</th>
</tr>
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</table>
| **Big Idea & Enduring Understandings** | **Big Idea 1, 2, 4**  
EU 1C – Life continues to evolve within a changing environment  
EU 2C – Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis  
EU 4A – Interactions with biological systems lead to complex properties  
EU 4C – Naturally occurring diversity among and between components within biological systems affects interactions with the environment |
| **Overview of Lecture and Discussion Topics** | Scientific method and experimental design  
Practice with data collection, analysis, and presentation  
Address problems in research, such as confirmation bias  
Emphasis on evidence collecting, why evolution is considered a unifying theory  
Address the complexity of interactions within biological systems and between organisms and their environment  
Characteristics of life  
Emphasis on maintaining homeostasis and the basics of feedback loops |
| **Activities** | 1. Design and conduct an experiment, create and revise hypotheses, organize data, present finding {SP}  
2. Lead class discussion on experimental design by explaining the design process and identifying controls and variables {SP}  
3. Read and learn to annotate scientific articles  
4. Summarize and discuss effects of maintaining homeostasis within biological systems and the effects of the environment on that organism through reading and annotating scientific articles.  
*Learning objective 2.16*: The student is able to connect how organisms use negative feedback to maintain their internal environments. [CR4b]  
5. Case Study: nonbacterial and viruses- discuss what unifies and diversifies life and how it continues to change [CR4a] |

### Unit 2: Biochemistry and energy (4 week) [CR2]

<table>
<thead>
<tr>
<th>Resources</th>
<th>Ch 2, 3, and 6 in Mader, AP Biology Investigative Labs</th>
</tr>
</thead>
</table>
| **Big Idea & Enduring Understandings** | **Big Idea 2 (and 1 & 4)**  
EU 2A – Growth, reproduction, and maintenance of the organization of living systems require free energy and matter  
EU 2D – Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment  
EU 1D – The origin of living systems is explained by natural processes.  
EU 4A – Interactions within biological systems lead to complex properties. |
| **Overview of Lecture** | Identify basic elements of living organisms  
Distinguish between inorganic and organic compounds |

*Big Idea 2 is addressed in this unit and tied to Big Idea 1 with regard to the diversity of life. Big Idea 2 is tied to big idea 4 in showing how complex processes maintain homeostasis, especially through the enzyme lab and case study [CR3b]*
and Discussion Topics

- Describe water’s unique properties
- Describe the structure of organic compounds
- Understand the pH scale, redox reactions, and hydrolysis/condensation
- Apply the laws of thermodynamics to biological systems
- Explain how life maintains a high degree of organization
- Apply concepts of homeostasis
- Investigate enzyme structure and function

Activities

1. Connecting chemistry to biology
2. Properties of Water: video clip and “Popcorn Water” case study- analyze effect of water, salt, and sugar levels on health of environment and humans [CR5]
3. Macromolecule poster and presentation: students assigned a macromolecule, conduct research and become an expert and teach that molecule to the other 3 people in their group [CR8] Students must quantitatively represent the molecules, their building blocks, and their use in living organisms.
   * Learning objective 4.2: The student is able to refine representations and models to explain how the subcomponents of a biological polymer and their sequence determine the properties of that polymer. [CR4d]
4. Macromolecule concept map
   * Learning objective 2.9: The student is able to represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth and reproduction. [CR4b]
5. Enzyme Lab: Conduct an experiment to determine the optimal pH and temperature of the enzyme catalase
6. Cell Energy activity: cut and manipulate organic molecule to show the ATP ADP cycle [CR4b]

Unit 3: Cellular Processes (5 weeks) [CR2]

Resources

- Ch 4, 5, 7, & 8 in Mader, *AP Biology Investigative Labs*, NSF Case Study, Ch 9 OpenStax

Big Idea & Enduring Understandings

Big Idea 2 and 1, 4
- EU 2B – Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environment
- EU 2C – organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis
- EU 2D – Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment
- EU 2E – many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
- EU 1B – Organisms are linked by lines of descent from common ancestry
- EU 1C – Life continues to evolve within a changing environment
- EU 1D – the origin of living systems is explained by natural processes
- EU 4C – Naturally occurring diversity among and between components within biological systems affects interactions with the environment

