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| **Biology Core** | **Take Away** | **Honors Curriculum** |
| **STANDARD I: Students will understand that living organisms interact with one another and their environment.** | | |
| **Objective 1:** Summarize how energy flows through an ecosystem. | | |
| a. Arrange components of a food chain according to energy flow. | 1. Energy flows through a food chain from the Sun🡪producers 🡪 1st level consumer 🡪 2nd level consumer 🡪 3rd level consumer. |  |
| b. Compare the quantity of energy in the steps of an energy pyramid. | 1. 10% of the available energy passes to the next level of the energy pyramid. |  |
| c. Describe strategies used by organisms to balance the energy expended to obtain food to the energy  gained from the food (e.g., migration to areas of seasonal abundance, switching type of prey based  upon availability, hibernation or dormancy). | 1. Organisms conserve energy by various behaviors. 2. Migration 3. Hibernation 4. Cold blooded vs. Warm blooded 5. Behaviors are used to maintain homeostasis. 6. Shivering, sweating 7. Warming on rocks, sitting in the shade |  |
| d. Compare the relative energy output expended by an organism in obtaining food to the energy gained  from the food (e.g., hummingbird - energy expended hovering at a flower compared to the amount of  energy gained from the nectar, coyote - chasing mice to the energy gained from catching one, energy  expended in migration of birds to a location with seasonal abundance compared to energy gained by  staying in a cold climate with limited food). | 1. Organisms must expend less energy to obtain food than the energy gained by that food. |  |
| e. Research food production in various parts of the world (e.g., industrialized societies’ greater use of  fossil fuel in food production, human health related to food product). | 1. All food production has an ecological cost. |  |
| **Objective 2:** Explain relationships between matter cycles and organisms. | | |
| a. Use diagrams to trace the movement of matter through a cycle (i.e., carbon, oxygen, nitrogen, water)  in a variety of biological communities and ecosystems. | 1. Atmospheric CO2 🡪Autotrophs 🡪 Consumers 🡪 Decomposers 🡪 Released back into atmosphere 2. Autotrophs release O2 🡪Consumers/Decomposers 🡪 Released as H2O 🡪Autotrophs 3. Evaporation/Transpiration 🡪 Condensation 🡪 Precipitation 🡪 Evaporation 4. Nitrogen in soil & atmosphere 🡪 Autotrophs (proteins) 🡪 Consumers/Decomposers 🡪 Release into atmosphere & soil |  |
| b. Explain how water is a limiting factor in various ecosystems. | 1. All living organisms require water. |  |
| c. Distinguish between inference and evidence in a newspaper, magazine, journal, or Internet article  that addresses an issue related to human impact on cycles of matter in an ecosystem and determine  the bias in the article. | 1. Evidence is measurable and eliminates bias. |  |
| d. Evaluate the impact of personal choices in relation to the cycling of matter within an ecosystem  (e.g., impact of automobiles on the carbon cycle, impact on landfills of processed and packaged  foods). | 1. Ecological footprint: release of greenhouse gases, driven by personal choices. |  |
| **Objective 3:** Describe how interactions among organisms and their environment help shape ecosystems. | | |
| a. Categorize relationships among living things according to predator-prey, competition, and  symbiosis. | 1. Symbiotic Relationships 2. Mutualism: Both organisms benefit 3. Commensalism: One organism benefits, the other is not affected 4. Parasitism: One organism benefits, the other is harmed 5. Predator-prey: predator depends on prey as a food source, prey depends on Predator for population control. 6. Competition leads to natural selection. |  |
| b. Formulate and test a hypothesis specific to the effect of changing one variable upon another in a small ecosystem. | 1. State a hypothesis 2. Identify independent variables (components you can manipulate) 3. Identify dependent variables (components that change because of that manipulation) |  |
| c. Use data to interpret interactions among biotic and abiotic factors (e.g., pH, temperature,  precipitation, populations, diversity) within an ecosystem. |  |  |
| d. Investigate an ecosystem using methods of science to gather quantitative and qualitative data that  describe the ecosystem in detail. | 1. Quantitative Data: Components that can be measured and expressed in numbers. 2. Qualitative Data: Components that can be interpreted differently, non-numerical. |  |
