Suzanne Huntemann

AP Biology UbD

AP Biology is a college level course designed to help students learn the fundamentals of biology. The course is separated into three main topics: Molecules and cells-25%; Heredity and Evolution-25% and Organisms and Popuations-50%. Each unit emphasizes the following eight themes:

Science as a process
Evolution
Energy transfer
Continuity and Change
Relationship of structure to function
Regulation
Interdependence in Nature
Science, technology and Society

The main reference for the course is Biology, 7th Edition by Solomon, Berg and Martin with study guide, Spiral Bound Lab notebook, Cliffs AP Biology Review Guide, 2nd edition by Phillip Pack (optional), Three-ring binders with separators for each unit and for labs. The class meets seven periods per week allowing for double periods for labs twice a week.

The course includes both wet and dry labs as well as internet activities that help advance and support understanding. At least twelve of the labs have been created by the College Board. More have been included, several of which are "design your own" labs. Articles will be used to help keep students current and provide a source for enrichment. Field trips, speakers and videos will also be used to provide enrichment and are a source for authentic learning.

Writing direction and assignments will also develop students' skills in writing informative essays and labs as well as test taking strategies. Frequent discussion on important issues will help enhance logical and critical thinking as well as highlight that in science answers frequently lead to more questions and that explanations of data can differ among individuals. Finally, students will have fun and learn the main aspects of a career in science. Guest speakers regarding various science professions will be arranged whenever possible.

Need for Beauty and Inquiry

"Science without religion is lame; religion without science is blind." "I want to know how God created the world" Albert Einstein, Nobel Laureate, Physics

"Beauty is crucial to the human enterprise because it triggers wonder."

(Thomas Dubay in The Evidential Power of Beauty) Wonder leads to discovery and discovery leads to knowledge. Knowledge leads to power and power lead to responsibility. Religion with responsibility will result in a better life for all.

AP Biology Year-long Enduring Understandings

Science is a process used to increase our understanding of the world around us. Controlled experimentation provides the optimal pathway to this increase in understanding.

The goal of all living things is to survive and perpetuate its own species.

All living things are subject to change. Change can be good or bad.

All living systems from individual cells to populations are interdependent.

Living things must maintain a dynamic equilibrium within their environment and with other living things through positive and negative regulatory processes.

All living things share common characteristics. These behaviorisms and/or structures function to ensure the organism's survival.

Livings things need energy to survive.

The development of new technology and ideas advances scientific discovery. It is the responsibility of scientists to ensure these advances lead to the greater good of the world.

AP Biology Year-long Essential Questions

What is experimentation and what drives it? What makes an experiment a good experiment? Is the information gained from an uncontrolled experiment useless?

What characteristic or attribute best enables a living thing to survive?

What is more important, survival or reproduction?

How do living things or cells respond to critical environmental changes?

Do structural changes in an organism lead to changes in function or do changes in function lead to changes in structure?

Where does energy come from? How are living things structured to acquire the energy they need for life and how do available energy sources affect an organism's structure?

What drives change? Why is change constant?
When is change good; when is change bad?

Can a living system survive unaffected if another living system dies or is eliminated?

If technology stopped being developed, would scientific advancement stall? What is the role of funding in scientific advancement and how does it affect the research that is being done?

Who is qualified to judge the value of new technology and what criteria should be used?

Title: AP Biology-Introduction, Basic Principles of Biology and controlled experimentation
ALL units meet the following state standards:
Goal 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems. 12A: Know and apply concepts that explain how living things function, adapt and change. 12B: Know and apply concepts that describe how living things interact with each other and with their environment.

Understandings

- The study of Biology is a process that leads to better understanding of who and what we are, our purpose/role in the living world, and ways of improving the living world.
- In order to live successfully all living things must have at least 7 basics characteristics.
- Biologists and living things use organization to make sense of the biological world and to live successfully.
- Scientific Method is a systematic process scientists use in order to elicit information.
- A scientific laboratory investigation is a cyclic process (not a linear sequence) that includes asking questions, making observations, proposing a hypothesis to be tested, designing and conducting experiments, analyzing results and expressing conclusions.
- Science is "messy."
- All observations, qualitative and quantitative have some degree of uncertainty.
- Your laboratory notebook is an important document. Observations and measurements should be recorded in your laboratory notebook **as you are making them, not later.**
- During a laboratory investigation you must record what you see not what you expect to see.
- You can learn MORE from a failed experiment than a successful one.
- Biology can be organized into several broad themes/issues (see year-long Enduring Understandings) that affect every living thing:

Essential Questions	Knowledge & Skill
♦ What is the role of biology in our lives and how has it affected your life? ♦ What is the most important characteristic of the seven characteristics of living things? ♦ What are the basic steps of Scientific Method and how do we use SM in our daily lives. ♦ What determines what research is done and what is the role of funding? ♦ What is good research and what is bad research and can "bad" research still give us useful	**Knowledge** ♦ Student should be able to explain what biology is, what information biological research provides, and how biological research affects our lives. ♦ Students should be able to explain the 7 basic characteristics of life? ♦ Students should be able to define the broad themes of biology and understand the relationship between each. ♦ Students should know the steps of SM and be able to create a series of experiments following the scientific method plus identify the weaknesses and strengths of their own and other's research.

information? ♦ Which broad theme of science has the greatest affect on living things?	♦ Students should understand the broad areas of science that we will be studying and be able to relate material to one or more areas of understanding. **Skills** ♦ Graph and analyze data ♦ Use a microscope properly ♦ Create a wet mount ♦ Write an If, Then hypothesis ♦ Create a lab write up following a formal format ♦ Work effectively in a group ♦ Create their own experiment ♦ Analyze experiments created by others ♦ Identify an Observation vs. an Inference and a Hypothesis vs. a Prediction ♦ Identify the dependent variable and independent variable in an experiment

Performance Task Summary	**Rubric Titles**
♦ Microscope lab write up	Basic lab write up rubric
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Characteristics essay Assessment worksheet of experimental process Quizzes/Tests Lab Reports: scientific method, microscope and plant geotropism

♦ (W) What is the most important characteristic of the seven characteristics of living things essay?
♦ (H) Worksheets assessing experimental set up and group discussion regarding experimental design.
♦ (E) Creation of laboratory flow chart with student created experiments to solve disappearing frog dilemma.
♦ (R) Microscope lab
♦ (E) Principles of Technical Writing including the creation and evaluation of free response question.
♦ Design your own lab using sprouts testing geotropism.

Title: AP Biology Ecology Unit-Behavior, Regulation and Interdependence

Categorize organisms by their energy relationships. Explain competitive, adaptive and survival potential of species across different ecosystems. Study impact of multiple factors that affect organisms in their natural habitats.

Chapter 50-55

Understandings

- ALL resources are limited and ecosystems are always changing in response to the availability of individual resources.
- All living things need energy and this energy is attained from their environment.
- All living things, even humans, have a role or niche in their habitat.
- Interactions and especially competition, among species help shape ecosystems.
- All living things are interdependent. A change in one organism may affect a change in another.
- Predation is a huge selective force that shapes organisms' behavior, morphology, and dispersion within an ecosystem.
- All organisms must be able to adapt to change. Changes in an organism's environment may lead to new opportunities or new niches. Those that can adapt, survive. Those that don't must either move to a more suitable environment or die.
- The abiotic and biotic resources of an ecosystem including water, carbon, nitrogen, and phosphorus cycle through the ecosystem in various ways.
- The energy within most ecosystems is derived from the sun. The role of plants, phytoplankton and other primary producers is to capture that energy and make it available to the ecosystem. The efficiency of the primary producers regulates the structure and biomass within an ecosystem.
- Energy moves through the ecosystem via the food chain.
- Biomes differ from each other primarily in the amounts of and timing of available resources.
- Available resources, variability of abiotic and biotic factors, and climate determine a biome's structure and diversity.
- The earth's rotation, gravitational pull of the moon, and the heat of the sun cause temperature changes in the air resulting in air currents and in oceanic currents which lead to differing climates in differing areas of the earth. An ecosystem's or biome's climate is a primary abiotic influence on the species and diversity within that ecosystem or biome.
- The use of fossil fuels to help support human's need for energy could irreversibly change the earth's environments. Other sources of energy are available and must be employed.
- The size of the Earth's population is growing at an alarming rate. The question of "What is the Earth's carrying capacity?" needs to be answered.

Essential Questions	Knowledge & Skill
♦ How do the amounts and timing of available resources affect the structure of an ecosystem? ♦ What factors influence a	**Knowledge** .**Students will know . . .** ♦ The definition of a population and how its characteristics and dispersion are influenced by

population size and how will population size change in response changes in these factors? ♦ How do food webs and food chains differ across ecosystems? ♦ What is the relationship between primary productivity and energy flow in ecosystem? ♦ What are the factors that differentiate one biome from another? ♦ What factor(s) determine where species live and how does competition and species interaction play a role in that decision? ♦ How do organisms respond to change? ♦ What influence does environment have on species adaptations? ♦ It is OK to allow a species to become extinct and should humans attempt to "SAVE" all species? ♦ How have humans and humans' need affected the Earth's biomes? ♦ Can humans satisfy their needs and still live in harmony with the environment?	environmental pressures. ♦ Identify forces that shape a population's attributes. ♦ Environmental pressures include both Abiotic and biotic factors. ♦ What determines an ecosystem and how do they work. ♦ How competition shapes a community. ♦ How predation shapes an organism and an ecosystem. ♦ What a niche is and the concept of limiting resources. ♦ The concept of succession and difference between primary and secondary succession. ♦ Describe the various cycles that affect an ecosystem or biome ♦ Seven major biomes on Earth. ♦ The role of humans in the environment. ♦ **Skills:** ♦ Identify the Abiotic and biotic factors in an environment and describe their influence on a population. ♦ Construct a food chain and use it to make a food web. ♦ Summarize and describe the key features of each of the earth's biomes. ♦ Explain an age structure diagram and describe the population's attributes. ♦ Identify ways in which humans are negatively affecting the environment and design ways to minimize his impact. ♦ Identify and describe how changes in climate lead to changes in ecosystems and ultimately changes in diversity.

Performance Task Summary	Rubric Titles
♦ Self design model ecosystem experiment using bottle biology. ♦ AP #11-Behavior of Isopods Self design experiment ♦ AP #12-Dissolved Oxygen and Primary Productivity	Formal lab write up Rubric Volo bog Journal Rubric Ecology Research Essay Rubric Bottle Biology Ecosystem Rubric

- Survival Game: food chain and behavior adaptations in ecosystem.
- Biosphere report
- Volo Bog Field Guide
- Owl pellet food web
- Ecology research essay with a Letter to Congressman re: some environmental crisis of choice

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets Examining owl pellets Biome presentation Class and blog discussion

(W): Post essential questions and distribute project packets – review as a class.
(H): Conduct class activity: "Survival Game"
(E): Create a living biome: Ecosystem Dynamics Home Project using bottle biology
(R): Bog research followed by Volo bog field trip
(E): AP bio biosphere Internet exercise and report
(T) Owl Pellet Dissection Analysis
(O) AP #11-Behavior of Isopods Self design experiment
AP #12-Dissolved Oxygen and Primary Productivity
Unit Assessment
Video and discussion on global warming
Illinois State Module on watershed ecology--
http://www.epa.gov/owowwtr1/watershed/wacademy/acad2000/ecology/

Title: **AP Biology Biochemistry Unit**

Chapters 1-3

Understandings

- The laws of thermodynamics states all living organisms require energy to grow, synthesize new molecules and maintain current body structures.
- Biological molecules are polymers put together in different ways from simpler molecules.
- Each biological molecule plays an important a role in the structure and physiology of an organism.
- Biological organisms have a sophisticated system to regulate the levels of each biological molecule.
- Not all biological molecules can be created within the organism. Some molecules can only be attained through ingestion of or harboring of organisms that contain or make that molecule.
- Biochemical needs provide the first reason for the interdependence of organisms.
- Water is the most important biological molecule.
- DNA is the recorder and library for all "living" information. Two different types of chemical bonds provide the structure DNA needs to maintain integrity while allowing it to break apart in a specific way allowing for replication and protein production.
- ATP and GTP are both nucleic acids used in the short term storage and transfer of energy.
- Proteins are the primary "doer" molecules and can act as the facilitators or regulators (enzymes or transcription factors) in biological process as well as provide structure and energy.
- Carbohydrates are the primary form of energy. Living things use glucose obtained through ingestion or synthesis to provide the energy needed for biological processes.
- Lipids are needed for cells membrane integrity, structure, homeostasis and cell communication.
- Proteins' long sequences of amino acids are held together with peptide bonds. There are four levels of structure in a protein based on the sequence of amino acids in the protein and the interactions of the r-groups of each amino acid. The structure of the protein is related to its function. Changes in the sequence of amino acids can lead to changes in form which leads to changes in function. In addition, the environment surrounding the protein may alter the protein's ability to function.
- Permanently altering proteins is a process called denaturation. Denaturing a protein can be done with heat, changes in pH or ion concentration.
- Some proteins serve as biological catalysts in the metabolic activities of an organism. Catalysts can be affected positively by activators or co-enzymes and negatively by denaturation or inhibitors- both competitive and allosteric.
- The metabolic processes in living organisms are tightly regulated and usually part of a large pathway of controlled reactions each dependent on part in some other process.