Big idea 4 and 2 are connected through the case study and cell plasmolysis lab as regulation of homeostasis is studies during the interaction of cells with the environment [CR3d]

Overview of Lecture

- Review basic cellular components, construct models comparing differences between prokaryote, eukaryote, animal, and plant cells
### and Discussion Topics

- Explain the concept of selectively permeable as it applies to the cell membrane, distinguish between active and passive transport
- Understand methods of cell to cell connection and communication
- Understand the process by which the cell theory was developed
- Understand the Endosymbiosis theory and its connection to evolution [CR3A & CR3B]
- Illustrate how transport is used to maintain an internal environment
- Understand the role of photosynthesis and cellular respiration in maintaining homeostasis

### Activities

1. Create cell models using a story and pictures [CR4B]
2. Discussion of the Endosymbiosis Theory which includes an article annotation and summary [CR3B] & [CR4B]
3. Diagram method of cell to cell interaction
5. Diffusion and Osmosis Lab [ CR6 ]
6. Case Study: Osmosis is Serious Business: predict the cause of real life crop production problems and hospital deaths due to imbalances in homeostasis. Students must use the provided data to solve the “case” by figuring out how homeostasis was disrupted and why that caused cell death. [CR4b] [CR5]
   * Learning objective 2.12: The student is able to use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes.
7. Light intensity and wavelength simulation: online simulation of how the rate of photosynthesis is effected
8. Photosynthesis Lab [CR6]
   - also connects Big Idea 2 to Big Idea 4 [CR3B] and [CR3D]
10. Case Study: Case of the 7 Deaths: students investigate the cause of death (eventually find the disruption of cellular respiration by arsenic) [CR4b & CR4d]

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### Unit 4: Cell Cycle and Communication (5 weeks) [CR2]

#### Resources

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<thead>
<tr>
<th>Big Idea &amp; Enduring Understandings</th>
<th>Ch 9, 10, 11 in Mader, Ch 12-13 OpenStax</th>
</tr>
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</table>

- **Big Idea 3 and 2**
  - EU 3A – Heritable information provides for continuity of life
  - EU 3B – Expression of genetic information involves cellular and molecular mechanisms
  - EU 3C – The processing of genetic information is imperfect and is a source of genetic variation
  - EU 2D – Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment
  - EU 2E – many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
  - EU 1D – the origin of living systems is explained by natural processes

**Big Idea 3 is tied to 2 as genetic information and regulation of that information is tied to dynamic homeostasis and feedback mechanisms to maintain and use that information [CR3c]**

#### Overview of Lecture and Discussion

- Mitosis and Meiosis, and the Cell Cycle
- What is cancer?
- Mendelian genetics (Law of Segregation, Independent Assortment, Dominance)
- Mathematical predictions (punnett squares) and Chi Square Analysis
### Topics
- Chromosomal Patterns of Inheritance (sex linkage)
- Human Genetic Disorders

### Activities
1. Modeling of the cell cycle [CR4c]
2. Cancer and HeLa cells article and discussion: understanding cancer, its development and regulation, as well as research and ethical issues surrounding it [CR5] [CR3c]
4. Genetic Disorders Presentation [CR4c] [CR5]
   * Learning Objective 3.13: The student is able to pose questions about ethical, social, or medical issues surrounding human genetic disorders.
5. Practice genetic problems [CR4c]
6. M&M activity: into to Chi Squared
7. Fruit Fly Genetics Lab [CR 6]

### Unit 5: Genetics and Gene Activity (5 weeks) [CR2]

<table>
<thead>
<tr>
<th>Resources</th>
<th>Ch 12, 13, 14, 20 in Mader, Ch 16 OpenStax, AP Biology Investigative Labs, NSF Case Study</th>
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#### Big Idea & Enduring Understandings
- **Big Idea 1, 2, 3, and 4**
  - EU 1A – Change in the genetic makeup of a population over time is evolution.
  - EU 1C – Life continues to evolve within a changing environment
  - EU 2C – Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
  - EU 3A – Heritable information provides for continuity of life
  - EU 3B – Expression of genetic information involves cellular and molecular mechanisms
  - EU 3C – The processing of genetic information is imperfect and is a source of genetic variation
  - EU 3D – Cells communicate by generating, transmitting, and receiving chemical signals
  - EU 3E – Transmission of information results in changes within and between biological systems
  - EU 4A Interactions within biological systems lead to complex properties.