| e. Research and evaluate local and global practices that affect ecosystems. | 1. Deforestation, Endangered Species Act, Global Warming, Habitat Destruction, Greenhouse Effect, Habitat Protection Acts |  |
| **STANDARD II: Students will understand that all organisms are composed of one or more cells that are made of molecules, come from preexisting cells, and perform life functions.** | | |
| **Objective 1:** Describe the fundamental chemistry of living cells. | | |
| a. List the major chemical elements in cells (i.e., carbon, hydrogen, nitrogen, oxygen, phosphorous,  sulfur, trace elements). | 1. C, H, N, O, P, S, are the major elements found in living things. | 1. Basic bonding behavior (ionic, covalent, hydrogen) and their relative strengths |
| b. Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic  acids). | 1. Macromolecules 2. Carbohydrates provide energy 3. Proteins (enzymes) build/repair tissue, make reactions happen 4. Lipids provide energy and protection/insulation 5. Nucleic acids carry instructions for life | 1. Four levels of protein structure    1. Shape determines function    2. Hydrogen bonding   **Recognize** basic structure of the macromolecules and their monomers |
| c. Explain how the properties of water (e.g., cohesion, adhesion, heat capacity, solvent properties)  contribute to maintenance of cells and living organisms. | 1. The polarity of water allows for unique properties that are necessary for life. 2. Water forms hydrogen bonds 3. Properties   Adhesion/cohesion – capillary action  Water is universal solvent  High heat capacity | 1. Emphasize polarity and hydrogen bonds. A solid understanding of the properties of water is essential to prepare for upper level courses. (See suggested labs in Biology Class Rubric). 2. pH scale (Possible applications: water, enzyme function, and acid rain) |
| d. Explain the role of enzymes in cell chemistry. | 1. Enzymes are proteins 2. Enzymes can change the rate of biological reactions. | 1. Induced fit model 2. Competitive/noncompetitive inhibitors 3. Effects of changes in pH, temperature, and salt on enzyme function 4. Calculating rates    1. From lab data collected or provided |
| **Objective 2:** Describe the flow of energy and matter in cellular function. | | |
| a. Distinguish between autotrophic and heterotrophic cells. | 1. Autotrophic cells make their own food from the sun’s energy. 2. Heterotrophic depend on another organisms for food. |  |
| b. Illustrate the cycling of matter and the flow of energy through photosynthesis (e.g., by using  light energy to combine CO2 and H2O to produce oxygen and sugars) and respiration (e.g., by  releasing energy from sugar and O2 to produce CO2 and H2O). | 1. CO2 + H20 O2 + C6H12O6 2. Light intensity increases photosynthesis 3. All organisms respire for the breaking down food of food for energy. | 1. Light Independent/Light Dependent Reaction    1. Where they occur    2. Reactants and products    3. Chemiosmosis 2. Cellular Respiration    1. Where the reactions occur    2. Reactants and products    3. Chemiosmosis 3. Analyze relationship between photosynthesis and aerobic respiration and their roles in the carbon cycle   \*Note (Relate differences in processes between prokaryotes and eukaryotes) |
| c. Measure the production of one or more of the products of either photosynthesis or respiration. | 1. Photosynthesis Lab: pick a variable. Example: floating disc lab   [http://t3.gstatic.com/images?q=tbn:ANd9GcRfcgFMNFPWIZFqv9e6qVuhzWOjIPDxjSTSN4gcljRNCT25yoFo](http://www.google.com/imgres?q=rate+of+photosynthesis+and+temperature&hl=en&safe=active&biw=1024&bih=559&tbm=isch&tbnid=y-t_uRVEzHVsYM:&imgrefurl=http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/plants/plants2.shtml&docid=LkTwv-amTwl2VM&imgurl=http://www.bbc.co.uk/schools/gcsebitesize/science/images/photosyn_3.gif&w=226&h=210&ei=JugsUdrrM4mw2QXysYHwBg&zoom=1&iact=hc&vpx=231&vpy=139&dur=2032&hovh=168&hovw=180&tx=55&ty=51&sig=105536514344175928068&page=1&tbnh=141&tbnw=167&start=0&ndsp=16&ved=1t:429,r:1,s:0,i:83)[http://t0.gstatic.com/images?q=tbn:ANd9GcSaL5hb8wAk8tw0sF63Mm3xp92sc4VlyRGmHFRpsqG6jdEatcAa6w](http://www.google.com/imgres?q=rate+of+photosynthesis+and+light+intensity&hl=en&safe=active&biw=1024&bih=559&tbm=isch&tbnid=MINU9GZL4QbiOM:&imgrefurl=http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_21c/life_processes/plantfoodrev5.shtml&docid=jX3JzmdXd6FVRM&imgurl=http://www.bbc.co.uk/schools/gcsebitesize/science/images/photosyn_1.gif&w=226&h=210&ei=e-csUZm8IeWU2QWv8IGQBg&zoom=1&iact=hc&vpx=157&vpy=135&dur=2047&hovh=168&hovw=180&tx=84&ty=90&sig=105536514344175928068&page=1&tbnh=134&tbnw=145&start=0&ndsp=16&ved=1t:429,r:1,s:0,i:86) |  |