Essential Questions **Knowledge & Skill**

♦ Why do atoms bond to other atoms and what determines the type of bond that is created? ♦ How do chemical bonds determine life's capabilities? ♦ Why is carbon present in almost all biological molecules? ♦ What are the properties of water that make it so important to life? ♦ Why are oxidation reactions always connected to reduction reactions? ♦ What is the advantage to connecting exergonic and endergonic reactions in the body? ♦ What is the most important biological molecule in living things? ♦ In what ways do biological processes show interdependence? ♦ In what ways are biological processes regulated? ♦ What is the relationship of the structure of a biological molecule to its function? ♦ How are biological molecules dependent on their environment or altered to work within a specific environment and what is the effect of changing that environment?	**Knowledge** ♦ Understand the basic structure of the atom and why and how atoms bond with other atoms. ♦ Know the difference between covalent and ionic bonds and the characteristics of each. ♦ Understand hydrogen bonding and its importance in biological molecules. ♦ Water is essential to life on this planet due to its polar nature and hydrogen bonding between individual water molecules. This interaction makes water adhesive, cohesive, and have a high specific heat. ♦ Explain redox reactions. ♦ Explain what pH measures and how changes in pH affect biological molecules. **Skills** ♦ Given two or more elements be able to determine the type of bond formed and the compound's formula. ♦ Be able to identify the transfer of electrons in oxidation and reduction reactions. ♦ Explain what happens to a protein when it denatures. ♦ Explain how enzymes work and are regulated. ♦ Name the basic units of all four classes of biological molecules. ♦ Be able to design an experiment testing a chemical reaction. ♦ Identify the type of biological molecule based on standard chemical tests. ♦ Label an enzyme diagram and identify activation energy and exothermic reaction vs. an endothermic reaction.
Performance Task Summary	**Rubric Titles**
♦ Biomolecules Identification lab ♦ AP biology Lab #2 Enzyme Catalysis ♦ Design your own lab testing enzyme function. ♦ Proteins Web quest	Lab Report rubric
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam	Quizzes/Tests

performance Free response questions	Lab reports Worksheets and web quest Class discussion

- (W) Biomolecules Identification lab
- (H) AP biology Lab #2 Enzyme Catalysis
- (E) Design your own lab testing enzyme function and kinetics.
- (R) Proteins Web quest
- (E) Protein Structure activity
- (T) Free Response Q & A
- (O)

Title: The cell, cell membrane and transport

Chapters: 4-5

Understandings

- The cell is the basic unit of all life.
- The organization of all cells is basically similar.
- Prokaryotic cells and eukaryotic cells have some similarities and many more differences.
- Diffusion of a molecule is dependent on the molecule's size and shape.
- Cells derive their nutrients and get rid of waste via diffusion. There is an optimal size that they will be able to achieve and still be able to survive. Therefore all cells are small.
- Size and shape of a cell is related to its function.
- All cells, even single celled organisms, are dependent on the environment or other cells in order to survive.
- Cells must be able to maintain homeostasis.
- Eukaryotic cells are organized into three main areas; nucleus, cytoplasm and Cell membrane.
- Inner membranes in Eukaryotic cells act to compartmentalize organelles allowing a controlled environment and a "work table" upon which molecules needed for metabolic reactions are kept in close proximity increasing efficiency.
- The membrane also acts as an energy barrier across which certain organelles are able to create energy potentials in the quest for capturing energy in ATP.
- The fluid mosaic model is the current theory explaining the properties of the cell membrane.
- The cell membrane is a selective barrier and that allows the cell to maintain homeostasis.
- Osmosis is the diffusion of water across a membrane from high concentration to low concentration.
- Small and non-polar molecules can diffuse across the membrane.
- Two solutions can be isotonic, hypotonic or hypertonic to each other. A hypertonic solution contains more energy then a hypotonic solution.
- Besides diffusion, cells use facilitated diffusion, and three forms of active transport using channel proteins, cell receptors and carrier proteins, to move substances across the membrane barrier.
- Passive transport moves molecules down their concentration gradient and requires no energy. Active transport moves molecules across the membrane against their concentration gradient and requires energy usually in the form of ATP.
- Cells, regardless of whether the cell is a unicellular organism or one cell of many in a multicellular organism, must be able to communicate and react to changes in the cell's environment. The area on the outer side of the membrane contains receptors used in signaling and communication.
- Cells that exist side by side in a tissue have different junctions, tight and anchoring junctions that serve to hold cells together at times creating a water tight barrier.
- Plant cells have plasmodesmata cell junctions that result in every cell in the plant being connected. This allows that plant to quickly spread signals through the plant's tissues. It also provides bacteria and viruses to spread quickly throughout the plant.

Essential Questions	Knowledge & Skill
♦ What is the importance of cells in living things?	**Knowledge** ♦ Understand the basics of Cell Theory

♦ How does the structure of the cell enable the cell to withstand and respond to changes in its environment? ♦ Which statement is true, the design of the cell allows for its ultimate function or the function of the cell determines its design? ♦ Explain the following statement "Cells could not exist and grow as they do if the membrane did not exist or had different properties". ♦ Which activity of a cell is most important to its survival? ♦ If cells could not communicate would we still be able to have multicellular organisms?	♦ The basic definition used to classify cells as prokaryote and eukaryote. ♦ How do cells make proteins? Lipids? Carbohydrates? ♦ How do cells recycle or deal with defective and old structures? How do cells obtain energy to run these processes? ♦ How do cells move? Or maintain their shape? ♦ How do plants differ from animal cells? What are the organelles specific to plant cells? ♦ How do cells communicate with their neighbors? **Skills** ♦ Identify all the cellular organelles and identify their purpose. ♦ Design a cell that is capable of doing a certain function. ♦ Evaluate the Symbiosis Theory. ♦ Draw and label the parts behind the fluid mosaic model of the membrane and identify the role of the four major areas. ♦ Explain the basics behind cell signaling.

Performance Task Summary	**Rubric Titles**
♦ Cell design ♦ Exam ♦ Identification of cellular organelles and their function ♦ Identification of the components of the fluid mosaic model and the function of each.	Lab Write up rubric Cell Arch presentation and poster rubric.
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets Class discussion Cell Arch presentation and poster Free response rubric

(W) AP BIOLOGY LAB #1 - diffusion
(H) Free response Question Activity
(E) Cell Arch: Design a cell activity and poster/presentation
(R) Symbiosis Article and evaluation

(E) Cellular Organelle identification coloring worksheet
(T) Cell Size lab
(O) Cell structure and function crossword puzzle (vocabulary)
Cellular organelles and fluid mosaic model coloring worksheets and table

Title: Energy Transfer, Cell respiration and photosynthesis- Follow the energy/money
Chapters: 6-8

Understandings

- Energy can never be created nor destroyed. Entropy (disorder), however, in the universe is increasing. Energy is required to maintain order.
- All organisms are dependent on their environment or other organisms for their energy needs.
- Organisms must use energy immediately or store it in the form of chemical potential energy for later use.
- Free energy increases with endergonic reactions and decreases with exergonic reactions. It is therefore more efficient for an organism to couple endergonic reactions with exergonic reactions so that less energy is transferred to the surroundings. This transferred energy is heat.
- ATP is the energy "currency" of the cell. Synthesizing ATP from ADP and Pi is an endergonic reaction. Decomposing ATP into ADP and Pi is an exergonic reaction. ATP, ADP and Pi are free to move throughout the cell and may be coupled with an exergonic reaction forming ATP in one reaction and moving to another part of the cell where the energy released from the decomposition of ATP is used by a different endergonic reaction. The cell can send ATP where it needs energy the most.
- The cell's anabolic (endergonic) reactions have evolved to efficiently use the amount of energy in the phosphate – phosphate bond of ATP. The cell has evolved to efficiently capture the energy released in catabolic reactions.
- Enzymes work to minimize the energy catabolic and anabolic reactions need to begin. This energy is called activation energy.
- Enzymes are proteins with a conformation that creates an active site. This site is specific for the enzyme's target molecule(s). These enzymes can be enhanced by activators and reduced by inhibitors. In addition, changing the environment of the enzyme could alter its conformation and thus its activity.
- All cells do some form of respiration in order to create ATP from a longer term energy storage molecule, primarily glucose.
- There are four main stages of cellular respiration: glycolysis, formation of acetyl CoA, Citric Acid cycle, and the electron transport chain.
- All cells do glycolysis. Glycolysis occurs in the cytoplasm and allows for enough energy to be produced to maintain an organism but not enough energy to allow for large growth or development. Glycolysis is anaerobic and works to cut glucose in half to create pyruvate.
- In the presence of oxygen, pyruvate is processed to form acetyl-CoA which enters the citric acid cycle.
- Carbon dioxide and ATP are produced along with two electron carriers, NADH and $FADH_2$. The electrons are handed over to the electron transport chain where more ATP is produced and the final electron acceptor is oxygen. The ETC creates ATP using a proton gradient.
- If no oxygen is present pyruvate undergoes either alcoholic or lactic acid fermentation. The primary objective of fermentation is to recycle NADH to NAD+ so that glycolysis continues.

