**What I Need to Know for the NC Biology EOC**

**CELLS**

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| **Standard** | **# Questions** | **Sample Questions** |
| **Summarize the structure and function of organelles in eukaryotic cells (including the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and ways that these organelles interact with each other to perform the function of the cell**.   * Identify these cell organelles in diagrams of plant and animal cells. * Explain how the structure of the organelle determines it function. (Example: folded inner membrane in mitochondria increases surface area for energy production during aerobic cellular respiration). * Summarize how these organelles interact to carry out functions such as energy production and use, transport of molecules, disposal of waste, and synthesis of new molecules. (Example: DNA codes for proteins which are assembled by the ribosomes and used as enzymes for energy production at the mitochondria). | 2 | (1) A runner is competing in a 10km track meet and just before completing the race, the runner is nearly out of breath and the energy needed to finish the race. Which cell structure is most affected by this lack of energy?  a. nucleus  b. ribosome  c. mitochondria  d. plasma membrane  (2) Some unicellular organisms are motile (have the ability to move) and some are nonmotile. Which cellular structures are associated with movement?  a. chloroplasts  b. ribosomes  c. vacuoles  d. flagella  (3) When an animal eats, food stays in the stomach for a period of time. When a unicellular organism, such as  *Paramecium*, takes in food, the food is contained in which organelle?  a. chloroplast  b. mitochondrion  c. vacuole  d. nucleus  (4) What is the correct movement of protein from its manufacture to its exportation from the cell?  a. nucleus 🡪 chloroplast 🡪 vesicle 🡪 lysosome  b. ribosome 🡪 endoplasmic reticulum 🡪 plasma membrane 🡪 nucleus  c. ribosome 🡪 endoplasmic reticulum 🡪 Golgi 🡪 vesicle 🡪 plasma membrane  d. chloroplast 🡪 Golgi 🡪 cytoplasm 🡪 plasma membrane 🡪 ER |
| **Compare prokaryotic and eukaryotic cells in terms of their general structures (plasma membrane and genetic material) and degree of complexity.**   * Proficiently use proper light microscopic techniques as well as determine total power magnification. The purpose is to use microscopes to observe a variety of cells with particular emphasis on the differences between prokaryotic and eukaryotic as well as plant and animal cells. While students are not expected to understand how scanning and electron transmission microscopes work, they should recognize that they reveal greater detail about eukaryotic and prokaryotic cell differences. * Infer that prokaryotic cells are less complex than eukaryotic cells * Compare the structure of prokaryotic and eukaryotic cells to conclude the following: ▪ Presence of membrane bound organelles – mitochondria, nucleus, vacuole, and chloroplasts are not present in prokaryotes.   ▪ Ribosomes are found in both.  ▪ DNA and RNA are present in both, but are not enclosed by a membrane in prokaryotes.  ▪ Contrasts in chromosome structure – circular DNA strands called plasmids are characteristic of prokaryotes.  ▪ Contrasts in size – prokaryotic cells are smaller. | 2 | (5) Which of the following organelles is present in both prokaryotes and eukaryotes?  a. nucleus  b. ribosome  c. endoplasmic reticulum  d. Golgi body  (6) Which of the cells characterized in the chart below is a prokaryote?    a. Cell A  b. Cell B  c. Cell C  d. Cell D  (7)  What is the total magnification used to view these onion cells through this microscope setup?  a. 50x  b. 40x  c. 30x  d. 400x  (8) When viewing a prepared slide under the compound microscope, a student has to remove his glasses. This means he will need to readjust for fine focus with which part labeled?  EOCbio0306.gif  a. 1 c. 3  b. 2 d. 4 |
| **Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms.**   * Compare a variety of specialized cells and understand how the functions of these cells vary. (Possible examples could include nerve cells, muscle cells, blood cells, and sperm cells.) * Explain that multicellular organisms begin as undifferentiated masses of cells and that variation in DNA expression and gene activity determines the differentiation of cells and ultimately their specialization.   ▪ During the process of differentiation, only specific parts of the DNA are activated; the parts of the DNA that are activated determine the function and specialized structure of a cell.  ▪ Because all cells contain the same DNA, all cells initially have the potential to become any type of cell; however, once a cell differentiates, the process cannot be reversed.  ▪ Nearly all of the cells of a multicellular organism have exactly the same chromosomes and DNA.  ▪ Different parts of the genetic instructions are used in different types of cells, influenced by the cell's environment and past history.   * Recall that chemical signals may be released by one cell to influence the development and activity of another cell. * Identify stem cells as unspecialized cells that continually reproduce themselves and have, under appropriate conditions, the ability to differentiate into one or more types of specialized cells.   ▪ Embryonic cells which have not yet differentiated into various cell types are called embryonic stem cells.  ▪ Stem cells found in organisms, for instance in bone marrow, are called adult stem cells.  ▪ Scientists have recently demonstrated that stem cells, both embryonic and adult, with the right laboratory culture conditions, differentiate into specialized cells. | 3 | (9) Myosin is plentiful in muscle cells, but is not found at all in lens cells of the eye. Lens cells contain large amounts of crystallins, which are not found in muscle cells. Why do some proteins appear in one type of cell but not in another?  a. During differentiation, certain genes are added to cells to produce proteins that enable specific functions.  b. During differentiation, certain genes are activated to produce proteins that enable specific functions.  c. Differentiated cells produce all proteins but destroy the proteins they do not use.  d. Myosin cells never undergo differentiation.  (10) Research has shown that specialization of stem cells into specific cell types results, in part, from cell shape. What provides a specialized cell with its shape?  a. number of mitochondria  b. presence of a nucleus  c. structure of the cytoskeleton  d. salt concentration of the cytoplasm  (11) Which molecule is primarily responsible for the differentiation of cells?  a. DNA  b. monosaccharides  c. glycerol  d. fatty acids  (12) Which ***best*** describes cell specialization in humans?  a. Each cell contains a complete copy of the organism’s DNA, and all of the DNA is used for cell specialization.  b. Each cell contains a specific set of DNA, which uses four different types of amino acids for cell specialization.  c. Each cell contains a complete copy of the organism’s DNA, and a specific set of DNA is activated for cell specialization.  