  **Big Idea 3 is connected to 2c through the investigation of try and lab operons and how these feedback mechanisms are involved in gene regulation and expression [CR3c]**

  **Big Idea 1c is linked to 3 using the “infectious cure” case study and the bacterial transformation lab: connecting the idea of retroviruses and bacterial evolution with certain environments to how that can affect gene transition and expression [CR3c & CR3a]**

#### Overview of Lecture and Discussion Topics
- DNA is the genetic material (historical experiments, DNA structure and function, DNA replication)
- Flow of genetic information (genetic code, role of other polymers, transcription, translation)
- Mutations
- Gene expression (operon systems in prokaryotes, eukaryotic gene expression)
- Cell signaling with regulation of gene expression and epigenetics
- Restriction enzymes, plasmids, transformation
- DNA technology (how gel electrophoresis works and applications of this technology) [CR5]
- Biotechnology: stem cells, synthetic biology, genetically modified foods [CR5]
- Virus and bacterial interactions
### Activities

1. **DNA Concept Map** [CR4c]  
   GATTACA activity: DNA Modeling, showing transcription and translation. Starting with a raw DNA sequence of a gene, student will transcribe and translate the DNA into a amino acid that they will identify with given traits [CR4c]  
   * **Learning Objective 3.1** The student is able to construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, RNA, are the primary sources of heritable information.

2. *lac/tryp operon diagram and coloring [CR4c]*
3. Nova Video, article, and class discussion on modern research on epigenetics
4. Restriction Enzymes & Gel Electrophoresis [CR6]
5. Bacterial Transformation Lab [CR6] - also ties Big Idea 3 to Big Idea 1 [CR3A] and [CR3C]
6. Class discussions on biotechnology and bioethics, student lead discussions [CR5]
7. Case Study: “An Infectious Cure,” students investigate the cure for Cholera, using a retrovirus, and learn about the reproductive cycles of bacteria and viruses, tying the information in coevolution and predicting patterns of natural selection in bacteria. [CR3c & CR3a]
   * **Learning objective 1.3:** The student is able to apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future. [CR4a]

8. Mini Group Presentation on viruses and bacteria: each student researches one virus and one bacteria, then design their own way to teach about it to their small group of 6. [CR8]

### Resources

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**Big Idea 1 is tied to 4, as the interactions of systems with the environment are tied to the changing genetic makeup of a population over time.** [CR3a]

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<th>Overview of Lecture and Discussion Topics</th>
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<tbody>
<tr>
<td>How natural selection serves as a mechanism for evolution</td>
</tr>
<tr>
<td>Scientific evidence supporting evolution</td>
</tr>
<tr>
<td>Hardy-Weinberg equilibrium</td>
</tr>
<tr>
<td>Origin of Life; Fossil Records, Concepts of speciation</td>
</tr>
<tr>
<td>Current events in evolution, resistance to antibiotics, pesticides, artificial selection</td>
</tr>
<tr>
<td>Cladogram and basic phylogeny</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Types of Selections in Snakes Activity: students graph population data and identify types of natural selections based on the data; connecting 1A with 4C [CR3a]</td>
</tr>
<tr>
<td>* Learning objective 1.2:* The student is able to evaluate evidence provided by data to qualitatively and/or quantitatively investigate the role of natural selection in evolution. [CR4a]</td>
</tr>
<tr>
<td>2. Article Discussion: “Sex and the Single Guppy” “How females choose their mates”</td>
</tr>
</tbody>
</table>
and student generated articles, groups share on findings in each. [CR8]

3. Hardy-Weinberg activity and problem set
   - this also ties Big Idea 1, enduring understanding 1.A to Big Idea 4 (interactions) [CR3a] and [CR3d]
4. How to make a cladogram online information and practice:
   http://evolution.berkeley.edu/evolibrary/article/evo_03
5. Cladogram and BLAST lab [CR6]
6. Case Study: “White Striped Clover”: Student interpret data on the white striped and regular clover, make predictions of
   * Learning objective 1.5: The student is able to connect evolutionary changes in a population over time to a change in the environment. [CR4a]