Understandings (continued)

- Respiration is an example of a metabolic pathway. Should anyone of the components of the pathway becomes unavailable the entire pathway shuts down.
- The formation of acetyl CoA, Citric acid cycles, and ETC take place in the mitochondria using enzymes embedded in the mitochondrial membrane. The membrane is also used as a barrier upon which the proton concentration gradient is formed. The mitochondria use an enzyme, ATP synthase, which uses the energy of the proton gradient to create ATP. Aerobic respiration makes the most ATP and provides enough energy to grow, develop, and evolve.
- Glycolysis occurs in the cytoplasm under anaerobic conditions and is performed by the cells of all organisms, even prokaryotic single celled organisms. This is strong evidence for the common ancestry of all living cells
- Photosynthesis is the process of capturing radiant energy from the sun and ultimately storing it in chemical energy. It occurs in the chloroplasts in two main phases. Phase one requires light energy, two photosystems embedded in the membrane of the thylakoid contain pigments that are able to capture the energy of the sun and use it to excite electrons in the photosystems. These excited electrons pass through an electron transport chain where the energy is used to create a proton gradient across the membrane. Each photosystem differs in the wavelengths of light energy it can capture and in where the electrons originate from and ultimately go to.
- Water is split by photosystem II creating protons and oxygen. The electrons from the water molecule are used to replace those that had previously been excited. These electrons from photosystem II are excited and then moved to an electron transport chain where the energy is used to create a proton gradient and ultimately ending up at photosystem I. In photosystem I the electron is reenergized and put into a second ETC. This electron's energy is used to supplement the proton gradient. This electron ends up as part of NADPH in noncyclic electron transport or ends back in photosystems I ready to be reenergized in cyclic electron transport. Cyclic electron transport makes no NADPH or oxygen gas.
- The chloroplast uses the same enzyme, ATP synthase, as in respiration which uses the energy of the proton gradient to create ATP. These process similarities indicate common origins and ancestry.
- The ATP and NADPH that was created is used in the Calvin cycle to fund the energy needs to fix carbon dioxide. This pathway occurs at anytime as long as there is enough energy. The first step of this pathway is fixing CO_2 to a five carbon sugar by an enzyme called rubisco. Through a number of endothermic reactions three carbon dioxide molecules are fixed and ultimately net to a three carbon sugar molecule which is then used to create various types of sugar molecules.

Understandings (continued)

- Rubisco is the most common enzyme in the world. It has an affinity for carbon dioxide and for oxygen. If the oxygen concentration is high then rubisco will bind with oxygen and do photorespiration which uses energy rather than makes it. Plants have evolved holes in their stems and the under side of their leaves which open and close in response to humidity to prevent water loss. The pores called stomata allow for the diffusion of oxygen out of the cell and the intake of carbon dioxide. In dry climates or on hot days the stomata will close to prevent water loss causing an increase of oxygen reacted during photosynthesis leading to photorespiration. Plants that live in arid areas or regions that are periodically hot and dry have evolved alternate methods of carbon fixation to decrease photorespiration. These are called C-4 or CAM plants.
- An organism's need to obtain and conserve energy shapes its morphology, physiology, and behavior. Organisms that are best able to obtain, use and conserve the available energy in their environment will survive and reproduce. Those that don't die. The difference of being able to obtain 1% Calories more than another organism is the difference between life and death. This difference provides an important selective pressure for evolution.

Essential Questions	Knowledge & Skill
♦ What exactly is energy and how does it exist in the world around us? ♦ How are organisms structured individually to ensure efficiency and survival? ♦ How are organisms dependent on other organisms and their environment for their energy needs. ♦ Describe how an organism's energy needs and mechanisms of obtaining energy support evolution and common ancestry? ♦ Which came first ATP synthase or the Krebs cycle (Citric acid cycle)? ♦ Which came first the Krebs cycle or the Calvin-Benson cycle? ♦ Could living things exist without the sun? ♦ Could living things obtain energy without membranes? ♦ Should we consider the energy lost as heat really lost? ♦ Are the most complex organisms the most energy efficient? ♦ What determines how energy	**Knowledge** ♦ Explain the first two laws of thermodynamics and what they mean. ♦ Explain how the chemical structure of ATP allows it to transfer a phosphate group. This allows ATP to function as the primary carrier and short term storage molecule used for metabolism by the cell. ♦ Once created, if it is not used, ATP lasts for approximately a day. This means the cell must continue to make ATP. How do cells make ATP? ♦ Explain the advantage of membranes in the regulation and facilitation of metabolic processes and why most cells couple endergonic and exergonic reactions. ♦ Explain how enzymes operate and the various ways they can be denatured and regulated. In addition how cells create interlinking pathways allowing for complicated step by step regulation of enzyme and metabolic processes. ♦ Explain how an enzyme lowers the required energy of activation for a reaction. Describe specific ways enzymes are regulated. ♦ Outline and explain the steps of cellular respiration and how it is used to make ATP. ♦ Compare and contrast the two different types

efficient an organism is and what are some ways that organisms have adapted to increase their energy efficiency either overall or seasonally. ♦ What is the best arrangement for a metabolic pathway cyclic or linear? ♦ Why have organisms evolved so many different short term ways of capturing energy? ♦ Explain this statement: Energy efficiency is an important selection pressure in the evolution of organisms.	of respiration: anaerobic (no oxygen) and aerobic (with oxygen). ♦ Explain the two types of anaerobic respiration called fermentation and the types of cells that do each process and when. ♦ Describe a cyclic pathway and the significance of this type of pathway vs. a linear pathway. ♦ Explain what electron carriers are and their role in metabolic processes and energy transfer. ♦ Describe cellular respiration, what happens, where it happens, details of the various reactions, how a cell gets energy if glucose in not available, the importance of oxygen, and what organisms do what. ♦ Explain the similarities and differences between C3 and C4 and CAM plants and the pathways used to fix carbon. ♦ Describe ways that organisms have evolved to ensure the most efficient use of energy. (e.g. C4 and CAM, blubber, estivation, hibernation…) **Skills** ♦ Draw and label an energy diagram showing changes in free energy for exergonic and endergonic reactions, and give examples of how they may be coupled. ♦ Identify and use examples to contrast potential energy and kinetic energy. ♦ State the first and second laws of thermodynamics, and discuss the implications of these laws as they relate to organisms. ♦ Compare the energy dynamics of a reaction at equilibrium with the dynamics of a reaction not at equilibrium. ♦ Create a lab measuring the activity of an enzyme. ♦ Describe how electrons are transferred between molecules and how electron carrier molecules like NAD+/NADH, FAD+/$FADH_2$, and NADP+/NADPH function. ♦ Draw the steps of cellular respiration, where each occurs, and the compounds involved and follow an electron through cellular respiration ♦ Draw the steps of photosynthesis, where each occurs, and the compounds involved and follow an electron through photosynthesis.

	♦ Show in cellular respiration where molecules from other sources such as proteins and fats are able to enter in the cycle and provide an alternate source of energy other than dietary glucose or glycogen. ♦ Identify the redox reactions that occur during cellular respiration and which substances are reduced and which are oxidized. ♦ Describe the differences between aerobic respiration and anaerobic respiration and identify which organisms use which process and when in order to release energy. ♦ Understand why cells use fermentation, where it occurs and why, and what compounds are involved. ♦ Describe how organisms' energy needs and mechanisms of obtaining energy support evolution and common ancestry. ♦

Performance Task Summary	Rubric Titles
♦ Cellular respiration and photosynthesis poster highlighting commonalities. ♦ AP #4-Plant Pigments ♦ AP #5-Cell Respiration ♦ Self design photosynthesis lab ♦ Free response question ♦ Exam	Poster Rubric Formal Lab Report rubric
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets Class discussion

(W) AP lab #4
(H) AP bio lab #5
(E) respiration and photosynthesis poster
(R) Free Response exercise
(E) Photosynthesis and respiration table
(T) Biology Place Web Quest
(O) Intro to Spectrophotometer
Energy adaptation contest "Who can find the most number of ways that organisms have adapted themselves to be more energy efficient" Create and maintain year-long poster for room.

Title: Mitosis, Meiosis, Cell cycle and DNA structure and replication-
Chapters: 9, 11 and 48

Understandings

- Mitosis is cellular replication. All cell replicate. For single celled organisms this is their method of reproduction. For Multicellular organisms, mitosis is used to develop, grow, and replace old cells.
- DNA (or RNA) is found in the cells of all living things. Experimentation done by Hershey and Chase showed that DNA is the transformation factor and the source of DNA determines the characteristics of the cell. When cells replicate they must replicate their DNA.
- Watson and Crick synthesized empirical evidence form the work of other scientists, Rosalind Franklin, Maurice Wilkins and Edwin Chargaff, and suggested the correct structure of DNA as a double helix.
- Passion and thought are as important in the advancement of science as experimentation.
- Prokaryotes do not have a nucleus. Replication, or fission, begins with replication of their circular DNA. The DNA and its duplicate are attached to the cell's membrane. As the membrane grows the duplicates separate. Eventually the cell splits resulting in the creation of two cells with identical DNA.
- Replication in eukaryotic cells is more complex. A large portion of the energy needed to replicate eukaryotic cells is devoted to replicating the DNA inside the nucleus and then splitting that DNA creating two nuclei each having identical DNA.
- DNA is composed of four different types of nucleotides each contain a phosphate, Deoxyribose sugar and either a pyrimidine (cytosine, and thymine) or purine (guanine, adenine) bases. The nucleotides are linked in a strand with a phosphodiester backbone of strong bonds that prevent the strands from breaking apart.
- DNA is composed of two strands of DNA each complementary and antiparallel to the other (A:T and C:G) held together by hydrogen bonds between the bases. Hydrogen bonds are weak individually but strong in numbers and hold the strands together while at the same time allowing under the right condition the strand to come apart during replication. The hydrogen bonds provide rungs in a helical staircase structure.
- The DNA strand is negatively charged. The physical structure of DNA is further supported by positively charged protein globs called histones or DNA proteins upon which the double helix is wound creating a nucleosome. Eukaryotic DNA is arranged in rods. The nucleosome ensures the strands do not tangle. The nucleosomes are packed together and further supported by scaffolding proteins to form chromatin. DNA must shed this protein structure in order to function. The structure is one way the cell regulates the function of the DNA.
- During DNA replication the DNA unwinds from its protein structure and uncoils with the help of helicase. DNA replication is semi-conservative each new doubled strand of DNA produced contains an original strand and a new strand with each original providing the template for the creation of the new.

Understandings (continued)

- DNA replication always proceeds in a polymerase 5'—3' direction with DNA polymerase responsible for reading the strand and attaching the nucleotide that is the complement of the template. RNA primer is needed for the attachment of DNA polymerase. This primer is created by RNA primase and then removed once DNA polymerase attached and replication begins. Because replication only proceeds in a 5'—3' direction the leading strand in synthesized in one continuous strand. The lagging strand is synthesized in small fragments called Okazaki fragments that are linked together with DNA ligase.
- Telomeres are non-coding DNA repeated sequences that "cap" the ends of linear DNA molecules. The length of the telomere shortens with every replication and has been associated with cell aging and apoptosis (cell suicide). Telomerase is an enzyme that lengthens the telomere. Cells with high amounts of active telomerase allow the cell to replicate and unlimited number of times reducing the aging process. High amounts of telomerase may also cause a cell to replicate uncontrolled leading to cancer.
- Although polymerase attempts to correct mistakes, replication is a chemical process and mistakes happen in at a measurable rate. These mutations lead to cancer, cell death in somatic cells and are the basis for diversity and evolution in germ cells.
- An average cell has four basic stages, G1, S, G2 (all part of Interphase) and mitosis. During G1 the cell grows and operates normally. Cells spend the majority of their time in G1. The length of g1 depends on the type of cell. Some cells never leave g1. If the cell has the resources, it commits to mitosis and begins by replicating its DNA. This is called the S phase. After S phase the DNA consists of sister chromatids attached to each other at the centromere. Next is G2 where the cell makes its final preparations for mitosis.
- Mitosis results in two somatic cells that are identical to the parent cell with the exact same amount of DNA. Mitosis begins after G2 and is separated into two parts, mitosis- splitting of the nucleus and cytokinesis- splitting of the cytoplasm. Mitosis is sectioned into four parts each phases distinguishable by the activities occurring during that phase. The first phase is prophase. During prophase the chromosomes condense and are visible under a microscope. Attached to the centromere is a protein structure called the kinetochore upon which the mitotic spindle fibers are able to attach. The spindle fibers begin forming and attaching during prophase and are possibly visible. The nuclear membrane breaks down and the nucleolus disappears. The centrioles in animal cells (asters in plants) begin to migrate to opposite ends.
- Metaphase: the chromosomes line up at the metaphase plate. The centrioles establish the two poles and the spindle fibers line up to begin pulling the chromatids apart each toward an opposite pole. Anaphase follows metaphase. The spindle fibers separate the chromatids and pull them to the opposite poles. Once at the pole Telophase begins and the chromosomes are encased in a new nuclear membrane.