d. Each cell contains a specific set of DNA, which provides instructions for rearranging genes needed for cell specialization.  (13) Which***best*** describes cell differentiation?  a. occurs only in mammalian cells  b. more specialized cells become a less specialized cell type  c. occurs once during the development of a multicellular organism  d. cells specialized in function lead to specialized tissues and organs  (14) What causes DNA instructions to make a muscle cell instead of a nerve cell?  a. The muscle cell and nerve cell inherit different DNA sequences.  b. Transcription of different genes leads to the synthesis of different proteins in the two cell types.  c. The chromosomal DNA is rearranged and mutated so that the cell can become a muscle cell instead of a nerve cell.  d. The muscle cell has more mitochondria than the nerve cell.  (15) Nerve cells and bone cells are specialized cells that descend from the same single cell (fertilized egg or zygote). Which statement best explains how each type of cell results in a different structure with a specialized function?  a. Nerve cells and bone cells begin with the same structure; however, bone cells harden over time.  b. Nerve cells and bone cells receive different DNA that determines the structure and function that each will perform.  c. Nerve cells and bone cells receive the same DNA; however, only specific parts of the DNA are activated in each cell.  d. Nerve cells and bone cells receive the same DNA; however, bone cells receive more to make the protective outer covering. |
| **Explain how homeostasis is maintained in a cell and within an organism in various environments (including temperature and pH).**   * Explain how cells use buffers to regulate cell pH and how cells can respond to maintain temperature, glucose levels, and water balance in organisms. * Compare the mechanisms of active vs. passive transport (diffusion and osmosis). * Conclude how the plasma membrane structure functions. * Explain changes in osmotic pressure that occurs when cells are placed in solutions of differing concentrations. | 2 | (16) Josh and Jamie were studying the rate of diffusion. They prepared four cubes of agar that were equal in size and volume. Then they cut each cube into smaller cubes that were also equal in size and volume. The table shows into how many pieces each original cube was cut.  **Experimental Design**   |  |  | | --- | --- | | **Original Cube** | **Number of Small Cubes Produced** | | W | 0 left uncut | | X | 8 | | Y | 27 | | Z | 64 |   The cubes were then placed into beakers containing the same type and volume of chemical solution for observation.  Based on the table, which original cube would now have the greatest diffusion rate when placed into the chemical solution?  a. W  b. X  c. Y  d. Z  (17) Which process moves an ion across a cell membrane against the concentration gradient?  a. passive diffusion  b. osmosis  c. facilitated transport  d. active transport  (18) A student used a microscope to observe *Elodea* submerged in a solution. The student observed the cell cytoplasm pull away from the cell wall and clump together in the center of the cell.  https://homebase.schoolnet.com/files/assess_files/5447a7bc-e1ad-46e2-b582-cb540b255d1a/image/150769.jpg  Which statement BEST explains why this occurred?  a. The cell was submerged in a pure water solution.  b. The cell was submerged in a hypotonic solution.  c. The cell was submerged in an isotonic solution.  d. The cell was submerged in a hypertonic solution.  (19) The diagram below shows a container divided into two compartments by a membrane permeable  to water but not to starch. Two solutions containing different concentrations of dissolved starch were placed on each side of the membrane.  Which of the following describes what will happen to the water level during the process of osmosis?  a. The water level on both sides of the membrane will decrease.  b. The water level on the right side of the membrane will increase.  c. The water level on the left side of the membrane will increase.  d. The water level on both sides of the membrane will stay the same. |
| **Analyze how cells grow and reproduce in terms of interphase, mitosis and cytokinesis.**   * Outline the cell cycle – Growth1, Synthesis, Growth2, Mitosis, and Cytokinesis. * Recognize mitosis as a part of asexual reproduction. * Organize diagrams of mitotic phases and describe what is occurring throughout the process. | 3 | (20) A student observes a typical onion root tip where many of the cells have just successfully completed mitosis. Which statement *best* explains what must have happened to result in cells that only have half as many chromosomes as all of the other cells in the same section of the tip?  a. The parent cell completed mitosis after undergoing interphase.  b. The parent cell completed mitosis after undergoing cytokinesis.  c. The parent cell completed mitosis before undergoing cytokinesis.  d. The parent cell completed mitosis before undergoing interphase.  (21) Cell cycle checkpoints are proteins that monitor and regulate the progress of the cell cycle in eukaryotic cells. Which statement best describes what would *most likely* happen if a cell is permitted to progress to mitosis without the preparation stage of interphase?  a. The new cells would have all of the organelles except the nucleus.  b. The new cells would have all of the organelles except the mitochondria.  c. The number of chromosomes in the daughter cells would be the same as the number of chromosomes in the parent cell.  d. The number of chromosomes in the daughter cells would be different from the number of chromosomes in the parent cell.  (22)  Which phase of mitosis would be seen next?  a.  b.  c.  d.  (23) A bone cell of a goat contains 60 chromosomes. How many chromosomes will be in each daughter cell after mitosis?  a. 60  b. 30  c. 120  d. 90 |
| **Explain how specific cell adaptations help cells survive in particular environments (focus on unicellular organisms).**   * Explain how various structures of unicellular organisms help that organism survive. Emphasis is on contractile vacuoles, cilia, flagella, pseudopods, and eyespots. * Summarize adaptive behaviors – examples include chemotaxis and phototaxis. | 1 | (24) A single-celled organism is placed in fresh water. The contractile vacuole pumps excess water out of the cell. How does this action help the organism to survive?  a. It helps the organism maintain a stable internal environment.  b. It helps the organism communicate with other cells.  c. It helps the organism reproduce.  d. It helps the organism convert energy.  (25) A euglena is a unicellular organism that undergoes photosynthesis in chloroplasts. There is a photosensitive organelle called the eyespot near the anterior (front) end of the organism to aid in keeping the organism near the sun. This movement toward the sun is an example of what type of animal behavior?  a. territoriality  b. courtship  c. taxis  d. trial and error learning |