Unit 7: Plants Diversity and Ecology (4 week) [CR2]

<table>
<thead>
<tr>
<th>Resources</th>
<th>Ch 23, 26 and 43-45 in Mader, <em>AP Biology Investigative Labs: An Inquiry-Based Approach</em>, Lab Bench</th>
</tr>
</thead>
</table>
| Big Idea & Enduring Understandings | *Big Idea I, 2, 3, & 4*  
EU 1B – Organisms are linked by lines of descent from common ancestry  
EU 1C – Life continues to evolve within a changing environment  
EU 2E – many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination  
EU 3E – Transmission of information results in changes within and between biological systems  
EU 4A – Interactions with biological systems lead to complex properties  
EU 4B – Competition and cooperation are important aspects of biological systems  
EU 4C – Naturally occurring diversity among and between components within biological systems affects interactions with the environment |

Big Idea 4 is connected to big ideas 2 and 1 as student study the affect of environmental changes and natural selection on biodiversity and how orgasm are affected by such changes. [CR3d] [CR3a]

| Overview of Lecture and Discussion Topics | Plant Diversity and Phylogeny  
Species diversity. Composition, and regulation of growth  
Transpiration and plant feedback control loops  
Regulation and Plant hormones  
Biodiversity and Sustainability  
Human Activities that threaten biodiversity [CR5]  
Population growth models  
Primary productivity with Energy flow and chemical cycling |

| Activities | 1. Mapping of plant phylogeny, creating a phylogenetic tree  
2. Transpiration Lab: measuring change in plant mass in different environments over time [CR6] also connects Big Idea 2 to Big Idea 4 [CR3B] and [CR3D]  
3. Plant diversity lab: applying understanding of plant reproduction and phylogeny with real plant samples, while identifying adaptations and predicting interactions and other reasons for natural selection.  
   - This again ties big idea 4 with 1, as competition and biological interactions are investigated, looking at how these changes cause life to continue to evolve [CR3d]  
4. Plant Hormone and Tropism Webquest: student investigate plant hormonal regulation and its real life applications through a series of online resources and videos *This ties big idea 4 with 2E, as well as 3E*, while looking at temporal and hormonal regulation of plants and how that helps regulate biological systems [CR3d] [CR3b] |

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**Learning objective 4.23:** The student is able to construct explanations of the influence of environmental factors on the phenotype of an organism. [CR4d]

5. Lab Bench virtual lab: population ecology and trophic levels simulations
6. Animal Behavior lab: student design and implement their own lab procedures, creating a scientific lab report that they will present to other group, as each groups experiment will vary. [CR6] [CR8]

### Unit 8: Biological Systems– Organism Form and Function (summer assignment, 1 week) [CR2]

<table>
<thead>
<tr>
<th>Resources</th>
<th>Ch 31, 33, 20, 37 in Mader, Lab Bench</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Big Idea &amp; Enduring Understandings</strong></td>
<td>Big Idea 4, 1, 2, 3</td>
</tr>
<tr>
<td>EU 1.B – Organisms are linked by lines of descent from common ancestry.</td>
<td></td>
</tr>
<tr>
<td>EU 2.A – Growth, reproduction and maintenance of the organization of living systems require free energy and matter.</td>
<td></td>
</tr>
<tr>
<td>EU 2C – organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis</td>
<td></td>
</tr>
<tr>
<td>EU 2D – Growth and dynamic homeostasis of a biological system are influenced by changes in the system’s environment</td>
<td></td>
</tr>
<tr>
<td>EU 2E – many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.</td>
<td></td>
</tr>
<tr>
<td>EU 3E – Transmission of information results in changes within and between biological systems</td>
<td></td>
</tr>
<tr>
<td>EU 4A – Interactions with biological systems lead to complex properties</td>
<td></td>
</tr>
<tr>
<td>EU 4B – Competition and cooperation are important aspects of biological systems</td>
<td></td>
</tr>
</tbody>
</table>

*Big Idea 1 is tied to Big Idea 4 as comparative anatomy emphasizes the relationships between organisms and similarities that imply common descent, as well as differences due to adaptations to different environments. [CR3A] and [CR3D]*