Understandings (continued)

- Cytokinesis begins as soon as the DNA is separated and reaches the poles (sometime during Telophase) and separates the cytoplasm equally into two new cells. During cytokinesis in animal cells the cleavage furrow forms as the plasma membrane pinches inward to create the two new cells. In plant cells, cytokinesis must create a new plasma membrane as well as a new cell wall. The plant cell is rigid thus the plasma membrane is created using migrating vesicles that meet at the midline between the two new cells. The vesicles merge becoming larger and larger until they form the new membrane and cell wall.
- The cell cycle includes cell cycle checkpoints to ensure the cell replicates properly. Proteins including growth factors, protein kinases and cyclins regulate replication. Interruptions in the cell cycle can lead to unregulated growth or cancer.
- Germ cells undergo meiosis. Meiosis is a process ultimately resulting in cells that contain half the number of chromosomes of the parent. The chromosomes are mixed up and pieces recombined such that chromosomes with potentially unique combinations of genes are created.
- Meiosis is similar to mitosis except the cell undergoes a second division without synthesizing new chromatids thus resulting in a reduction in the number of chromosomes. Meiosis like mitosis begins in interphase with the synthesis of new DNA-chromatids. Prophase I- recombination takes places where homologous chromosomes synapse at the Chiasmata to form a tetrad. The tetrads exchange genes in a process called crossing over or recombination. Chromosomes are formed with new combination of alleles. This is important to genetic diversity.
- Metaphase-The homologous chromosomes lines up at the metaphase plate and during anaphase I, each chromosome (set of chromatids) migrates to a pole. The cells that are formed have half the number of chromosomes or haploid. Telophase I also marks the creation of a new nucleus. This nucleus is short lived. The cells quickly undergo a second division. The second is more like mitosis in which chromosomes condense during prophase II, line up at the metaphase plate (Metaphase II), migrate to the poles (anaphase II) and from new cells with new nuclei (Telophase II and cytokinesis).
- During both meiosis I and II, the chromosomes separate independently from the other in a process of independent assortment. Because crossing over in prophase I can result in the creation of chromosomes with differing sets of alleles, each daughter cell created during meiosis has the possibility of being totally unique and different. Independent assortment is another source of genetic diversity.
- During sexual reproduction gametes created through meiosis come together to form individuals with unique sets of genetic combinations. No two individuals formed through sexual reproduction are alike except those that come from the same zygote such as identical twins.

Understandings (continued)

- During meiosis I if homologous chromosomes fail to separate or during meiosis II if chromatids fail to separate gametes may be formed with too many or too few chromosomes. Animal zygotes produced from these gametes are unlikely to survive. Plants, however, frequently can be found with multiple complete sets of chromosomes called polyploidy. Polyploidic plants are frequently hardier than the original and are an important source of new species in plants.
- Animals are diploid. Other species such as some plants, fungi, and algae spend as much time in the gametophyte (or haploid) stage as the diploid stage.
- The timing of gametogenesis can differ among different species and among different sexes of the same species. Spermatogenesis occurs in the testes of the male and results in the formation of four equal gametes in large numbers. Oogenesis occurs in the ovary of the female and, in animals, results in the formation of one large oocyte and three polar bodies. This process ensures that the egg gets ample resources to grow and develop. In addition, the zygote receives ALL its organelles along with the extranuclear DNA (e.g. mitochondrial DNA) intact from its mother. The nuclear DNA in a zygote is half from the father and half from the mother.
- Asexual reproduction is less energy intensive and produces a clone of parent. Sexual reproduction requires more energy but produces a unique individual with a mixture of parental DNA. This mix of DNA may provide an evolutionary advantage in a changing environment.
- In sexual reproduction fertilization may occur externally or internally. The organism's morphology, physiology and behavior determine an organism's success and thus determine the evolution of these processes.
- External fertilization is inefficient thus requires large numbers. Internal fertilization is more efficient but requires more energy and appropriate behaviorisms.
- The rigors of internal fertilization provide the basis for sexual selection important in evolution.
- There are many hormones that control ovulation. The frequency of ovulation is the basis for natural population control, behavior and life processes. (Refer to Ecology).
- Biotechnology has developed several different types of procedures to ensure a successful pregnancy. External fertilization processes such as IVF and ZIFT, as well as, internal fertilization processes such as AI, AID and GIFT have all been developed to increase a couple's chance of a successful pregnancy.

Essential Questions	Knowledge & Skill
♦ Is DNA the basis of life or just a conduit for information storage and flow? ♦ How does the structure of DNA support evolution? ♦ Is it better to be genetically unique or genetically similar to others of the same species?	**Knowledge** ♦ Describe the chemical structure of DNA, the experimental work that confirms this structure and the role of DNA in cells and heredity, and how this structure allows the maintenance of the integrity and accurate replication of DNA. ♦ Describe the arrangement of DNA in prokaryotic and eukaryotic cells and how this

♦ What happens to a cell when the cell next to it becomes cancerous? ♦ If sexual reproduction allows for greater diversity why are there still organisms doing asexual reproduction? ♦ If the physical aspects of sexual reproduction require so much energy why aren't there more hermaphrodites? ♦ Should extraordinary means be used to allows those living things that can't reproduce to reproduce? How might these efforts affect genetic diversity?	structure affects the process of replication or fission in each cell. ♦ Describe how the process of DNA replication can result in mutation and which types of mutations lead to evolution and which types lead to cell death or cancer. ♦ Outline Meselson and Stahl's work that verified the mechanism of semi conservative replication and the ramifications of semi conservative replication on mitosis and meiosis. ♦ Explain how semi conservative replication affects mutation and how mutations are passed on to new cells. ♦ Explain DNA replication and highlight the important enzymes involved. ♦ Describe the role of telomeres and their possible role in cancer, apoptosis and cell aging. ♦ Outline the cell cycle and how cancer can result when the regulatory check points of the cell cycle do not function properly. ♦ Outline the steps of mitosis and meiosis. ♦ Compare and contrast mitosis and meiosis. ♦ Explain how chemotherapy products stop cancer. ♦ What kinds of adaptations do plants and other organisms have in response to mitosis and meiosis. ♦ Explain why mutations can be good or bad. ♦ Compare and contrast asexual and sexual reproduction. ♦ Compare internal and external fertilization and highlight the adaptation organisms have to ensure the success of each. ♦ Outline the different ways that organisms use mitosis and meiosis and reproduction to ensure their survival. **Skills** ♦ Draw the structure of DNA and the steps and enzymes involved in replication. ♦ Outline the Meselson and Stahl experiments that lead to the description semi-conservative replication. ♦ Identify the enzymes involved in replication and the role of each.

	♦ Given a sequence of DNA, write the complementary sequence. ♦ Identify the leading and lagging strands of DNA and identify the directionality of DNA replication. ♦ Label the cell cycle and identify the check points that help determine when the cell is ready for mitosis. ♦ Describe mitosis and meiosis. Given a picture or slide of a cell be able to identify which process the cell is undergoing and the stage it is in. ♦ Fill in a table comparing meiosis and mitosis and describe the similarities and differences between each. ♦ Outline different types of reproduction and discuss advantages/disadvantages of each. ♦ Identify the primary structures of the human reproductive structures. ♦ Label diagrams of alternate reproductive methods by plant and some algae.

Performance Task Summary	Rubric Titles
♦ Isolate DNA ♦ Given a diagram of DNA replication be able to label the components ♦ Identify given a picture the stage of mitosis a cell is in. ♦ Identify given a picture the stage of meiosis a cell is in and be able to determine whether the cell is undergoing spermatogenesis or oogenesis. ♦ Compare and contrast mitosis and meiosis using a Table format. ♦ Diagram of alternative reproduction mechanisms.	Formal Lab report rubric

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets and diagrams Class discussion

	Web quests

(W) Free Response Question
(H) AP#3-Cell Division(Mitosis)
(E) Meiosis observation lab-plants and animal gametocytes
(R) Mitosis/Meiosis Web Quest-University of Arizona
(E) Mitosis/Meiosis Movie
(T) DNA Movie: Secret of Life
(O) Isolate DNA of strawberries
DNA replication web quest-University of Arizona
Mitosis/ meiosis comparison table
Human reproduction diagram
Alternate reproduction diagram.
Cell cycle diagram

Title: Transcription, Translation and Inheritance-expressing yourself
Chapters 10,12, and 13

Understandings

- DNA is organized into chromosomes. Each chromosome has multiple genes. Each gene codes for at least one or more proteins. Proteins result in the morphologic and physiologic traits each organism presents.
- Mendel studied the inheritance of physical traits. Genes were unknown at the time. His work, however, resulted in a new science, Genetics.
- Mendel's work lead to the creation of several Laws of Heredity that still exist today. Complex organisms are diploid meaning they have two copies of a gene. Differing versions of a gene are called alleles. A population can have two or more alleles for a gene, however, a single individual has only two possible alleles. The individual inherited one allele from the mother and one from the father. Dominant alleles or traits can suppress the expression of recessive traits. Recessive traits may be masked by dominant traits but will be expressed in an individual with only recessive traits.
- A monohybrid cross involves one trait and a dihybrid involves two. A test or back cross allows the research to determine whether or not the individual is heterozygous for a trait by crossing them with an individual with the recessive trait.
- The Punnet square can be used to predict the statistical probabilities that an individual will inherit a trait. Normal rules of statistics, the product rule and the sum rule can be used as well.
- Alleles that are not linked (on the same chromosome) will sort independently and be inherited with a predictable probability. Those that are linked will not follow these rules and will be inherited together. Alleles on the same chromosome do undergo recombination. The farther the two alleles are from each other the more likely recombination will take place.
- All homologous chromosomes are of equal size except the X and Y chromosomes. The Y chromosome is much smaller than the X and contains only a limited number of genes. The X chromosome contains more genes than are on the Y. A boy, who inherits only one X will have a higher incidence of X related recessive conditions than a female. The boy inherits these conditions from his mother. A girl must inherit both the conditions from both her mother and her father.
- A Barr body is an inactivated or mostly inactivated X chromosome. Barr bodies are created during development when one of the X chromosomes becomes inactivated. An adjoining cell may inactivate the other X chromosome. All subsequent daughter cells will have the same X inactivated resulting in an individual with a variegated phenotypic expression.
- Incomplete dominance and Codominance are two inheritance patterns where the dominant allele does not completely mask the second allele or both alleles are completely expressed.
- Inheritance patterns may include a combination of any of the above. E.g. blood type
- Pleiotropy occurs when a gene affects the expression of multiple genes. Epistasis occurs when one gene masks the expression of another. Most genes are polygenic meaning that they have similar but additive affects on a single character. E.g. Skin color. Polygenic inheritance results in a normal distribution inheritance curve in a population.