**GENETICS**

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| **Standard** | **# Questions** | **Sample Questions** |
| **Explain the double-stranded, complementary nature of DNA as related to its function in the cell.**   * Develop a cause-and-effect model relating the structure of DNA to the functions of replication and protein synthesis:   ▪ The structure of DNA is a double helix or “twisted ladder” structure. The sides are composed of alternating phosphate-sugar groups and “rungs of the DNA ladder” are composed of complementary nitrogenous base pairs (always adenine, A, to thymine, T, and cytosine, C, to guanine, G) joined by weak hydrogen bonds.  ▪ The sequence of nucleotides in DNA codes for proteins, which is central key to cell function and life.  ▪ Replication occurs during the S phase of the cell cycle and allows daughter cells to have an exact copy of parental DNA.  ▪ Cells respond to their environments by producing different types and amounts of protein.  ▪ With few exceptions, all cells of an organism have the same DNA but differ based on the expression of genes.  • Infer the advantages (injury repair) and disadvantages (cancer) of the overproduction, underproduction or production of proteins at the incorrect times. | 3 | (26) If a strand of DNA is CTGCAT, what is the sequence of nucleotides in the complementary strand?  a. GACGTA  b. CTGCAT  c. AGTACG  d. GACGUA  (27) Four different nucleotides are used as building blocks of DNA. Which of the following can be used to distinguish one nucleotide from another?  a. The nitrogenous base  b. The shape of the deoxyribose sugar  c. The length of the phosphate groups  d. The type of fatty acid  (28) Each strand of a DNA molecule contains nitrogenous bases that pair with other nitrogenous bases in very specific ways. A diagram of a section of DNA is shown.    What is the complementary DNA strand?  a.  b.  c.  d.  (29) The model represents the change in the DNA content of a cell during the cell cycle.    What part of the model represents the S phase of interphase?  a. I  b. II  c. III  d. IV |
| **Explain how DNA and RNA code for proteins and determine traits.**  Explain the process of protein synthesis:  ▪ Transcription that produces an RNA copy of DNA  ▪ mRNA traveling to the ribosome (rRNA)  ▪ Translation – tRNA supplies appropriate amino acids  ▪ Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains form protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemicals involved in cell chemistry).  • Interpret a codon chart to determine the amino acid sequence produced by a particular sequence of bases.  • Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism. | 2 | (30) In the early 1900s a scientist hypothesized a link between DNA and the production of proteins in the cytoplasm. However, the fact that DNA could not be found outside the nucleus led scientists to believe that another substance was also involved in the synthesis of protein in the cytoplasm. In the 1940s scientists performed an experiment that ultimately identified the site of protein synthesis. They also identified the molecule responsible for transporting information from the nucleus to the site of protein synthesis. What was this newly identified molecule?  a. A gene  b. mRNA  c. ATP  d. Thymine  (31) The initial steps in gene expression are modeled below. Double-stranded DNA first unwinds into two strands.    Which process and product are represented in Diagram 2?  a. Process: transcription; product: mRNA  b. Process: translation; product: protein  c. Process: replication; product: tRNA  d. Process: recombination; product: polymerase  (32) This chart represents amino acids that are coded from different combinations of mRNA codons.    Which amino acid sequence can be coded from the DNA sequence CAG TAG CGA?  a. valine – isoleucine – glycine  b. valine – aspartic acid – alanine  c. valine – isoleucine – alanine  d. valine – phenylalanine – alanine |
| **Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype.**  Understand that mutations are changes in DNA coding and can be deletions, additions, or substitutions. Mutations can be random and spontaneous or caused by radiation and/or chemical exposure.  • Develop a cause and effect model in order to describe how mutations change amino acid sequence, protein function, and phenotype. Only mutations in sex cells (egg and sperm) or in the gamete produced from the primary sex cells can result in heritable changes. | 1 | (33) Which of the following changes in DNA is likely to have the greatest effect on the resulting peptide?  a. in a strand of DNA, one C is changed to a T  b. a G is inserted at the beginning of a gene  c. a G is inserted at the end of a gene  d. in a strand of DNA, one T is changed to a C  (34) Which disease most likely occurs after excessive exposure to ultraviolet radiation?  