| **Objective 3:** Investigate the structure and function of cells and cell parts. | | |
| a. Explain how cells divide from existing cells. | 1. Cell cycle: Interphase, Prophase, Metaphase, Anaphase, Telophase, Cytokinsesis | 1. Understand the cell cycle in its entirety. Mitosis is only part of the cell cycle.   \*Note (Relate differences in processes between prokaryotes and eukaryotes) |
| b. Describe cell theory and relate the nature of science to the development of cell theory (e.g., built  upon previous knowledge, use of increasingly more sophisticated technology). | 1. Contributions to the Cell Theory: Leeuwenhoek, Hooke, Schleiden, Schwann, Pasteur. 2. The cell theory: 3. All cells come from pre-existing cells 4. Cells are the basic unit of life   All organisms consist of at least one cell |  |
| c. Describe how the transport of materials in and out of cells enables cells to maintain homeostasis  (i.e., osmosis, diffusion, active transport). | 1. Osmosis regulates water balance in the cell by moving water from a high concentration to a low concentration. 2. Diffusion regulates molecules like sugar/salt/waste balance in the cell by moving from areas of high concentration to an area of low concentration. 3. Active transport regulates balance by using energy (ATP) and moving molecules from a low concentration to a high concentration. | 1. Osmosis Lab    1. Water potential |
| d. Describe the relationship between the organelles in a cell and the functions of that cell. | 1. Prokaryotic cells do not have membrane organelles. Eukaryotic cells have membrane bound organelles. 2. Plant Cells contain a cell wall, a chloroplast, large storage vacuole. Animal cells do not have these three things. 3. Organelles    1. nucleus : contains DNA which control cell activity    2. mitochondria: provides energy (ATP) for the cell    3. ribosomes: site of protein production    4. lysosomes: break down waste and non-functioning cell parts    5. endoplasmic reticulum: part of protein production    6. golgi body: modification of proteins    7. vacuoles: site of storage | 1. Compare and contrast of prokaryotic and eukaryotic cells beyond membrane bound organelles. Relate applicable differences throughout all units ie cell division, energy utilization, sexual reproduction etc. |
| e. Experiment with microorganisms and/or plants to investigate growth and reproduction. |  |  |
| **STANDARD III: Students will understand the relationship between structure and function of**  **organs and organ systems.** | | |
| **o** | | |
| a. Diagram and label the structure of the primary components of representative organs in plants and  animals (e.g., heart - muscle tissue, valves and chambers; lung - trachea, bronchial, alveoli; leaf -  veins, stomata; stem - xylem, phloem, cambium; root - tip, elongation, hairs; skin - layers, sweat  glands, oil glands, hair follicles; ovaries - ova, follicles, corpus luteum). | Structure and function of organs is always related. Here are some examples of organ structure and function:   1. The heart is an involuntary muscle that depends on valves and chambers to push blood through the heart and to the body. 2. Lungs depend on trachea, bronchii and alveoli to receive oxygen from the atmosphere and exchange it with carbon dioxide leaving the body. 3. Plants depend on the vascular tissue xylem to move water throughout and phloem to move sugars throughout. 4. Roots have hairs on the to increase surface area which increases nutrient absorption. |  |
| b. Describe the function of various organs (e.g. heart, lungs, skin, leaf, stem, root, ovary). | Examles of organ function:   1. Skin is the body’s number one defense organ. It protects, is water repellant. 2. Kidneys filter and remove waste from the blood. 3. The heart pumps oxygen rich blood to the body and returns oxygen poor blood to the lungs 4. Leaves go through photosynthesis. 5. Roots anchor a plant and are responsible for nutrient absorption 6. Stems are used for support and transport |  |
| c. Relate the structure of organs to the function of organs. | Examples of organ structure:   1. Surface area increases the sites for reactions to take place in an organ. 2. Examples of organs with increased surface area include: alveoli, intestines, brain, etc) |  |