Understandings (continued)

- The expression of a gene can also be affected by the environment. E.g. fur color
- The structure and function of DNA and RNA is similar in ALL living things.
- All living things use DNA/RNA to store living information which is passed on to that organism's offspring in a predictable way.
- There is a one way directionality of the passage of this information from parent to offspring and from DNA to protein.
- The presence of a sequence of DNA that codes for a protein does not guarantee that that protein is made.
- There exists many very sophisticated ways that the expression of a gene or the creation of a "functioning" protein is controlled. These include internal and external controls.
- Genes that are only expressed under extreme environmental circumstances may aid in survival.
- Sexual reproduction provides the method of creating the greatest amount of genetic diversity within a species.
- The work of Beadle and Tatum advanced the theory of one gene one protein. Although some genes can make more than one version of a protein most genes make only one.
- The sequence of the bases on a strand of DNA determines what protein is created. Protein synthesis begins at the promoter. The DNA is unwound by helicase, RNA polymerase binds to the DNA creating an mRNA strand called transcription. The mRNA is edited and Introns are removed. This editing process may be altered depending on what version of the protein is needed.
- Bacteria do not have Introns and transcription and translation all take place in the cytoplasm at the same time. This allows protein synthesis in bacteria to occur very rapidly.
- The mRNA moves to cytoplasm where ribosomes do translation. The transcript attaches to the small subunit of the ribosome. Translation is initiated at the start codon AUG. The start codon sets up a frame of reference from which the remainder of the mRNA strand is translated. The bases are read in a series of threes. Each set of three bases translates to a single amino acid. Each combination of three bases translates to one amino acid. This is called the genetic code.
- There are 64 possible combinations but only twenty amino acids. One group of three is the start codon AUG, there are three stop codons, the remaining 60 codons are divided among the remaining 19 amino acids. Many amino acids are represented by more than one codon. The first base and second bases are always the same. For some amino acids the third base doesn't matter. This provides a protective affect against mutation.
- The code is degenerative but it is also universal. Bacteria, plants, fungi, protists and animals use the same genetic code. This universality has allowed for major advances in biotechnology and gives more evidence supporting the evolution of all living things from one common ancestor.
- Retroviruses carry RNA instead of DNA. Once they have infected a host cell they use Reverse transcriptase to created the DNA from the RNA. This DNA becomes past of the cellular DNA and is transcribed and translated by the cell as usual.

Understandings (continued)

- Mutation in the DNA sequence can lead to altered or incomplete proteins being created or even prevent the creation of the protein. The simplest type of mutation is a base substitution where a base pair mutation can lead to the incorporation of an incorrect amino acid called a missense mutation. Many metabolic diseases are caused by missense mutations.
- A base substitution that leads to a stop codon is called a nonsense mutation. The insertion or deletion of a base will cause a frameshift mutation.
- Transposons are sequences of bases that can "jump" into other genes causing inactivation. Transposons may be remnants of old viral sequences from retroviruses.
- Organisms have genes that are turned on only when necessary. This allows the organism to conserve resources and turn on genes only when needed. Some gene may be turned on for only one day or even an hour of an organism's life.
- Gene expression has many places where regulation can be applied. A constitutive gene is one that is expressed constantly. Many constitutive genes create proteins that operate in gene regulation at the transcriptional level.
- Our knowledge of regulation occurs mainly in bacteria where transcriptional level regulation is the primary regulative process. Many bacterial metabolic genes are organized in operons. Each operon contains an operator, promoter and at least one or more genes. Regulation of the expression of the gene occurs at the operator segment. Repressors bind to the operator preventing the attachment of polymerase. If the repressor is not present or inactivated then the coding genes are transcribed. An inducer or activator turns a gene on.
- An inducible gene is normally not transcribed unless the inducer is present and the repressor is inactivated. An activator protein stimulates the transcription of a gene.
- Translational control changes depending on the circumstances and controls how much a gene is transcribed into RNA. Posttranslational controls affect the rate at which the mRNA is edited and translated into proteins. Most regulation is done at the transcriptional level.

Essential Questions	Knowledge & Skill
♦ What makes you, you? ♦ If your DNA were altered would that change who you are? ♦ Why does our DNA carry so many DNA sequences or genes that are not expressed? Why aren't unexpressed sequences lost as the cell differentiates? ♦ Why do we need regulation at both the transcriptional and translational levels?	**Knowledge** ♦ Describe Mendel's work, the significance of his discoveries and his law of inheritance.. ♦ Describe the relationship between phenotype and genotype, dominant and recessive alleles of a gene, and homozygous and heterozygous genotypes. ♦ Explain how the concept of independent assortment during meiosis can lead to the prediction of expected phenotypes and genotypes of the next generation. ♦ Define linkage and how it relates to meiosis. ♦ Explain how incomplete dominance, co-dominance, multiple alleles, pleiotropy, and the environment act to alter phenotypes. ♦ Discuss the genetic determination of sex and

	the inheritance of X-linked genes in mammals. ♦ Explain gene expression and the differences between expression in bacteria and eukaryotes. ♦ Explain some of the ways genes may interact to affect the phenotype; discuss how a single gene can affect many features of the organism simultaneously. ♦ Explain the effect of environment on gene expression. ♦ Explain the significance of the degenerative nature of the DNA code and how the universal nature of the code provide support for evolution from common ancestry and how this universality has lead to major advancements Biotechnology. ♦ Describe positive and negative gene control in bacteria and the differences between transcriptional and translational level regulation. ♦ Describe the work of Beadle and Tatum and its implications in the "one gene-one protein" theory. ♦ Describe the basic types of mutations and their causes. **Skills** ♦ Be able to diagram a mono- or dihybrid genetic cross using upper and lower case letters to symbolize alleles of a gene and the Punnet square to predict possible offspring and the ratios of occurrence. ♦ Solve genetics problems involving incomplete dominance, co-dominance, multiple alleles, epistasis, and polygenes. ♦ Design and/or read a pedigree based on evidence of inheritance of a trait. ♦ Identify abnormality in a Karyotypes. ♦ Create a correct transcript of a sequence of DNA and the sequence of the amino acids coded by that DNA. ♦ Identify if a mutation is a nonsynchronous or synchronous mutation. ♦ Describe examples of genetically inherited disease and explain the etiology of the disease and the symptoms. ♦ Perform a chi square analysis on given or gathered data.

Performance Task Summary	Rubric Titles
♦ Genetics Web Quest and group discussion ♦ Inherited Disease Project ♦ Punnet Square activity ♦ Chi Square Activity ♦ Virtual Lab write up	Inherited Diseases Presentation

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam performance	Quizzes/Tests Presentation and Brochure Punnet Square Worksheets Movie Worksheets Web Quest Virtual Lab Write Up Chi Square practice

(W) Inherited Disease presentation
(H) Punnet Square practice worksheets
(E) Genetics Web quest and discussion
(R) Drosophila Genetics Virtual lab AP Bio Lab # 7
(E) Longevity Genes article and worksheet
(T) Transcription and Translation modeling lab
(O) Linkage Lab
M & M Chi Square Introduction
Movie: Darwin's Dangerous Idea

Web sites:

- What can our chromosomes tell us? http://biology.about.com/science/biology/gi/dynamic/offsite.htm?site=http://gslc.genetics.utah.edu/. This is a site that talks about Karyotyping and what we can understand due to Karyotyping. Newsletter from the Genetics Science Learning Center.
- The National Human Genome Research Institute http://www.nhgri.nih.gov/. This site tells you all about the human genome project.
- Department of Energy - Human Genome Project Information http://www.ornl.gov/hgmis/. This site also gives a lot of information about the human genome project. It also includes some fact sheets on cloning and gene testing.
- A Gene Map of the Human Genome http://www.ncbi.nlm.nih.gov/science96/. Within this site you can see the mapping of several different chromosomes found within the body.
- Learning about the Human Genome Project and Genetics through the World Wide Web http://www.kumc.edu/gec/hgpwww.html. This site includes a section on the ethics issues of genetic research that the genetic counselor may want to look at.
- Understanding Gene Testing

http://www.accessexcellence.org/ae/AE/AEPC/NIH/index.html. This site talks of how genes are linked to disease, how does a faulty gene trigger disease, and much more.

- Basics of DNA Fingerprinting http://protist.biology.washington.edu/fingerprint/elementa.html. This site will give you the basic understanding of DNA fingerprinting.
- What is Genetic Testing? http://www.lbl.gov/Education/ELSI/Frames/genetic-testing-f.html. This site shows the basics of genetic testing and also gets into some of the ethical issues of genetic testing.
- Human Genetics: Human Karyotypes http://biology.about.com/science/biology/gi/dynamic/offsite.htm?site=http://gened.emc.maricopa.edu/bio/bio181/BIOBK/BioBookhumgen.html%0D%0A. This site talks about Karyotypes, chromosomal abnormalities, and allelic disorders.
- http://learn.genetics.utah.edu/units/disorders/karyotype/flash/karyotype_try_it.swf includes an activity that allows the student to create a Karyotypes.

Title: Gene regulation, Biotechnology, Human Genome

Chapters: 13-15

Understandings

- The DNA molecule shows constancy and variation from one species to the next. This provides the molecular foundation for the unity and diversity of life.
- DNA is universal. The DNA in all living things is identical. The processes controlled by DNA are identical in all living things. This universality allows for the manipulation of all living things at the most basic levels.
- The constancy of DNA and the process of protein synthesis (transcription and translation) in all species allows for the manipulation of these processes in a way that potentially benefits or harms all species.
- All life consists of chemicals. Life processes are a series of chemical reactions. An understanding of these chemical reactions allows for control. Control leads to manipulation.
- The manipulation of life processes could lead to a greater good or a greater evil. Only knowledge and an understanding of these processes can determine which is which.
- All organisms have polymorphisms (genetic variation) due to mutation over time. These polymorphisms can be used to identify individuals, relate individuals and track microevolutionary change in populations both past and present.
- DNA sequencing technology is changing many sciences including forensics, paleontology, medicine and agriculture.
- DNA technology is only limited by our understanding of genes, gene regulation, vector sizes, and our own beliefs.
- Ethical dilemmas will only increase over time. There is a tremendous degree of misunderstanding about DNA technology fueled by poor journalism and Hollywood film. What we can do and what we should do must be decided by the public that is affected.
- The Human genome project was only the first step. We now have a basic understanding of the human genome. The next step is proteomics, the study of the proteins created by the genes in the human genome.
- Karyotypes and pedigrees are useful tools in determining inheritance and gene interaction.
- Gene therapy may be a useful tool in eliminating genetically inherited diseases at the molecular level.

Essential Questions	Knowledge & Skill
♦ Is good science only that, that advances the human race? ♦ When should we stop? Is there a line that should not be crossed? ♦ Who should determine what is allowed, the Federal Government, religious and cultural leaders or the	**Knowledge** ♦ Explain recombinant DNA technology and its basic uses. ♦ Explain the role of a vector and how the type of vector used limits the researcher. ♦ Describe the different types of cloning and what each can be used for and the pros and cons

scientist? ♦ Should these rules be world-wide? ♦ Should Americans be allowed to use research that is illegal or deemed unethical in the US but was performed outside the US? ♦ Is there a universal definition for genetic abnormality?	of each along with the objections by groups. ♦ Describe stem cell technology and its uses and issues. ♦ Explain how these technologies are being used to create transgenic organisms for use as bioreactors and to "improve" the characteristics of crops, animals and man. ♦ Describe the process of gene therapy and how it is being used today. ♦ Describe genetic polymorphisms and STRs and LTRs and how they are being used in medicine. ♦ Describe microarray technology and the future of this exciting technology. ♦ Describe bioinformatics and pharmacogenetics and the possible uses for these young sciences. ♦ Describe the technology available today for diagnosing genetic disease or abnormalities and the possible ramifications for genetic selections using IVF technology. **Skills** ♦ Be able to isolate DNA from any living thing. ♦ Describe how restriction enzymes work and be able to map a series of DNA sequences using restriction mapping. ♦ Perform electrophoresis and explain the principles behind this separation technique. ♦ Explain PCR and perform PCR on a sample of DNA they have isolated.