a. malaria  b. asthma  c. skin cancer  d. polio  (35) Cells typically respond to DNA damage in three ways: by ceasing to grow and divide until the damage is repaired, by permanently ceasing to grow and divide, or by dying. In 2010 a group of scientists reported that a certain kind of immune reaction can cause DNA damage that leads to a fourth response. DNA damage can turn off genes involved in cell-signaling pathways. Turning off these genes can cause less-mature cells to divide too rapidly, often leading to the development of  a. tumors  b. allergies  c. hemophilia  d. cardiovascular disease  (36) Cells pass through a checkpoint before entering mitosis. Ideally, if DNA damage is detected, the cells do not enter mitosis until the damage is repaired. Why is DNA damage repaired before cells enter mitosis?  a. So that another round of DNA synthesis does not have to take place  b. So that the chromosomes can align at the metaphase plate during mitosis  c. So that the cytoplasm can be divided equally between the two daughter cells  d. So that healthy daughter cells are produced, allowing the organism to continue growing |
| **Explain the role of meiosis in sexual reproduction and genetic variation**   * Recall the process of meiosis and identify process occurring in diagrams of stages. (middle school review) Note: Students are not expected to memorize the names of the steps or the order of the step names.   • Infer the importance of the genes being on separate chromosomes as it relates to meiosis.  • Explain how the process of meiosis leads to independent assortment and ultimately to greater genetic diversity.  • Exemplify sources of genetic variation in sexually reproducing organisms including crossing over, random assortment of chromosomes, gene mutation, nondisjunction, and fertilization.  • Compare meiosis and mitosis including type of reproduction (asexual or sexual), replication and separation of DNA and cellular material, changes in chromosome number, number of cell divisions, and number of cells produced in a complete cycle. | 2 | (37) Why is the process of meiosis important to sexual reproduction?  a. It provides genetic variation in offspring.  b. It doubles the number of chromosomes in offspring.  c. It reduces the number of alleles from parent to offspring.  d. It produces a hybrid of all genetic traits in offspring.  (38) Human body cells each have 46 chromosomes in their nuclei. Meiosis is necessary in order to ensure that each gamete produced in the human body has  a. 12 chromosomes  b. 23 chromosomes  c. 46 chromosomes  d. 92 chromosomes  (39) Sexual reproduction in animals depends on the production of gametes. Which of these processes produces gametes in animals?  a. mitosis  b. fertilization  c. meiosis  d. binary fission  (40) Which process listed occurs in meiosis to increase genetic variability, but does NOT occur in mitosis?  a. crossing over  b. chromosomes line up on the metaphase plate  c. spindle fibers condense to pull apart sister chromatids  d. the cell pinches in or forms a cell plate |
| **Predict offspring ratios based on a variety of inheritance patterns (including dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).**   * Interpret Punnett squares (monohybrid only) to determine genotypic and phenotypic ratios. Understand that dominant alleles mask recessive alleles.   • Determine parental genotypes based on offspring ratios.  • Interpret karyotypes (gender, and chromosomal abnormalities).  • Recognize a variety of intermediate patterns of inheritance (codominance and incomplete dominance).  • Recognize that some traits are controlled by more than one pair of genes and that this pattern of inheritance is identified by the presence of a wide range of phenotypes (skin, hair, and eye color).  • Interpret autosomal inheritance patterns: sickle cell anemia including the relationship to malaria, cystic fibrosis (recessive heredity), and Huntington’s disease (dominant heredity).  • Solve and interpret codominant crosses involving multiple alleles including blood typing problems. (Blood Types: A, B, AB and O and Alleles: IA , IB , and i). Students should be able to determine if parentage is possible based on blood types.  • Understand human sex chromosomes and interpret crosses involving sex-linked traits (color-blindness and hemophilia). Students should understand why males are more likely to express a sex-linked trait.  • Interpret phenotype pedigrees to identify the genotypes of individuals and the type of inheritance. | 3 | (41) A parent with type A blood and a parent with type O blood have a child. Which of the following is a possible genotype of their offspring  a. IAIA  b. IAIB  c. IBi  d. ii  (42) What conclusion can be made from the karyotype shown?  Image result for karyotype biology eoc  a. the person is a male, as noted by the presence of an X and Y chromosome  b. the person has Down’s Syndrome as characterized by the presence of 2 chromosome pair # 2  c. the person has hemophilia, as evidenced by the presence of a Y chromosome  c. the person has Huntington’s, as seen by the absence of a third chromosome at pair # 6  (43) Tomato plants usually have hairy stems. Hairless stems are present in tomato plants that are homozygous recessive for this trait. If the stem characteristics are determined by a single gene, what is the expected outcome of crossing two tomato plants that are heterozygous for hairy stems?  a. 75% hairy stems : 25% hairless stems  b. 100% hairy stems  c. 100% hairless stems  d. 50% hairy stems : 50% hairless stems  (44) What type of trait is shown on the pedigree below?    a. sex-linked dominant  b. sex-linked recessive  c. autosomal dominant  d. autosomal recessive  (45) A calico cat is heterozygous for fur color and has both orange and black fur. This type of inheritance is  a. complete dominance  b. incomplete dominance  c. codominance  d. complete recessiveness |