| d. Compare the structure and function of organs in one organism to the structure and function of  organs in another organism. | 1. An organism’s efficiency level is based on its environment.   Example 1:   * Fish have gills to help with gas exchange and a 2 chambered heart. * As organisms (amphibians) moved to land more energy was required for gas exchange. Lungs developed as well as a 3 chambered heart. Gas exchange may also happen through skin. * A four chambered heart developed to make animals even more efficient with gas exchange and keeping oxygenated blood separate from deoxygenated blood.   Example 2:   * The digestive began as a “bag” model in cnidarians. The mouth and anus are the same opening. * It evolved into a “tube” system. The mouth at one end and the anus at the other in all other organisms. * Insects and birds have a crop and gizzard to help break things down. * Ungulates have multi chambered stomachs to help break down the cellulose. * Others have one stomach with multiple organs that aid in digestion (pancreas, small intestine, large intestine). |  |
| e. Research and report on technological developments related to organs. | 1. Stem cells, cloning organs. |  |
| Objective 2: Describe the relationship between structure and function of organ systems in plants and   1. Gas exchange is necessary in organisms. The way it takes place is different. 2. Animals depend on the lungs for gas exchange. Gas exchange between tissues in organisms is dependent upon capillaries. 3. Fish depend on gills for gas exchange. 4. Plants depend on stomata opening and closing for gas exchange. | | |
| a. Relate the function of an organ to the function of an organ system. | 1. Organ systems are made up of individual organs all working toward the primary function of the system.   Examples:   * The circulatory system depends on the heart, the veins, the arteries, the capillaries * The digestive system depends on the mouth, esophagus, stomach, intestines, pancreas to absorb nutrients and get rid of wastes | 1. Digestive, respiratory, circulatory system focus on how animals obtain and use energy.    1. Trace a glucose molecule and oxygen molecule from entrance to exit including: transport, transfer and processing of energy. |
| b. Describe the structure and function of various organ systems (i.e., digestion, respiration, circulation,  protection and support, nervous) and how these systems contribute to homeostasisof the organism. | 1. Homeostasis is balance with all systems in an organism.   Examples of Homeostasis:   * Digestion maintains balance by absorbing nutrients and getting rid of wastes. * Respiration maintains balance by exchanging carbon dioxide and oxygen * Circulatory system maintains balance by taking nutrients to organs and taking wastes away. * The muscular system allows for movement. * The nervous system interprets stimuli and provides a response | 1. Endocrine system    1. Examples of negative feedback loops       1. Insulin and glucagon 2. Difference between positive and negative feedback |
| c. Examine the relationships of organ systems within an organism (e.g., respiration to circulation,  leaves to roots) and describe the relationship of structure to function in the relationship. | 1. Systems within organisms do not work independently of each other. They work together. 2. The respiratory system is responsible for gas exchange and the circulatory system is responsible for the transport of these gases. 3. Leaves are the location of gas exchange and photosynthesis in plants. The sugars that are made in photosynthesis are stored in the roots. | 1. Transpiration 2. Relate to the properties of water and environmental factors that influence transpiration.    1. See suggested labs 3. Adaptations that make plants successful in different environments for example leaf shape, cuticles, leaf reduction etc. |
| d. Relate the tissues that make up organs to the structure and function of the organ. | 1. Organelles – Cells – Tissues – Organs – Organ systems – Organism. 2. Cells become specialized early on in development so they can fulfill their specific functions.    1. Nerve cells are designed to carry impulses (dendrites, axons)    2. Bone cells provide support and make new cells    3. Muscles cells are designed for movement. |  |
| e. Compare the structure and function of organ systems in one organism to the structure and function  in another organism (e.g., chicken to sheep digestive system; fern to peach reproductive system). | 1. Respiratory – gills, lungs, – similar functions 2. Digestion – crop, rumen, gizzard, stomach 3. Reproduction - Spores (fern) and seeds (plants) – ovary vs ovule | 1. Compare the structure and functions of two or three systems in five different animal phyla. For example circulatory, digestive, and respiratory systems of Cnidaria, Echinodermata, Mollusca, Arthropoda, and Chordata. |
