Name _____ Block _____ Date _____

Test 5 Study Guide: DNA, RNA, and Protein Synthesis

Date of Test: Tuesday, March 28 (4th, 6th and 8th Block) or Wednesday, March 29 (3rd Block)
Relevant Dates of Instruction: February 14 – March 27, 2017
SOL: BIO.5c, e-j

DNA

- **Describe the basic structure of DNA and its function in inheritance.**
  - **DNA** is a **polymer** consisting of **nucleotides**. A DNA nucleotide is identified by the **base** it contains: **adenine (A), guanine (G), cytosine (C) or thymine (T)**.
  - DNA is a **double-stranded** molecule. The strands are composed of **covalently bonded sugar and phosphate molecules** and are connected by **complementary nucleotide pairs (A-T and C-G)** like rungs on a ladder. The ladder twists to form a **double helix**.
- **Describe the key events leading to the development of the structural model of DNA.**
  - Once DNA was shown to be the genetic material, a race among scientists took place to work out its structure. Studies of the amounts of each DNA base in different organisms led to the concept of **complementary base-paring**.
    - % A = % T and % G = % C. A + T + G + C = 100%
  - Interpretations of **X-ray photographs** of DNA were used to describe the shape and dimensions of the molecule. An analysis of this and other available data led to a structural model for the **DNA double helix**.
    - Story of **Erwin Chargaff, Rosalind Franklin, James Watson,** and **Francis Crick**
- **Describe the importance of cell specialization in the development of multicellular organisms.**
  - The many body cells of an organism can be **specialized** to perform **different functions**, even though they are all **descended from a single cell** and contain **essentially the same genetic information**.
- **Explain the process of DNA replication.**
  - The **genetic code** is a **sequence of DNA nucleotides** in the **nucleus** of eukaryotic cells. Before a cell divides, the instructions are **duplicated** so that each of the two new cells gets all the necessary information for carrying on life functions (**S-phase**). Cells pass on their genes by **DNA replication.**
  - During **DNA replication**, **enzymes** unwind and **unzip** the double helix (**helicase**) and each strand serves as a **template** for building a new DNA molecule. Free nucleotides bond to the template **(A-T and C-G)** forming a **complementary strand (DNA polymerase)**. The final product of replication is **two identical DNA molecules**.

Protein Synthesis (Gene Expression)

Explain the process of protein synthesis, including DNA transcription and translation.

- DNA stores the **information** for directing the **construction of proteins** within a cell. These proteins determine the **phenotype** of an organism. The genetic information encoded in DNA molecules provides instructions for assembling protein molecules. The **code is virtually the same for all life forms**.
  - Code is organized into groups of three bases (**codons**). Be able to use a codon chart to identify a sequence of amino acids from a sequence of mRNA bases (and vice versa).
- At the **ribosome**, **amino acids** are linked together to form specific **proteins**. The **amino acid sequence is determined by the mRNA molecule**.
  - Amino acids are delivered to the ribosome by **tRNA** molecules, which have three-letter **anticodons** that are complimentary to codons on the mRNA strand.

Describe the importance of cell specialization in the development of multicellular organisms.

- The many body cells of an organism can be **specialized** to perform **different functions**, even though they are all **descended from a single cell** and contain **essentially the same genetic information**.
    - How are all cells in a single organism related? Similar? Different?

Provide examples of mutations that are lethal, harmful, and beneficial.

- **Inserting**, **deleting**, or **substituting** DNA bases can alter genes. An altered gene may be passed on to every cell that develops from it, causing an altered phenotype. An altered phenotype may be **neutral**, **beneficial** or **detrimental**.
    - Be able to analyze a **mutation** in a **gene** and predict its effect on the resulting amino acid sequence.

Evaluate karyotype charts and make a determination of the gender and genetic health of the individual.

- Sometimes entire **chromosomes** can be added or deleted, resulting in a genetic disorder. These abnormalities may be diagnosed using a **Karyotype**.

Provide examples of reasons for genetic diversity and why it can be an advantage for populations.

- **Genetically diverse** populations are more likely to survive changing environments. **Recombination** and **mutation** provide for **genetic diversity**. Some new gene combinations have little effect, some can produce organisms that are better suited to their environments, and others can be **deleterious** (**harmful**).

Describe the uses, limitations, and potential for misuse of genetic information.

- DNA technologies allow scientists to **identify, study, and modify genes**. **Forensic identification** is an example of the application of DNA technology.
- **Genetic engineering techniques** are used in a variety of industries, in agriculture, in basic research, and in medicine. There is great benefit in terms of **useful products** derived through genetic engineering (e.g., human growth hormone, insulin, and pest- and disease-resistant fruits and vegetables).
- The **Human Genome Project** is a collaborative effort to **map the entire gene sequence** of organisms. This information may be useful in **detection, prevention, and treatment of many genetic diseases**. The potential for **identifying and altering genomes** raises practical and ethical questions.
- **Cloning** is the production of **genetically identical cells and/or organisms**.

Parents: By signing below, you indicate that you are aware of the upcoming test. To the best of your knowledge, your child has prepared for this test by carefully studying materials from class, using the online resources listed, and/or reading the textbook, as well as completing all homework assignments related to this topic. DO NOT TURN IN BEFORE TEST DAY. (5 bonus points)

Child's Name (Print) _____

Parent's Signature _____ **Date** _____