Performance Task Summary	**Rubric Titles**
♦ Chapter Exam ♦ Free Response Questions Write up ♦ Who done it? Letter from lab to Police Chief ♦ Lab Report on PV92 lab ♦ Various Webquests ♦ Opinion papers	Letter rubric Formal lab report rubric.
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Labs and reports Worksheets and internet activities Opinion papers

	Class discussion
(W) AP Bio Lab #6 (Biorad) Restriction digestions and transformation (H) Secret of the Sequence: Spider Goats, Cloning and Parkinson Disease, (E) Movie regarding the Human Genome project: DNA, The Human Race (R) Restriction enzyme Electrophoresis Web quest (Biology Place and DNAI.org) (E) PCR Web quest (DNAI.org) (T) Restriction enzyme paper mapping (O) Electrophoresis of predigested DNA fragments. A who done it exercise. Paper PCR lab DNA sequencing Web quest and paper lab. Isolate DNA from strawberry and from own buccol cells PV92 PCR lab (BioRad) Movie: DNA; Pandora's Box WS Secret of the Sequence: The chosen Child followed by Class Debate on three issues regarding use of embryonic screening to select embryos that are either free of disease or a tissue match to another child Cloning Web quest and Secret of the sequence: Cloning Sam Rhine Field trip and discussion	

Title: Genes and Development

Chapters: 16 and 49

Understandings

- All cells in a multi-celled organism are derived from one single cell. This cell divided through mitosis conserving the DNA in each daughter cell. In time each of these cell became committed to a cell type and began the process of differentiation in which only certain genes of DNA are expressed, differential gene expression, giving rise to cells with differing morphology and function. Regardless of morphology and function, somatic cells demonstrate nuclear equivalence or the same DNA.
- Development includes all the changes an organism goes through throughout its lifespan. .
- Totipotent (Stem cells) cells are undifferentiated cells that are able to direct the development of an entire organism. Pluripotent cells are stem cell that are partially committed to one differentiation pathway. These cells are present in the organism throughout its life.
- Different species follow different pathways of differentiation. In a mosaic development pattern (as in C. elegans) each cell from the beginning have a rigid differentiation pathway. Removal of the founder cell results in abnormal development with missing pieces. In regulative development (as in H. sapiens) cells as self-regulating and migrate within the zygote to ensure normal development. Development is dependent on the position of that cell in relation to other cells. Removal of a cell may not affect development.
- There are three main processes in which differentiation is influenced in a zygote; Maternal effect genes are maternal mRNA in the egg prior to fertilization that establish polarity in the zygote and influence morphogens. Segmentation genes create a repeated pattern of development in the embryo and result in organization of the body plan and body segments. Finally, homeotic genes work to specify the identity of each segment.
- These master development genes influence other genes using transcription factors.
- Two important processes in development are induction and apoptosis.
- Different species develop differently. Conception in sexual reproduction occurs when the sperm penetrates the zona pellucida. Pronuclei are formed and then merge creating one nucleus. ALL organelles including the extranuclear DNA come from the mother.
- The zygote undergoes cleavage to form a small ball of blastomeres and then a hollow ball called the blastula. In humans the blastula undergoes gastrulation where the basic body plans is laid out with three layers of germs cells, ectoderm, endoderm and mesoderm. Each layer develops into different organs during organogenesis.
- Development includes both the creation and growth of new cells and the death of cells. Some organs are formed when certain cells die.
- Human prenatal development takes 266 days. Fertilization takes place in the fallopian tubes and the majority of organogenesis takes place in the first 60 days of life. Human are mammals. The fetus grows in the uterus. Cells from the trophoblastic cells that surround the zygote create a placenta. Nutrients go in and waste is passed out from the child to the mother via the placenta.

Essential Questions	Knowledge & Skill
♦ How does a mutation in a master control gene affect the development of an organism differently than a mutation in a tissue gene? ♦ Which is better mosaic or differential development?	**Knowledge** ♦ Identify and describe the role of the master control genes (toolkit genes) involved in development and differentiation. ♦ Describe the basic sequence of human development. ♦ Know the three germs layer and the tissues that are derived from these layers. ♦ Describe the various types of stem cells and their role in development. ♦ Compare and contract mosaic and differential development and the consequences of each in terms of manipulation. **Skills** ♦ Identify the three germs layers and the tissues that are derived from each. ♦ Sequence the development of a human embryo.

Performance Task Summary	Rubric Titles
Development Web quest Stem cell opinion paper	

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam performance	Quizzes/Tests Coloring worksheets Class discussion

(W) Stem cell summary
(H) Coloring of blastula and gastrulation
(E) Web Quest of human embryonic development
(R) Quiz
(E)
(T)
(O)

Title: Evolution Chance Mutation, time, and selection
Chapters: 17-21

Understandings

- Change is constant. Change can be good. Change can be bad. Only the environment surrounding the change at that moment will decide. Modern species are not necessarily better equipped than their ancestors just different.
- Change provides both challenges and opportunities.
- These changes accumulate over time resulting in the tremendous variation we see within a population and the tremendous species diversity we see in ecosystems.
- Life on earth is thought to have begun as simple, one-celled organisms about 4 billion years ago. During the first 2 billion years, only single-cell microorganisms existed. Approximately 1 Billion years ago, increasingly complex multicellular organisms evolved.
- The major land masses of the Earth were at one time connected (called Panagea) and through continental drift began to split apart. These masses are still moving but at an incredibly slow rate. The topography of the Earth was determined by this process along with climatic changes. Climates and topography together create ecosystems. Topography and climate also change (evolve) over time resulting in the loss of old ecosystems and the creation of new ecosystems.
- DNA Replication is a chemical process that results in a predictable rate of error or change. Changes in the replication of germ cells lead to inheritable changes in the DNA code. These changes are referred to as mutations.
- The genome of an organism includes DNA segments that do not code for a protein or transcription factor. Changes in these non-coding regions of DNA do not change the organism. In addition, the DNA of somatic cells do not impact evolution. Only mutation in germ cells undergoing meiosis impact evolution OR mutations in zygotic cells that occur during differentiation and development impact evolution.
- The genetic code is redundant. Changes in the individual base in a coding region of an organism's DNA may not result in a change in the function of the protein coded for by that DNA.
- The existence of DNA sequences that encode for the same protein sequence or do not destroy the protein function, provide evidence that natural selection acts on genes that are being expressed and works to destroy injurious variations.
- The overall function of the changed protein will determine the affect of the change on the organism.
- Mutations in master control genes particularly those expressed during development (maternal effect genes, segmentation genes and Homeobotic genes) can have extensive effects on the morphology and physiology of an organism.
- The frequency of mutation in a population is determined by the size of the genome, the rate of reproduction and the size of the population.
- In order to pass change onto future generations the changed organism must survive and reproduce.

Understandings (continued)

- Detrimental changes in a population will be removed from the population through natural selection. A mutation that is detrimental in one environment may be beneficial and thus survive in another environment.
- Characteristics that are neither beneficial nor detrimental may or may not over time stay in a population. These characteristics are a source of diversity within that population.
- Natural selection cannot preserve what is not being used and it cannot plan for the future. The fossilization and loss of genes will occur due to mutation. Natural selection works to select only those changes that do not affect an individual's ability to survive and/or reproduce. Over time chance mutations in unused or unnecessary genes accumulate. Changes in essential genes, do not.
- Individuals do not evolve. Populations do.
- Two of the most important selective forces are predation and sexual selection. Many of the bizarre traits and adaptations (camouflage and mimicry) seen in species are due to these forces. Sexual selection may result in individuals that are more vulnerable to predation (peacock's feather or elaborate courtship rituals).
- Organisms are constantly mutating. These mutations are the basis for change. Fossils, comparative anatomy, comparative embryology, biogeography, and molecular biology all provide evidence which substantiates evolution and provides additional detail about the sequence of the various lines of descent.
- Natural selection provides the following mechanism for evolution: Some variation in heritable characteristics exists within every species, some of these characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.
- Heritable characteristics can be observed at molecular and whole-organism levels-in structure, chemistry, or behavior. These characteristics strongly influence what capabilities an organism will have and how it will react, and therefore influence how likely it is to survive and reproduce.
- New heritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.
- Evolution builds on what already exists, so the more variety there is, the more there can be in the future. But evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms (homology).
- Living organisms have the capacity to produce populations of unlimited size, but the environment can support only a limited number of individuals from each species therefore all organisms' niches are constantly being stressed.

Understandings (continued)

- Gene mutations occur at a constant rate but can be increased by such things as radiation and chemicals. Mutations in sex cells can be passed on to offspring; The resulting features may help, harm, or have little or no effect on the offspring's success in its environment. The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions, and a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.
- Changes in an organism's environment includes physical, ecological and chemical changes that stress that organism's established niche within that environment. These changes can lead to extinction or speciation.
- The selective pressures within an environment can have a similar effect on all species living in that environment and can lead to the evolution of similar adaptation (fins or feathers) even in unrelated species. Species occupying similar niches but in different ecosystems may also evolve similar adaptations (long nose and tongue) of animals that eat ants)..
- Microevolutionary forces include genetic drift (bottleneck affect and founder effect), gene flow, nonrandom mating, mutation, and natural selection.
- Macroevolutionary forces include all microevolutionary forces as well as some isolating event that resulted in the isolation of a gene pool which then through chance mutation, natural selection and time, embarked on its own evolutionary pathway resulting in two separate species.
- Adaptive radiation is the process by which populations spread and became isolated by exploiting new ecological niches resulting in species diversity. Most plants have evolved through adaptive radiation.
- Evolution is intrinsically connected with all other biological disciplines.

Essential Questions	Knowledge & Skill
♦ Which is more important to evolution; mutation, time or natural selection? ♦ If natural selection selects for those individuals best adapted to a particular environment, why don't all those living in a particular environment look alike? ♦ When is it OK for a species to become extinct? ♦ How are humans being changed by the process of evolution? How are our actions affecting natural selection and how much influence do we have on our own evolution? ♦	**Knowledge** ♦ Explain the basic idea of biological evolution how the earth's present-day species developed from earlier, distinctly different species. ♦ Explain the role of fundamental life processes, the physical structure and the chemical activities of the cell in evolution. ♦ Explain how diversity and polymorphisms exist within a single species and the source of these differences. ♦ Explain Darwin's theory of Natural Selection and its four tenets. ♦ Describe the evidence used to support evolution. ♦ ♦ Describe the current biological models for the

♦ Which selection process has the most influence on evolution; sexual, environmental, predation and chance?	pressures of change within a population (microevolution), within a species (macroevolution)? ♦ Explain why mutations that do not affect an organism's ability to survive or reproduce do not matter. ♦ Describe how natural selection leads to organisms that are well suited for survival in particular environments and how chance alone can result in the persistence of some heritable characteristics having no survival or reproductive advantage or disadvantage for the organism. ♦ Explain how when an environment changes, the survival value of some inherited characteristics may change. ♦ Why do species become extinct? ♦ Define a species. ♦ Describe Darwin's premises of evolution. ♦ Summarize the evidence for evolution from fossil record, comparative embryology, comparative anatomy, biogeography and molecular biology. ♦ Define examples of vestigial, homologous and analogous structures. ♦ Discuss factors that alter allele equilibrium including: genetic drift, gene flow, mutation, and natural selection. ♦ Explain how sickle cell anemia illustrates heterozygote advantage. ♦ Describe the concept of differential reproduction and the factors including pre-zygotic and post-zygotic that affect reproductive success along with isolating mechanisms. ♦ Identify and give examples of factors that affect speciation and macroevolution including allopatric and sympatric, evolutionary trends, adaptive radiation, and extinction. ♦ Explain the differences between macroevoluation and microevolution. ♦ Discuss the empirical evidences that support evolution. ♦ Explain the difference between micro and

	macroevolution? Determine if and when microevolution leads to macroevolution? ♦ Outline the differences between Pre-zygotic and post-zygotic isolating barriers and the effects of hybrid breakdown. ♦ Compare and contrast two models of evolution, punctuated equilibrium and gradualism. **Skills** • Use the Harvey-Weinberg equation to calculate allele frequency in a population. • Predict the effects of change on allele frequency • Identify and describe the modes of selection based on phenotypic graphs. • Describe Endler's guppy experiment.