| **STANDARD IV: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.** | | |
| **Objective 1:**  Compare sexual and asexual reproduction. | | |
| a. Explain the significance of meiosis and fertilization in genetic variation. | 1. Meiosis produces four haploid cells that are genetically different. 2. Variation is a product of crossing over and random assortment. 3. Random fertilization creates variation | 1. Use models to simulate the behavior of chromosomes during the phases of meiosis. |
| b. Compare the advantages/disadvantages of sexual and asexual reproduction to survival of species. | 1. Sexual reproduction produces genetic diversity that may lead to evolutionary advantages. 2. Asexual reproduction produces clones and larger number of offspring in shorter period of time. 3. Sexual reproduction requires a mate, invested energy, unused gametes 4. Disadvantages to asexual reproduction would be a small gene pool, less able to adapt to changing environments. | \*Note (Relate differences in processes between prokaryotes and eukaryotes) |
| c. Formulate, defend, and support a perspective of a bioethical issue related to intentional or unintentional chromosomal mutations. | 1. Pros and Cons of the following: Stem Cells, Cloning, genetic engineering |  |
| **Objective 2:**  Predict and interpret patterns of inheritance in sexually reproducing organisms. | | |
| a. Explain Mendel’s laws of segregation and independent assortment and their role in genetic  inheritance. | 1. Segregation is the separation of alleles during meiosis. 2. Independent assortment is that genes are different chromosomes may be inherited independently of each other.   Both laws increase genetic diversity |  |
| b. Demonstrate possible results of recombination in sexually reproducing organisms using one or two pairs of contrasting traits in the following crosses: dominance/recessive, incomplete dominance,  codominance, and sex-linked traits. | 1. Offspring inherit one allele from each parent. 2. Dominant/Recessive: recessive alleles are expressed only in the absence of the dominant allele. 3. Incomplete dominance: Phenotype is the blend of the two alleles 4. Co-dominance: Both alleles are expressed 5. Sex-linked: alleles are located on the sex chromosomes. 6. Ratios and punnett squares. 7. Pedigree Chart   http://home.earthlink.net/~dayvdanls/GenProbs/Pedigree1.GIF | 1. Determine Expected outcomes by using monohybrid and dihybrid crosses    1. Application of the multiplication rule 2. Mathematical application    1. Introduce Chi2 (See Virtual Fly Lab) |
| c. Relate Mendelian principles to modern-day practice of plant and animal breeding. | 1. We have the ability to choose desirable traits in plants and animals. |  |
| d. Analyze bioethical issues and consider the role of science in determining public policy. | 1. Stem Cells, Cloning, GMO’s (genetically modified organisms) |  |
| **Objective 3:** Explain how the structure and replication of DNA are essential to heredity and protein synthesis. | | |
| a. Use a model to describe the structure of DNA. | 1. Nucleotides make up DNA. 2. Nucleotides are made up of a sugar, a phosphate and a nitrogen base. 3. DNA is a double helix. | 1. Anti-parallel structure of DNA 2. RNA structure |
| b. Explain the importance of DNA replication in cell reproduction | 1. DNA replication ensures that a copy of DNA is passed on to the offspring | 1. Semiconservative 2. Leading/Lagging strand    1. Okazawki fragments 3. Builds 5’to 3’ 4. Major enzymes    1. DNA polymerase    2. Ligase    3. Helicase    4. Primase |
| c. Summarize how genetic information encoded in DNA provides instructions for assembling protein  molecules. | 1. Transcription 2. mRNA is a copy of the DNA made in the nucleus 3. Translation is in the cytoplasm 4. mRNA is translated to proteins using tRNA at the ribosomes 5. Codon is three nitrogen bases of mRNA. Anti-codon is three tRNA nitrogen bases, which is a complement to mRNA. 6. Codons code for amino acids. Amino acids link together to make polypeptide chains which become proteins. | \*\*Essential prior knowledge for success in an upper level course. Emphasize the stages of the process and the roles of the different RNA molecules. |
| d. Describe how mutations may affect genetic expression and cite examples of mutagens. | 1. A mutation is a change in the DNA sequence which alters the function of the protein. 2. Mutations typically harm the organism, but may benefit or have no effect on the organism. 3. Types of mutations include:   Gene Mutations  Point/substitution mutation: single base change  Deletion/Addition:  Inversions  Frameshift | 1. Provide examples for application of mutation for example sickle cell anemia, cystic fibrosis, Tay-Sachs etc. |