| **Explain how the environment can influence the expression of genetic traits.**  Develop a cause-and-effect relationship between environmental factors and expression of a particular genetic trait. All traits depend both on genetic and environmental factors. Heredity and environment interact to produce their effects. This means that the way genes are expressed depends on the environment in which they act. | 4 | (46) Why do identical twins become less alike as they get older?  a. Because the environment plays a role in influencing individuals.  b. Because the genetic makeup of the individual’s changes  c. Because the individuals’ cells undergo mitosis  d. Because the number of recessive alleles exceeds the number of dominant alleles  (47) In 1917 the biologist Thomas Hunt Morgan conducted studies in which he kept some caterpillars in the dark and placed some others under red, green, or blue lights. Exposure to red light produced butterflies with brightly colored wings. Exposure to green light resulted in dark-colored wings. Exposure to blue light or no light resulted in pale-colored wings. What was the most likely conclusion of Morgan’s research?  a. The pigment in butterfly wings absorbs light from the environment.  b. The phenotypic expression of wing shape depends on color pigmentation in butterflies.  c. The genes regulating wing color in butterflies are influenced by environmental factors.  d. Caterpillars exposed to red and green light are healthier than caterpillars exposed to no light or blue light. |
| **Interpret how DNA is used for comparison and identification of organisms.**   * Summarize the process of gel electrophoresis as a technique to separate molecules based on size. Students should learn the general steps of gel electrophoresis – using restrictions enzymes to cut DNA into different sized fragments and running those fragments on gels with longer fragments moving slower than faster ones.   • Interpret or “read” a gel.  • Exemplify applications of DNA fingerprinting - identifying individuals; identifying and cataloging endangered species. Summarize the process of gel electrophoresis as a technique to separate molecules based on size. Students should learn the general steps of gel electrophoresis – using restrictions enzymes to cut DNA into different sized fragments and running those fragments on gels with longer fragments moving slower than faster ones.  • Interpret or “read” a gel.  • Exemplify applications of DNA fingerprinting - identifying individuals; identifying and cataloging endangered species. | 3 | (48)    The diagram shows DNA fingerprints from a daughter horse, the mother horse, and four possible fathers. Which horse is *most likely* the father?  a. Horse 1  b. Horse 2  c. Horse 3  d. Horse 4  (49) Which statement is true concerning DNA fragment bands near the end of an electrophoresis gel?  a. they contain both DNA and RNA  b. they are shorter fragments  c. they are longer fragments  d. they were never placed in the wells |
| **Summarize how transgenic organisms are engineered to benefit society.**   * Generalize the applications of transgenic organisms (plants, animals, & bacteria) in agriculture and industry including pharmaceutical applications such as the production of human insulin.   • Summarize the steps in bacterial transformation (insertion of a gene into a bacterial plasmid, getting bacteria to take in the plasmid, selecting the transformed bacteria, and producing the product). | 2 | (50) How is the process of gene therapy used to treat cystic fibrosis?  a. by replacing the abnormal gene with a copy of a normal gene  b. by removing a portion of the abnormal gene  c. by adding a nitrogen base to the beginning of the DNA sequence  d. by inducing a mutation  (51) Which of the following is NOT a step in creating transgenic bacteria to produce human insulin?  a. the gene of interest is cut from the chromosome  b. restriction enzymes cut the bacterial plasmid  c. the two strands of DNA separate  d. bacteria take up the recombinant plasmid |
| **Evaluate some of the ethical issues surrounding the use of DNA technology (including cloning, genetically modified organisms, stem cell research, and Human Genome Project).**  • Identify the reasons for establishing the Human Genome Project.  • Recognize that the projectis useful in determining whether individuals may carry genes for genetic conditions and in developing gene therapy.  • Evaluate some of the science of gene therapy. (e.g. Severe Combined Immunodeficiency and Cystic Fibrosis)  • Critique the ethical issues and implications of genomics and biotechnology (stem cell research, gene therapy and genetically modified organisms). | 1\* | (52) Undifferentiated cells of an embryo are  a. embryonic stem cells  b. embryonic germ cells  c. diploblastic cells  d. coelom cells |