Performance Task Summary	**Rubric Titles**
• Exam and Quiz • 2 Summary and reflective articles • AP Bio lab #8 Human population study lab and Hardy-Weinberg problems • Natural Selection lab • Primate Evolution Timeline (to be used with movie)	Lab Write Up

Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Lab reports and analysis Worksheets and timeline Class discussion

(W) Video clips regarding evolution:
Slime to the sublime (141)
Night of the twisted helix (135)
Send in the marines – Help from the oceans (148)
(H) DVD: Walking with Cavemen (100 minutes)
(E) Lecture by Sean Carroll (Howard Hughes Holiday Series)
(R) Articles:
Short articles (read all, summarize and reflect on one)
Piltdown Man is revealed as a fake
Fossilized Footprints
The Leaky Family
Johanson finds 3.2 M-yr-old Lucy

Long articles (read all, summarize and reflect on one)

The adaptive importance of genetic variation

Female choice in mating

The evolution of early land plants.

(E) Human Population lab- Harvey Weinberg analysis of the frequency of various alleles in Carmel student population

(T) Natural selection simulation using beans as alleles

(O) Extinction opinion paper "Should man prevent all species from becoming extinct?"

Title: Classification and Systematics

Chapters 22

Understandings

- Grouping is a natural process which aids understanding based in similarities. Organisms are first grouped in domains, Kingdoms, the phylum, class, order, family, genus, and species. Kingdom is the most inclusive taxon or group and species the most specific.
- There is, however, more than one way to skin an elephant. Classification of an organism by two separate scientists or disciplines may differ due to interpretation and grouping differences.
- The introduction of DNA information into the arena has lead to many changes which will increase over time possibly leading to an entire new system of classification that includes both DNA evidence and development called cladistics whose groups are based on evolutionary ancestry rather than morphology.
- The binomial naming system of genus and species (possibly followed by a subspecies) is still being used.
- Currently there are three domains, two of which house prokaryotes all grouped under one Kingdom per domain and one that contains eukaryotes grouped in four Kingdoms.
- The kingdoms are archaebacteria, eubacteria, protista, fungi, animalia and plantae.
- Cladograms are replacing family trees as a means to describing related organisms. The cladogram include nodes which represent evolutionary steps or changes.
- During evolution the same morphologic feature e.g. fins, can evolve independently in organisms without a recent common ancestor. Therefore having fins doesn't mean that these two organisms belong in the same group.
- Phylogenic taxa include homologous structures, shared characteristics and DNA data.
- Scientists are beginning to look at LINES and SINES which are shared sequences of non-coding DNA that is not under selective pressures. The more LINES or SINES in common the more recent the common ancestor.

Essential Questions	Knowledge & Skill
♦ Will classification ever be finished?	**Knowledge** ♦ Explain why classification is so difficult to do using morphology? ♦ How has the inclusion of evolution and now the inclusion of DNA in classification changed our ability to understand organisms? ♦ Explain the degree of kinship between organisms or species can be estimated from the similarity of their DNA sequences, which often closely matches their classification based on anatomical similarities. ♦ Describe the similarities among organisms that are found in internal anatomical features, which

	can be used to infer the degree of relatedness among organisms. In classifying organisms, how do biologists consider details of internal and external structures to be more important than behavior or general appearance? ♦ What is the role of evolution in the classification of organisms. ♦ Can we classify without including evolution? ♦ How does a classification system that focuses on morphology differ from one that includes DNA? **Skills** ♦ Be able to construct and read a taxonomic key. ♦ Be able to construct and read a cladogram. ♦ Identify homologous or shared derived characteristics.

Performance Task Summary	**Rubric Titles**
♦ Create and read a cladogram ♦ Using a taxonomic key activity	

Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quiz Worksheets Class discussion

(W) Quiz
(H) Macaque cladogram web quest
(E) fish taxomic key

Title: AP Bio Viruses, Bacteria, Protista, Fungi

Chapters: 23-25

Understandings

- Viruses are non living structures that contain nucleic acids (RNA or DNA) that are surrounded by a protein coat that can only reproduce by invading a host cell.
- Viruses have two reproductive cycles: lytic cycle in which the virus destroys the host as it replicates. And the lysogenic cycle n which the viral DNA integrates in the host nuclear DNA and is replicated along with the cell's DNA during mitosis. All subsequent daughter cells are also infected.
- Prions and Viroids are other non living pathogenic particles. Viroids are hardy pieces of condensed RNA that do not have a protein coat. Prions are protein particles that when altered cause disease.
- There are two domains for bacteria, Archaeabacteria and Eubacteria. Both encompass very small single celled living things.
- Eubacteria have three common shapes: cocci (spherical), spirillum(flexible rod) and bacilli (rod shaped). The DNA of bacteria is circular and there is no nucleus or membrane bound organelles. Most have a cell wall consisting of peptidoglycans. Gram positive bacteria have a thick wall of peptidoglycan whereas gram negative bacteria have a thin peptidoglycan layer along with a thick carbolipid layer. Many have flagella and plasmids. Most reproduce by binary fission.
- DNA can be moved from one bacteria to another using transformation, transduction and/or conjugation.
- Bacteria obtain their food in many different ways and metabolize this food under many conditions. There are bacteria on and in every surface of the earth and it organisms.
- Archaeabacteria live in extreme conditions and do have peptidoglycan in their cell walls.
- All prokaryotes serve important functions in the biosphere and can be useful in biotechnology. Some, however, are pathogenic and cause disease. Most antibiotic work by disrupting the cell wall or inhibit fission.
- Nitrogen fixing bacteria (rhizobium) help plants to assimilate atmospheric nitrogen by converting it to ammonia.
- Protists are single celled and multi celled organisms with membrane bound organelles. They display numerous features, obtain their food in a variety of different ways and include an extraordinary number of types. Protists include zooflagelleates, ciliates, water molds, diatoms, plankton, algae, slime molds and amoebas. Many are pathogenic but most are essential for life on this planet and serve as primary producers in ecosystems and make the majority of oxygen on this planet.
- Fungi are heterotrophs serving as decomposers in most ecosystems. All have a cell wall containing chitin and extremely varied reproductive cycles with alteration of generations similar to that of plants.
- Fungi exist in important symbiotic relationships with phototrophic algae (lichen) and with plants as mycorrhizae.

Essential Questions	Knowledge & Skill
♦ Which is more important to the Earth, bacteria, fungi or protist? ♦ Should we change the definition of life to include viruses?	♦ What is a pathogen and how pathogens are transmitted. ♦ Explain the difference between the lytic and lysogenic cycle and the challenges of treating individuals with infection from viruses in each life cycle. ♦ Explain why a virus is considered nonliving. structure and function of a virus as nonliving ♦ Describe the structure and shapes of bacteria and identify each on a slide. Explain the difference between gram positive and gram negative bacteria. ♦ Outline the structures and processes that give microorganisms an advantage and why we will long be dead if they will never die out. ♦ How do features of microorganisms allow them a survival advantage? ♦ Explain the differences between a unicellular protist and a bacterium. ♦ Explain the special characteristics of fungi and protista and what determines which kingdom the species is put into. ♦ Discuss at least three symbiotic relationships involving bacteria, protists and fungi. **Skills….** ♦ If given a picture or a microscope slide along with lifestyle information students should be able to identify what the organism is and in what kingdom it belongs. ♦ Identify a coccus from a bacillus from a spirillum and determine with staining if it is gram positive or negative. ♦ Identify the basic types of protists and fungi

Performance Task Summary	Rubric Titles
♦ Virus Computer project ♦ Observation lab-bacteria & protists	Lab report

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam	Quiz

(W): Virus Identification computer project
(H): Transmission lab and Observation Lab and sketches of Bacteria

(E): Movie: Rx for Survival

Animal Kingdom and Organization: Are you a protostome or deuterostome?

Chapters: 28-30

Understandings

- Animals are multi-celled heterotrophs with specialized tissues that reproduce sexually, are able to move at some point in their lifetime, whose zygote begins development by undergoing gastrulation forming a blastula which contain the germ tissues from which the various tissues differentiate.
- Animals evolved in shallow marine environments during the Cambrian period. Fossil evidence shows the introduction of a diverse number of body plans evolving during a period called the Cambrian explosion. Molecular evidence indicates animals with diverse body plans evolved much earlier but may not have left fossil evidence.
- Tissue development enables the development of complex organisms. Like plants the larger and more complex organisms required vascular systems to move fluids and nutrients.
- The habitats colonized by animals led to the development of many adaptations needed to maintain homeostasis, safety and food. Movement to fresh water required osregulation and diet changes, movement to dry land required tissues to prevent dessication, wider temperature changes (especially if they live in Chicago) and more sophisticated reproductive strategies.
- There are three basic types of body plans: asymmetrical, radial symmetry and bilateral symmetry and three body types of body cavities: acoelomate, pseudocoelamate and coelomate. Similar body cavities and body types indicate a common evolutionary pathway. Organisms with bilateral symmetry also experienced a trend toward cephalization.
- Coelomates have true body cavities that are lined with mesoderm tissue. Coelomates are divided into two groups called deuterosomes and protosomes. In deuterosomes the blastopore becomes the anus and in protosomes, it becomes the mouth. Most protosomes show mosaic differentiation and determinate cleavage. Deuterosomes show regulative differentiation and indeterminate cleavage.
- The five main animal clades. Each clade differs in the areas of symmetry, level of organization (tissues), digestion, segmentation, pattern of development and circulation.
- The clades are: parazoa which includes sponges or Porifera; radiata including cnidarians (jellyfish) and ctenophores (comb jellies); Protosomes including Platyhelminthes (flatworms), Mollusca (clams, snails, squids), annelids (earthworms, leeches and marine worms), rotifer (wheel animals) and lophotrochozoan. A second group of protosomes include nematode (roundworms) and arthropods (insects, crustaceans, arachnids). Deutersomes include echinodermata (seastars, sea urchins), hemichordate, and chordate (vertebrates, lancets, tunicates).
- Important evolutionary adaptations in protosomes include circulatory system (either open or closed), segments with numerous types of appendages (including jointed appendages), exoskeleton, book lungs and malpighian tubules.
- Important evolutionary adaptations in deuterosomes include amniotic egg, bones and cranium, internal skeleton, skin and lungs, mammary gland and the placenta.

Essential Questions	Knowledge & Skill
♦ What does the term "higher life" form really mean and is something that has evolved more adaptations better?	♦ Explain the general characteristics of the animal kingdom and the current thinking on the origin of animals. ♦ Identify and explain the adaptations that presented major evolutionary milestones in the development of animals. ♦ Explain the key characteristics of each clade and give representative animals from each. **Skills…..** ♦ Name and identify common examples of selected phyla ♦ Distinguish between radial and bilateral symmetry ♦ Compare vertebrate classes on the basis of main characteristics.

Performance Task Summary	Rubric Titles
♦ Identification and organization lab ♦ Exam ♦ Creation of a clade table with characteristics.	