| e. Relate the historical events that lead to our present understanding of DNA to the cumulative nature  of science knowledge and technology. | 1. Hershey/Chase: DNA is the genetic material 2. Chargaff: Base pairing (adenine-thymine, cytosine-guanine)   Watson/Crick/Franklin: the structure of DNA – a double helix | 1. Use examples for interpretation of data    1. Hershey/Chase and Chargaff |
| f. Research, report, and debate genetic technologies that may improve the quality of life (e.g., genetic  engineering, cloning, gene splicing). | 1. DNA fingerprinting 2. Fragment size 3. Comparing individual DNA samples   Genetic engineering: possible examples insulin, food | 1. Lab Gel Electrophoresis (virtual if equipment is not available)    1. Use a standard graph of known sample to determine the size of an unknown fragments in base pairs. |
| **STANDARD V: Students will understand that biological diversity is a result of evolutionary processes.** | | |
| **Objective 1:** Relate principles of evolution to biological diversity. | | |
| a. Describe the effects of environmental factors on natural selection. | 1. Natural Selection is based on factors in the organisms environment. 2. The environment selects for or against certain traits. 3. An organisms with good traits for an environment will live longer and reproduce more frequently. | 1. Identify and explain the three different types of natural selection    1. Stabilizing    2. Directional    3. Disruptive |
| b. Relate genetic variability to a species’ potential for adaptation to a changing environment. | 1. The more variation within the gene pool for a given species the more likely the population is to survive changing environmental conditions. 2. Populations evolve – Not Individuals! | 1. Hardy-Weinberg conditions and predictions   Be able to calculate allele frequencies over multiple generations (See activity options) |
| c. Relate reproductive isolation to speciation. | 1. A portion of a population may become isolated from the rest of the population for a number of reasons (physical barriers, different traits). 2. If this happens these populations that were once the same evolve differently leading to speciation. | 1. Genetic Drift 2. Founder Effect/Bottleneck |
| d. Compare selective breeding to natural selection and relate the differences to agricultural practices. | 1. Natural Selection is when the environment selects the best traits for a population. 2. Selective breeding is when humans select the traits for the population. 3. This is often done in agriculture to produce foods that are bigger or sweeter or more resistant to insects or any number of other things. |  |
| **Objective 2**: Cite evidence for changes in populations over time and use concepts of evolution to explain these changes. | | |
| a. Cite evidence that supports biological evolution over time (e.g., geologic and fossil records,  chemical mechanisms, DNA structural similarities, homologous and vestigial structures). | There are multiple pieces of evidence supporting evolution. They include:   1. Fossils - Best evidence for evolution of life – There are different types (ie casts, amber, imprint, bones). Fossils are preserved remains of organisms no longer living. It is incomplete as not all organisms have been fossilized. We can determine the age of fossils by the following mechanisms 2. Relative dating - Fossils in deeper rock layers are older than those found closer to the surface. This idea makes the assumption that in the past, layers of sediment were deposited on top of each other the same as it is today. But this does not give exact dates 3. Radiometric Dating - is more accurate than relative dating. Scientists use the half life of an element to determine the age of fossils. 4. Molecular Evidence:   All organisms contain the same bases (adenine, thymine, guanine, cytosine). They also use the same amino acids. The more similar the individual DNA sequences the more similar the organism.   1. Similarities in DNA sequences provide evidence that present species developed from earlier species. The genetic code is found same in all living organism. For example - AUG codes for methionine in all living things. 2. Comparative anatomy 3. Vestigial structures – Structure that has little or no function (ie wings in flightless birds, pelvic bones in snakes and whales, appendix, wisdom teeth) 4. Homologous structures – Similar in structure but different function infer common ancestor. This is divergent evolution      1. Analagous structures – Similar function but different structure (ie wings in an insect vs bird) This is a type of convergent evolution 2. Comparative Embryology – Vertebrate embryos at certain stages exhibit similar structures suggesting shared ancestor. (ie gill slits and tales) |  |