<table>
<thead>
<tr>
<th>Overview of Lecture and Discussion Topics</th>
<th>Feedback control loops in animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nervous System</td>
<td></td>
</tr>
<tr>
<td>Immune system and Immunology</td>
<td></td>
</tr>
<tr>
<td>Vaccines &amp; Antibiotics</td>
<td></td>
</tr>
<tr>
<td>Social Issues in disease transmission</td>
<td></td>
</tr>
<tr>
<td>Advances in medicine, bioethical discussion [CR4C] &amp; [CR5]</td>
<td></td>
</tr>
<tr>
<td>Structure and function in body systems</td>
<td></td>
</tr>
<tr>
<td>Comparative anatomy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
<th>1. Diagramming a feedback look in the nervous system</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. HIV and Immunology, how to find a cure for a rapidly evolving virus [CR4a]</td>
<td></td>
</tr>
<tr>
<td>- ties Big Idea 1 to Big Idea 4 [CR3d] and [CR3a]</td>
<td></td>
</tr>
<tr>
<td>4. Article discussion: students bring in current articles on vaccine use and debate the use of vaccines in infants. [CR5]</td>
<td></td>
</tr>
<tr>
<td>5. Lab Bench Virtual Lab: Circulatory Physiology</td>
<td></td>
</tr>
<tr>
<td>6. Dissection: [CR6] choice of frog or pig, compare dissection of one animal with the other, compare similarities and differences, as well as adaptations and possible ancestry. [CR3A] and [CR3D]</td>
<td></td>
</tr>
</tbody>
</table>

* Timing on due dates may vary based on school schedule and student need.
<table>
<thead>
<tr>
<th>Curricular Requirements: <em>from College Board AP biology course description</em></th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR1 Students and teachers use a recently published (within the last 10 years) college-level biology textbook.</td>
<td>2</td>
</tr>
<tr>
<td>CR2 The course is structured around the enduring understandings within the big ideas as described in the AP® Biology Curriculum Framework.</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>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.</td>
<td>4, 6, 7, 8, 9</td>
</tr>
<tr>
<td>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.</td>
<td>3, 4, 8</td>
</tr>
<tr>
<td>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.</td>
<td>5, 6, 7</td>
</tr>
<tr>
<td>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.</td>
<td>2, 4, 8, 9</td>
</tr>
<tr>
<td>CR4a The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1</td>
<td>1, 3, 7</td>
</tr>
<tr>
<td>CR4b The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.</td>
<td>1, 3, 4, 5</td>
</tr>
<tr>
<td>CR4c The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.</td>
<td>1, 5, 6</td>
</tr>
<tr>
<td>CR4d The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.</td>
<td>1, 4, 5, 8</td>
</tr>
<tr>
<td>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.</td>
<td>1, 3, 5, 6, 8, 9</td>
</tr>
<tr>
<td>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.</td>
<td>2, 3, 4, 5, 6, 7, 8, 9</td>
</tr>
<tr>
<td>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.</td>
<td>2</td>
</tr>
<tr>
<td>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.</td>
<td>1, 2, 3, 7, 8, 9</td>
</tr>
</tbody>
</table>
### Science Practices Matrix for Major Labs: with connection to big ideas

<table>
<thead>
<tr>
<th></th>
<th>SP 1 Use representations and models</th>
<th>SP 2 Use mathematics</th>
<th>SP 3 Engage in scientific questioning</th>
<th>SP 4 Plan and implement data collection strategies</th>
<th>SP 5 Perform data analysis and evaluation of evidence</th>
<th>SP 6 Work with scientific explanations / theories</th>
<th>SP 7 Connect and relate knowledge</th>
<th>Big Ideas (covered in each lab)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Method, Crickets</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1, 2</td>
<td>[CR2]</td>
</tr>
<tr>
<td>Enzyme Lab</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2, 4</td>
<td></td>
</tr>
<tr>
<td>Cells and Plasmolysis Lab</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2, 3</td>
<td></td>
</tr>
<tr>
<td>Osmosis and Diffusion Lab</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2, 1</td>
<td></td>
</tr>
<tr>
<td>Transpiration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1, 2</td>
<td></td>
</tr>
<tr>
<td>Cellular Respiration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2, 3, 1, 4</td>
<td></td>
</tr>
<tr>
<td>Mitosis, Cancer and Karyotype Lab</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3, 4</td>
<td></td>
</tr>
<tr>
<td>Fruit Fly Genetics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3, 1</td>
<td></td>
</tr>
<tr>
<td>Restriction Enzymes &amp; Gel Electrophoresis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Bacterial Transformation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3, 1</td>
<td></td>
</tr>
<tr>
<td>Hardy Weinberg Activity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cladogram and BLAST lab</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1, 3</td>
<td></td>
</tr>
<tr>
<td>Animal Behavior</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>4, 2</td>
<td></td>
</tr>
<tr>
<td>Populations Studies</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>4, 2</td>
<td></td>
</tr>
<tr>
<td>Dissection</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1, 2, 4</td>
<td></td>
</tr>
</tbody>
</table>
**AP Biology brief course overview:** Below is an abridged outline of each semester and unit in the class.