**EVOLUTION**

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| **Standard** | **#**  **Questions** | **Sample Questions** |
| **Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.**   * Summarize the hypothesized early atmosphere and experiments that suggest how the first “cells” may have evolved and how early conditions affected the type of organism that developed (first anaerobic and prokaryotic, then photosynthetic, then eukaryotic, then multicellular).   • Summarize how fossil evidence informs our understanding of the evolution of species and what can be inferred from this evidence.  • Generalize what biochemical (molecular) similarities tell us about evolution.  • Generalize what shared anatomical structures (homologies) tell us about evolution. | 2 | (53) Species A and B share similarities in DNA sequences. What would this suggest about their evolutionary relationship?  a. Species A developed before Species B  b. Species A and B share a recent common ancestor  c. Species A and B are unrelated  d. Species B developed before Species A  (54) In 2010, scientists excavated a skull fossil that provides evidence of a newly discovered species of big cat. Based on the evidence, scientists hypothesize that big cats branched off from smaller wild cats about 6 million years ago. Which of these resources did the scientists most likely rely on to form their hypothesis?  a. A food web showing feeding relationships of organisms where the fossil skull was found  b. Population and migration data for small wild cats living in the ecosystem where the skull was found  c. The fossil record and DNA comparisons of big cats and small cats  d. The historical record of interactions between different species of big cats |
| **Explain how natural selection influences the changes in species over time.**   * Develop a cause and effect model for the process of natural selection:   ▪ Species have the potential to increase in numbers exponentially.  ▪ Populations are genetically variable due to mutations and genetic recombination.  ▪ There is a finite supply of resources required for life.  ▪ Changing environments select for specific genetic phenotypes.  ▪ Those organisms with favorable adaptations survive, reproduce and pass on their alleles.  ▪ The accumulation and change in favored alleles leads to changes in species over time.  • Illustrate the role of geographic isolation in speciation. | 3 | (55) During the Industrial Revolution, there were two variations of English Peppered Moths, those with light color and those with dark color. The soot from the factories covered the trees. Data was collected to measure the percentage of each type of moth in the area. It was noted that the percentage of dark-colored moths increased over time, while the percentage of light-colored moths decreased. What is the likely explanation for this change?  a. The presence of a mutation changed the color of the English Peppered Moths.  b. The presence of the dark-colored variation increased the likelihood for survival of the English Peppered Moths.  c. The presence of the light-colored variation increased the likelihood for survival of the English Peppered Moths.  d. The presence of an acquired trait changed the color of the English Peppered Moths. |
| **Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection**  Develop a cause and effect model for the role of disease agents in natural selection including evolutionary selection of resistance to antibiotics and pesticides in various species, passive/active immunity, antivirals and vaccines | 1 | (56) A researcher sprays a new pesticide on thousands of insects of the same species that live in a large field. A few of the insects survive. What can be concluded by the researcher?  a. The species of insects will likely become resistant to the pesticide.  b. The ideal interval between the first and second applications of the pesticide should be increased.  c. The pesticide has no effect on the species.  d. The concentration of the pesticide was too weak. |
| **Explain the historical development and changing nature of classification systems.**  Generalize the changing nature of classification based on new knowledge generated by research on evolutionary relationships and the history of classification system. | 2 | (57) Which of the following statements is true?  Two organisms in the same class must also belong to the same  a. species  b. kingdom  c. genus  d. family |
| **Analyze the classification of organisms according to their evolutionary relationships (including dichotomous keys and phylogenetic trees).**   * Classify organisms using a dichotomous key.   • Compare organisms on a phylogenetic tree in terms of relatedness and time of appearance in geologic history | 2 | (58) Using the key provided, drawing III can be identified as which bird?        a. *Bubo virginianus*  b. *Haliaeetus leucocephalus*  c*. Corlinus virginianus*  d. *Anas platyrhynchos*  (59) An analysis of DNA and RNA sequences can be used to classify organisms. A phylogenetic tree, such as the one shown below, is based on molecular data. It can be used to represent evolutionary relationships within a group of organisms that are hypothesized to have descended from a common ancestor.    Which statement is best supported by the diagram?  a. Lesser pandas are more genetically similar to giant pandas than they are to raccoons.  b. Brown bears are more genetically similar to giant pandas than they are to sun bears  c. Lesser pandas are more genetically similar to raccoons than they are to giant pandas.  d. The bear species are all more genetically similar to dogs than they are to giant pandas.  (60) A cladogram is shown below.    All the animals to the right of the hagfish would have the common characteristic of  a. fur  b. claws or nails  c. lungs  d. jaws |