Self-Assessments	Other Evidence, Summarized
Student self-assessment of exam performance	Quizzes/Tests Worksheets Class discussion

(W): Clade table
(H): Identification and organization lab
(E): Exam
(R): Movie: Shape of Life
(E): Class discussion
(T)
(O)

PLANTS-Evolution, growth, and reproduction

Chapters: 26-27 and 31-36

Essential Understandings

- Plants are multi-cellular autotrophs capable of capturing radiant energy and converting it into chemical energy.
- Plants are the base of all food chains.
- Plants evolved from green water algae. Important adaptations have allowed plants to colonize dry land which led to the evolution of four major groups of plants separated by the presence or absence of each adaptation.
- Plants evolved through mutation,(including polyploidy) and natural selection then spread through adaptive radiation. Important adaptations include waxy cuticle, sexual reproduction, tissues, vascular system, and seeds. Vascular plants that reproduce using seeds are the highest evolved plants.
- Plants life cycle includes an alteration of generation in which part of the life cycle includes a haploid gametophyte generation which produces gametes through mitosis that fuse and create a diploid sporophyte generation protected by the gametophyte which through meiosis produces the new gametophyte generation.
- Adaptations for dry land include a waxy cuticle to prevent water loss. Plants with the cuticle adaptation include bryophytes (mosses and liverwort). Bryophytes, however, still required water for reproduction and could not become very large.
- The next adaptation included xylem to conduct water and dissolved minerals and phloem to conduct dissolved sugar. These plants were able to grow large but still required water for reproduction. These included ferns, club mosses, horsetails and whisk ferns.
- Seeds were the next adaptation. Gymnosperms created seeds that did not have a covering originating from the ovary wall. Gymnosperms include conifers, ginkgoes, cyads and gnetophytes. These plant produce seeds in cones. Pollen is spread through wind.
- Angiosperms are the last group that includes cuticles, a vascular system, and seeds. Angiosperms produce a flower that includes its reproductive organs. Pollen is spread by wind, animals and insects. The main purpose of the flower is to attract animals and insects to help in dispersing pollen. The seeds are created in the ovary of the flower after fertilization. The ovary wall becomes the fruit. The purpose of the fruit to is aid in seed dispersal.
- Angiosperms have an unusual form of fertilization called double fertilization. In double fertilization two sperm enter the ovary; one fuses with the ovule and the other fuses with two haploid polar nuclei to become the endosperm, a nutrient rich tissue that supports the embryo. In dry climates or during droughts, seeds can last in a dormant state for years.
- Angiosperms and insects have co-evolved to form a complicated symbiotic relationship.
- Plants are either herbaceous or woody. Vascular plants have three basic types of tissues: ground, vascular and dermal. The tissues comprise the roots, stem system, reproductive structures and leaves.
- Growth occurs at the meristems. Primary growth from the apical meristem increases stem and root length and secondary growth at the lateral meristem increases girth.

Understandings continued

- Xylem tissues conduct water and minerals and is composed of tracheids and vessel elements.
- Phloem conducts sugar and is composed of sieve tube elements assisted by companion cells.
- Water is pulled through the plants through transpiration or evaporation at the leaves. Stomata permit gas exchange and allow for the passage of water out of the uppermost portion of the plant. Stomata open when it is wet and close when it is dry.
- In order to save energy in seasonal climates or during droughts, plants will lose their leaves, abscission, and remain dormant. Plants living in nutrient poor soil have evolved modified structures that allow them to digest insects as well as perform photosynthesis. Plants living in wet areas or in water have pneumatophores that assist in oxygen exchange.
- Mycorrhizae are symbiotic relationships between plants and fungi and plants and bacteria that allow plants to obtain nutrients and the nitrogen they need to grow.
- Flowering plants are also capable of asexual reproduction involving rhizomes, bulbs, tubers, and modified stems.
- The circadian rhythms of plants are dependent on the length of the day and temperature.
- Seeds need water or imbibition to germinate. Most germinate during the spring when water is plentiful and the length of the day is increasing.
- Certain parts of plants exhibit indeterminate growth. Flowers and leaves exhibit determinate growth.
- All plants exhibit tropisms including gravitropism, heliotropisms, phototropism and Thigmotropism.
- Important plant hormones such as auxins, gibberellins, ethylenes and Cytokinins affect growth, fruit ripening, differentiation and development.

Essential Questions	Knowledge & Skill
♦ Can plants survive without animals? Can animals survive without plants? ♦ Which is the most important adaptation by plants for their survival and continued growth.	♦ Explain the system used to classify plants highlighting the important adaptations. ♦ Explain the benefits of polyploidy ♦ Describe the basics of alteration of generations ♦ Explain the basics of the plant's vascular tissue ♦ Explain the importance of the seed. ♦ Compare gymnosperms and angiosperms; ♦ Compare vascular and non-vascular plants; ♦ Describe the key advantages of seeds and flowers and their dependence on insects. ♦ Describe plants many symbiotic relationships and the role of plants in the carbon, oxygen, water and nitrogen cycles. ♦ Explain how plants grow and how the roots, stems and leaves contribute to a plant's survival? ♦ Explain the various ways a plant can reproduce

	itself and the advantages and/or disadvantages of each. ♦ Explain tropism and the various types of tropisms plants exhibit along with each tropism's advantage. ♦ Describe the main plant hormones and their effects. **Skills . . .** ♦ Identify parts of the flower ♦ Recognize the structures that help prevent water loss ♦ Explain function of xylem and phloem ♦ Distinguish between vascular, ground and dermal tissues.

Performance Task Summary	**Rubric Titles**
♦ Self study unit worksheets ♦ Seed Lab Analysis: observation of seed germination and impact toxicity has on growth ♦ Plant Evolution Project. Diagram and interpret evolution of the major plant adaptations. ♦ AP Bio lab # 9 -Transpiration lab	Formal lab write up
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets

(W): Self study unit packet
(H): Plant part coloring and identification
(E): Flower dissection and tissue observation lab
(R): AP bio lab # transpiration
(E): Movie: "Sexual Encounters of the Floral Kind"
(T) evolution and adaptation table
(O) Take home Exam

Title: The Animal Body and Physiology

Chapters 37-47

Understandings

- The evolution of single celled to multi celled organization was followed by the evolution of tissues. Tissues allow an organization to achieve a higher level of efficiency due to specialization. In addition, adaptations in cell signaling and communication allowed for all cells to create and maintain an internal environment separate from the external environment.
- Tissues are made of cells working together for a common function. Almost all tissues of the body share the same DNA. The genes that are being expresses determine the morphology and physiology of the tissue.
- Tissues provide the body multiple levels of organization. Each level is dependent on one or more of the other levels. All tissues function to maintain homeostasis in response to internal and external change.
- Each animal's body operates to maintain itself within established "tolerance" levels. Should the animal's physiology move outside these tolerance levels multiple processes are activated in multiple tissues to return the animal back to "normal". The body has multiple responses to change. Should the primary response fail to return the body to homeostasis then a secondary response is activated or a third and so on until homeostasis is returned. Failure to return to homeostasis result in illness and eventually death.

♦ Tissues associate to create organs, organs associate to create organ systems. Classification of tissues depends on their origin and function.

♦ Tissues are comprised of multiple type of cells. Each cell has a role within the tissue and is formed to fulfill that role.

♦ The primary purpose of the muscular system is movement, protection and support. Muscle is elastic connective tissue. There are three types of muscle cardiac, smooth and skeletal. Muscle is also a reservoir of sugar.

♦ The primary purpose of the skeletal system is support and protection. The skeletal system includes bone and cartilage along with connective tissue. The bones of the skeletal system are in a constant state of flux or remodeling. Osteocytes are at the center of concentric layers of haversian canals. Two other important types of osteocytes are osteoclasts, which dissolve old or injured bone and osteoblasts, which make new bone. Bone is also a reservoir of calcium and phosphate.

♦ The Integumentary system is important for maintaining temperature, sensory functions, respiratory functions and protection. There are numerous types of specialized epithelial cells that reflect the integumentary system's many functions.

Understandings Continued

- The neural system is divided into two smaller systems, the central nervous system and the peripheral nervous system. The primary role of the nervous system is to collect and transmit information. Each system is regulated differently. The brain is the focus of the central nervous system and includes the parasympathetic and sympathetic systems. The brain requires an extreme amount of energy. It is organized to promote maximum efficiency. Drugs interfere with the function of the brain.
- There are six kinds of sensory receptors whose primary function is to collect information and send it to the brain so the organism is able to respond to changes in either it external or internal environment or both. Receptors include sensory receptors, mechanoreceptors, chemoreceptors, thermoreceptors, photoreceptors and electroreceptors.
- The circulatory system is used to transport nutrients, oxygen, etc. throughout the organism. The circulatory system also serves as the body cell's communication super highway.
- The immune system operates to defend the body against pathogens and other harmful agents. There are several levels of response that are either rapid or require several days. Each level attempts to eradicate the infection. Each level is activated in turn only if needed. The immune system is capable of storing information regarding its successes such that the response time decreases with each infection. This memory is the primary component of vaccines.
- For multi-cellular living things oxygen is needed for energy. The respiratory system provides a moist, expensive environment for gas exchange via diffusion. Carbon dioxide is eliminated and oxygen is taken in. Different organisms have different ways of exchanging gases. The respiratory system is integrally tied with the circulatory system which transports the oxygen to the body tissues and the carbon dioxide waste back to the lungs.
- All organisms need energy. Heterotrophs must eat other living thing in order to obtain this energy thus the need for a digestive system. The structure of an organism's digestive system is dependent on the organism's diet and habitat. Digestion is a step wise process that is also tied with the circulatory system for transport.
- Regulating water is a primary concern for all animals regardless if they live on land or in the water. Differing animals have differing structures for waste removal. The excretory system is also tied with the circulatory system for transport.
- The surplus of specialized tissues requires regulation. The endocrine system is responsible for maintaining this regulation by cell signaling and cell communication. The ability of cells to react, develop and act appropriately is dependent on the cell receiving the correct information at the correct time. The endocrine system is also tied with the circulatory system for the transport of chemical signals and information.
- In order to be an evolutionary success an organism must reproduce. Different organisms have differing strategies depending on their niche, physical structure and behavior.
- Animals exhibit both innate and learned behaviors. These behaviors are dependent of the animal's physiology and stage of development and have evolved to increase an organism's chance of survival.

Essential Questions	Knowledge & Skill
♦ How are the structure and function of tissues, organs and organ systems interdependent both within and amongst the various levels of organization? ♦ What is the most important influence in the environment on tissue design and function? ♦	**Knowledge** ♦ Describe the structure and function of the tissues, organs and organ systems that make up the human body and how their structure and function are interdependent, both within and amongst the various levels of organization. ♦ Describe the adaptations other animals have in the structure and function of their tissues that allow for success in extreme environments. ♦ Name the important function, structures and cells of the skeletal system. ♦ Name the important function, structures and cells of the muscular system. ♦ Name the important function, structures and cells of the digestive system. ♦ Name the important function, structures and cells of the circulatory system. ♦ Name the important function, structures and cells of the respiratory system. ♦ Name the important function, structures and cells of the excretory system. ♦ Name the important function, structures and cells of the nervous system. ♦ Name the important function, structures and cells of the endocrine system ♦ Identify and describe the ways in which the tissues, organs and organ systems are interdependent and the systems used to regulate each and react to changes in both the external and internal environments. ♦ Explain the physiological effects of various drugs. ♦ Explain common systems of regulating water, energy, temperature, general health, and infection. ♦ Explain how the body responds to infection and common disease states. **Skills** ♦ Identify different tissues based on morphology and explain their function. ♦ Identify various structures and pathways on given diagrams. ♦ Diagram the response of the body to infection.

Performance Task Summary	Rubric Titles
♦ AP Bio lab # 10 ♦ Fetal Pig Dissection Lab ♦ Heart dissection lab ♦ Case analysis write up	Formal Lab rubric Case study
Self-Assessments	**Other Evidence, Summarized**
Student self-assessment of exam performance	Quizzes/Tests Lab reports Worksheets Outline Test

- (W): Distribute essential questions and unit outlines.
- (H): AP Bio lab #10 Physiology of the circulatory system
- (E): Coloring Workbook
- (R): Movie: Body Story Videos; discuss lab results; review for test
- (E): Test; review/discuss test results
- (T): Case Study Lab