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
</tr>
</thead>
</table>
| **Unit 1:** Ch 1 View of Life  
- Reading: Ch 1  
- Project: Scientific Method Cricket Experiment Lab Report | **Unit 5:** DNA and Protein synthesis  
Ch 12: DNA and protein synthesis  
- protein synthesis activity  
- Ch 12 quiz  
Ch 13: Gene regulation  
- Lac and try operon coloring  
- Cell signaling  
Ch 14: Biotechnology  
- Biotech lab  
Test: protein synthesis and biotechnology |
| **Unit 2:** Biochemistry  
Ch 2: bonds, water, and pH  
- Ch 2 Quiz  
Ch 3: organic molecules  
- macromolecules mini poster  
- Macromolecules coloring HW packet  
-Macromolecules Quiz  
Ch: 6 ATP and Energy  
- Potato enzyme lab: Biological Science building room 136.  
- ATP activity  
  Unit Test: ch 2,3,6 | **Unit 6:** Evolution- Ch 15-19  
- Ch 15 HW reading guide  
- Ch 18 & 19 main concepts  
- Ch 16 17 HW  
- Cladrogram activity  
- BLAST  
- Hardy Weinberg equation  
Unit Test- evolution |
| **Unit 3:** The Cell  
Ch 4: Cell structure and function  
- Cell Diagram  
- Cell Structure and Function pkt  
Ch 5: Cell Membrane  
- Ch 5 Review packet  
- diffusion and cell osmosis lab: room 136  
  Test: Ch 4&5  
Ch 7: Photosynthesis:  
- vocab and chemiosmosis coloring  
- photosynthesis lab  
- ch 7 quiz  
Ch 8: Cellular Respiration  
- case study: the case of 7 deaths  
- Ch 8 notes packet  
- cellular respiration article  
Test: Ch 7&8 | **Unit 7:** Pathology  
Ch 20 Bacteria & Viruses  
- Bacteria and virus poster  
Ch 33: immune system  
Test- Pathology |
| **Unit 4:** Cell division  
Ch 9&10: Mitosis and Meiosis  
- Mitosis, Cancer and Karyotype Lab  
- Chromosome Disorder Mini-Project  
- Gametogenesis poster  
Ch 11: Heredity  
- Dragon Genetics  
- M& M lab- Chi squared  
- Fruit Fly Genetics Lab  
FINAL: cumulative | **Unit 8:** Plants/ Ecology  
Ch 23-26, 43-45  
- Ch worksheets  
- Plant Lab  
- Lab Bench virtual labs: ecology  
Test- plants and ecology |
| **Unit 9:** Body Systems & AP Review  
- Ch 37: nervous system  
- Quiz- nervous system  
Practice AP test for a grade in class  
- Dissection lab  
- body systems project |

*Please review the full, detailed course outline with standards and objectives on Mrs. Davisson’s website under the “syllabus” tab. Timing on due dates may vary based on school schedule and student need.*
Content Standards: Big Ideas and Enduring Understandings

The following is a list of the specific College Board content that this course is structured around. Each ‘Big Idea’ has Enduring Understandings (EU) and sub points for each EU. Although the outline does not go into detail on each sub point, it will help you to know what the important understandings are for each section. The chapters are included in parenthesis after each sub point. At the end are the science practices that will be emphasized this year through labs and class activities.

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 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 systems 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 indifferent 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 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 (CH
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 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 unites 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