**MOLECULAR BIOLOGY**

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| **Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.**  Compare the structure and function of each of the listed organic molecules in organisms: ▪ Carbohydrates (glucose, cellulose, starch, glycogen)  ▪ Proteins (insulin, enzymes, hemoglobin)  ▪ Lipids (phospholipids, steroids)  ▪ Nucleic Acids (DNA, RNA) | 2 | (61) Why would a distance runner consume carbohydrates instead of proteins before a race?  a. Carbohydrates provide insulation for heat.  b. Carbohydrates provide structure for tissues.  c. Carbohydrates provide genetic material for muscle cells.  d. Carbohydrates provide energy for endurance.  (62) The complex carbohydrates pictured below are made by linking molecules of glucose.    In all three complex carbohydrates, the subunits of glucose are bonded together differently. Because they have different structures, they most likely  a. contain different chemical elements  b. form different proteins  c. carry different nucleotides  d. perform different functions |
| **Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.**   * Recall that the sequence of nucleotides in DNA codes for specific amino acids which link to form proteins.   • Identify the five nitrogenous bases (A, T, C, G and U) found in nucleic acids as the same for all organisms. • Summarize the process of protein synthesis. | 2 | (63) How does the DNA code become a protein?  a. DNA 🡪 mRNA 🡪 tRNA 🡪 amino acid 🡪 protein  b. DNA 🡪 tRNA 🡪 mRNA 🡪 amino acid 🡪 protein  c. DNA 🡪 mRNA 🡪 tRNA 🡪 protein 🡪 amino acid  d. DNA 🡪 amino acid 🡪 mRNA 🡪 tRNA 🡪 protein |
| **Explain how enzymes act as catalysts for biological reactions.**  Develop a cause and effect model for specificity of enzymes - the folding produces a 3-D shape that is linked to the protein function, enzymes are proteins that speed up chemical reactions (catalysts) by lowering the activation energy, are re-usable and specific, and are affected by such factors as pH and temperature | 1 | (64) How do enzymes speed up biological chemical reactions?  a. Enzymes increase the energy required for a reaction to occur.  b. Enzymes decrease the energy required for a reaction to occur  c. Enzymes have no effect on the energy required for a reaction to occur.  d. Enzymes maintain the energy needed for a reaction to occur. |
| **Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems.**   * Analyze overall reactions including reactants and products for photosynthesis and cellular respiration and factors which affect their rates (amounts of reactants, temperature, pH, light, etc.).   • Compare these processes with regard to efficiency of ATP formation, the types of organisms using these processes, and the organelles involved. (Anaerobic respiration should include lactic acid and alcoholic fermentation.) | 2 | (65) How does the process of photosynthesis in plants provide energy for animals?  a. The water and carbon dioxide used in photosynthesis are converted into glucose for animals.  b. The glucose and ATP used in photosynthesis are converted into water and carbon dioxide for animals  c. The glucose and carbon dioxide used in photosynthesis are converted into proteins for animals.  d. The oxygen and glucose produced through photosynthesis are converted into lipids for animals.  (66) Yeast undergo a type of anaerobic respiration in which they  a. produce glucose (called glycolysis)  b. produce ethyl alcohol (called alcohol fermentation)  c. produce lactic acid (called lactic acid fermentation)  d. use large amounts of ATP |
| **Explain ways that organisms use released energy for maintaining homeostasis (active transport)**  Conclude that energy production by organisms is vital for maintaining homeostasis and that maintenance of homeostasis is necessary for life.  Examples: Active transport of needed molecules or to rid the cell of toxins; movement to avoid danger or to find food, water, and or mates; synthesizing needed molecules. | 2 | (67) The concentration of a certain molecule is greater inside the cell than outside the cell. If the cell needs more of that molecule, what is the best process to move more of this molecule inside the cell?  a. Active transport  b. Passive transport  c. Diffusion  d. Osmosis |