| b. Identify the role of mutation and recombination in evolution. | 1. Mutation is a change in DNA sequence that changes a trait. Then, natural selection determines whether the trait will be selected for or against. 2. Recombination provides variation which natural selection can determine whether it will be selected for. |  |
| c. Relate the nature of science to the historical development of the theory of evolution. | 1. Darwin built upon the ideas of others like Wallace, Lamark as he developed the theory of evolution by the mechanism of natural selection. 2. The theory of evolution is continually expanding as we learn more about organisms. |  |
| d. Distinguish between observations and inferences in making interpretations related to evolution  (e.g., observed similarities and differences in the beaks of Galapagos finches leads to the inference  that they evolved from a common ancestor; observed similarities and differences in the structures of  birds and reptiles leads to the inference that birds evolved from reptiles). | 1. Darwin observed the beaks of finches on the Galapagos islands and inferred that the birds once had a common ancestor but had adapted and evolved to their environment. (ie Difference in beak shapes and sizes evolved to meet their changing niches - Bigger beaks – crack bigger nuts). The finches on the Galapagos island are all finches. They evolved to fill different niches in the environment to reduce completion and increase survival. 2. The comparison of birds to reptiles leads to similarities of some anatomical structures, leading to make a connection that there may be a common ancestor. 3. Observation of fossil evidence leads scientists to infer that birds evolved from reptiles (ie archaeopteryx). |  |
| e. Review a scientific article and identify the research methods used to gather evidence that  documents the evolution of a species. | 1. Researchers collect data in a variety of methods. Qualitative vs quantitative. (ie Laboratory techniques, controlled experiments, computer modeling, nature observations and gathering fossils) |  |
| Objective 3: Classify organisms into a hierarchy of groups based on similarities that reflect their evolutionary relationships. | | |
| a. Classify organisms using a classification tool such as a key or field guide. | Example of a dichotymous key  Key to Common Evergreens  1a. Leaves linear, needle-like or scale like…………………………………………….2  1b. Leaves broad, not needle-like nor scale-like…………………………………………….5  2a. Leaves needle-like………….……………..3  2b. Leaves scale-like……………….Red Cedar  3a. Leaves in groups of 2 or 3………………..4  3b. Leaves in groups of 5…..Eastern White Pine  4a. Leaves in groups of 2………...Virginia Pine  4b. Leaves in groups of 3………..Loblolly Pine  5a. Leaf margin smooth……..……….Magnolia  http://www.dcnr.state.pa.us/forestry/commontr/Images/Virginia.gif5b. Leaf margin spiny……...….American Holly |  |
| b. Generalize criteria used for classification of organisms (e.g., dichotomy, structure, broad to  specific). | 1. Broad to specific 2. Domain, kingdom, phylum , class, order, family, genus, species 3. Binomial nomenclature is a two word naming system that consists of the genus and the species that consists of both words being italicized or underlined and the first letter of the genus being capitalized. *Homo sapien* or Homo sapien. |  |
| c. Explain how evolutionary relationships are related to classification systems. | 1. Organisms are grouped based on their evolutionary relationships.   The more they have in common the more closely they are related.   1. Molecular Evidence helps to classify organisms. The more the DNA sequence the two organisms have in common the more closely related they are. | 1. Use phylogeny to analyze the evolutionary history of organisms. 2. Analyze data and construct a cladogram (See activity options) |
| d. Justify the ongoing changes to classification schemes used in biology. | We are continually learning more about organsims and their make up. The more we learn the more accurately we can classify them. | 1. Be able to revise a cladogram or evolutionary tree based on new information. |