**ECOSYSTEMS**

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| **Standard** | **# Questions** | **Sample Questions** |
| **Analyze the flow of energy and cycling of matter (such as water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.**  • Deconstruct the carbon cycle as it relates to photosynthesis, cellular respiration, decomposition and climate change.  • Summarize the nitrogen cycle (including the role of nitrogen fixing bacteria) and its importance to synthesis of proteins and DNA.  • Identify factors that influence climate such as: ▪ greenhouse effect (relate to carbon cycle and human impact on atmospheric CO2)  ▪ natural environmental processes (relate to volcanic eruption and other geological processes)  • Explain the recycling of matter within ecosystems and the tendency toward a more disorganized state.  • Analyze energy pyramids for direction and efficiency of energy transfer.  ▪ Living systems require a continuous input of energy to maintain organization. The input of radiant energy which is converted to chemical energy allows organisms to carry out life processes.  ▪ Within ecosystems energy flows from the radiant energy of the sun through producers and consumers as chemical energy that is ultimately transformed into heat energy. Continual refueling of radiant energy is required by ecosystems. | 1 | (68) The diagram shows a glass container covered with plastic.    One way carbon is recycled in this ecosystem is by  a. as water evaporates, it condenses on the underside of the plastic, then falls down, such as rain  b. the plants take carbon dioxide from the atmosphere and make glucose with it; the snails then eat the plants and release carbon dioxide from cell respiration  c. the snails drink water and release it as urine  d. the light produces carbon monoxide and it cycles through the water and the plants |
| **Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations.**   * Analyze how various organisms accomplish life functions through adaptations within particular environments (example: water or land) to ensure survival and reproductive success. * Relate prior understanding of survival and reproductive success to evidence of variations observed in species in three areas: * behavioral adaptations – suckling, taxes/taxis, migration, estivation, hibernation, habituation, imprinting, classical conditional, and trial and error learning * structural adaptations–nutrition, respiration, transport and excretion mechanisms, camouflage, movement * reproductive adaptations– sexual versus asexual, eggs, seeds, spores, placental, types of fertilization. | 2 | (69) During extreme conditions like drought or high heat, frogs will dig a hole in the soil and bury themselves. Sometimes frogs will shed a layer of skin, wrap it around themselves for more protection, and wait for rain. How does this adaptation aid frogs?  a. This adaptation aids in the survival of frogs.  b. This adaptation attracts other frogs for mating.  c. This adaptation helps the frog find food.  d. This adaptation aids in the growth of frogs.  (70)    The differences in the above characteristics of flower species most likely resulted from  a. adaptations in response to different environmental factors.  b. parasitism, which did not harm the host species.  c. defensive mutations allowing concealment of species.  d. mutualism between different plant species.  (71)    Darwin’s studies of finches on the Galapagos Islands suggest that the finches' differences in beak structure were most directly due to  a. acquired characteristics in the parent finches  b. mating behaviors of the different finch species  c. the size of the island where the finches live  d. adaptations of the finches to different environments  (72) Below is a picture of a Viceroy and a Monarch butterfly.    To birds, the Monarch butterfly looks like the Viceroy butterfly. The Monarch butterfly is distasteful to birds; however, the Viceroy butterfly is not. Once a bird tastes a Monarch butterfly, it will not attempt to eat a Viceroy butterfly. How is this adaptation an advantage to the Viceroy butterfly?  a. This adaptation aids in the survival of the Viceroy butterfly. b. This adaptation attracts other Viceroy butterflies for mating. c. This adaptation helps the Viceroy butterfly find food.  d. This adaptation aids in the growth of the Viceroy butterfly |
| **Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.**  • Identify and describe symbiotic relationships such as mutualism and parasitism. (middle school review)  • Exemplify various forms of communication and territorial defense including communication within social structure using pheromones (Examples: bees, ants, termites), courtship dances, territorial defense (Example: fighting fish). • Explain patterns in predator /prey and competition relationships and how these patterns help maintain stability within an ecosystem with a focus on population dynamics. | 3 | (73) Classify the relationship between flowering plants and bees, where the plant provides the bee with food and the bee spreads pollen for the plant.  a. commensalism  b. mutualism  c. parasitism  d. predation |
| **Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease).**   * Generalizing that although some populations have the capacity for exponential growth, there are limited resources that create specific carrying capacities and population sizes are in a dynamic equilibrium with these factors. (e.g. food availability, climate, water, territory).   • Interpret various types of population graphs – human population growth graphs indicating historical and potential changes, factors influencing birth rates and death rates, and effects of population size, density and resource use on the environment.  • Explain how disease can disrupt ecosystem balance. (Examples: AIDS, influenza, tuberculosis, Dutch Elm Disease, Pfiesteria, etc.) | 1 | (74) The graph below represents the changes in deer population on an island over time.    Which statement below is true concerning the graph?  a. the deer have reached their carrying capacity  b. the deer population never demonstrated exponential growth  c. no conclusion can be made unless you also see the prey population changes  d. the number of deer exceeded 200 |
| **Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.**  • Summarize how humans modify ecosystems through population growth, technology, consumption of resources and production of waste.  • Interpret data regarding the historical and predicted impact on ecosystems and global climate.  • Explain factors that impact North Carolina ecosystems. (Examples: acid rain effects in mountains, beach erosion, urban development in the Piedmont leading to habitat destruction and water runoff, waste lagoons on hog farms, Kudzu as an invasive plant, etc.). | 3 | (75) Which of the following has contributed most to the overall warming of the earth’s atmosphere?  a. the burning of fossil fuels  b. the depletion of the ozone  c. the occurrence of acid rain  d. the melting of the polar ice caps |
| **Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.**  • Explain the impact of humans on natural resources (e.g. resource depletion, deforestation, pesticide use and bioaccumulation )  • Exemplify conservation methods and stewardship. | 4 | (76) One reason to explain the decline in the American bald eagle population is the increasing concentration of DDT in its tissues, which causes damage to their eggs. This increasing accumulation of a chemical is known as  a. ozone depletion  b. biohazard  c. acid rain  d. bioaccumulation |

**ANSWER KEY**

(1) c (2) d (3) c (4) c (5) b (6) c (7) d

(8) d (9) b (10) c (11) a (12) c (13) d (14) b

(15) c (16) d (17) c (18) d (19) c (20) d (21) d

(22) b (23) a (24) a (25) c (26) a (27) a (28) c

(29) b (30) b (31) a (32) c (33) b (34) c (35) a

(36) d (37) a (38) b (39) c (40) a (41) d (42) a

(43) a (44) b (45) c (46) a (47) c (48) b (49) b

(50) a (51) c (52) a (53) b (54) c (55) b (56) a

(57) b (58) a (59) c (60) d (61) d (62) d (63) a

(64) b (65) a (66) b (67) a (68) b (69) a (70) a

(71) d (72) a (73) b (74) a (75) a (76) d