Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DNA, PROTEIN SYNTHESIS, AND MUTATIONS STUDY GUIDE**

Part A: DNA and RNA Review

1. What are the 3 main differences between DNA and RNA?

|  |  |  |
| --- | --- | --- |
|  | **DNA**  | **RNA** |
| Number of Strands |  |  |
| Nitrogen Bases |  |  |
| Sugar Present in nucleotide |  |  |

2. For the characteristics below, mark (A) for DNA only, (B) for RNA only, or (C) for both DNA and RNA.

\_\_\_\_\_\_ 1. Deoxyribose sugar \_\_\_\_\_\_ 10. Genetic Information

\_\_\_\_\_\_ 2. Phosphate groups \_\_\_\_\_\_ 11. Is a nucleic acid

\_\_\_\_\_\_ 3. 3 types \_\_\_\_\_\_ 12. Double stranded

\_\_\_\_\_\_ 4. Nitrogen bases (G, A, and C) \_\_\_\_\_\_ 13. Single stranded

\_\_\_\_\_\_ 5. Nucleotide is the monomer \_\_\_\_\_\_ 14. Function is contains instructions for making proteins

\_\_\_\_\_\_ 6. Double helix \_\_\_\_\_\_ 15. Function is to copy the instructions and make proteins

\_\_\_\_\_\_ 7. Single helix \_\_\_\_\_\_ 16. Located in the nucleus only

\_\_\_\_\_\_ 8. Nitrogen base (U) \_\_\_\_\_\_ 17. Located in nucleus, cytoplasm or ribosomes

\_\_\_\_\_\_ 9. Nitrogen base (T) \_\_\_\_\_\_ 18. Ribose sugar

Part B: DNA Replication Review

1. Why does a cell go through the process of DNA replication? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Where in the cell does DNA replication take place? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What part of the cell cycle does DNA replicate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What enzyme unwinds and unzips DNA to begin replication? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. What enzyme brings in the new nucleotides on both sides of the DNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. DNA replication is described as being semi-conservative. This means that both of the copies of DNA are composed of ½ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ strand and ½ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ strand.

7. Using the ½ strand of DNA below, create the other ½ strand by matching the complementary bases. These are considered the parent strands. Highlight them in yellow. Now separate the parent strands and write in the new strands on both sides. Highlight the new strands in pink. These are called the daughter strands.

Parent: A T G C C C A T T T T A C C G Parent: A T G C C C A T T T T A C C G

Parent: Daughter:

 Daughter:

 Parent:

Part C. RNA

1. What are the 3 types of RNA? Label them on the pictures below.

36. Which type of RNA goes into the nucleus and retrieves the genetic information from DNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

37. Which type of RNA makes up ribosomes? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

38. Which type of RNA brings amino acids in to the ribosome while the message is read? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



2. Where in the cell is RNA found? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What are the 3 parts to an RNA nucleotide? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Can DNA leave the nucleus? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Why, then, do cells need RNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. What does making a protein have to do with your genetic traits coded by your DNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What is the monomer unit for a protein? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. What bases pair together when RNA matches up with DNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part D: Protein Synthesis

1. What are the two stages in protein synthesis? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What happens in transcription? DNA 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Where in the cell does transcription take place? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What enzyme aids in the production of mRNA by bringing in the RNA nucleotides? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. What type of RNA is made during transcription? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. mRNA is divided into sets of 3 nitrogen bases called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

7. Put the following steps in order (1-4) for transcription:

 \_\_\_\_\_\_ mRNA leaves the nucleus with the DNA message and heads to the ribosome.

 \_\_\_\_\_\_ RNA nucleotides enter the nucleus and RNA polymerase attaches the complementary nucleotides to the DNA.

 \_\_\_\_\_\_ DNA unwinds and unzips inside the nucleus.

 \_\_\_\_\_\_ A single strand of mRNA is created and then edited, removing introns and putting exons together.

8. Once the mRNA segment is created and detaches where does it go? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. Using the following segment of DNA create an mRNA strand:

 DNA segment: CGA TTA CGG CTT AAG CTA

 mRNA segment:

10. Where does translation occur? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. What is the end goal of translation? To make a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

12. What is the codon that starts the process of translation? What is the name of its corresponding amino acid?

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. What are the three stop codons that terminate translation? \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_

14. What type of RNA brings the amino acids to the growing polypeptide chain? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. What are the 3 bases on this molecule called? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

16. Put the following steps of translation in order:

 \_\_\_\_\_\_ mRNA is pulled through the ribosome and the message is read one codon at a time.

 \_\_\_\_\_\_ tRNA comes into the ribosome (carrying an amino acid) and its anticodon matches up to the codon on mRNA.

 \_\_\_\_\_\_ mRNA attaches to the ribosome.

 \_\_\_\_\_\_ Amino acids are linked together, beginning with the start codon and ending with one of the stop codons.

 \_\_\_\_\_\_ A polypeptide chain (protein) is made and leaves the ribosome to go golgi bodies to be folded/packaged.

17. Using the mRNA strand created above, divide it into codons, and tell what tRNA anticodons would be used to bring amino acids to this molecule. Then, use the codon chart on the next page to translate the message into the correct order of amino acids.

 mRNA segment from above: GCU AAU GCC GAA UUC GAU

 tRNA anticodons: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Amino acids: \_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_



Part E: Mutations

1. Fill in the following concept map using the following terms: Gene, Translocation, Point, Deletion, Duplication, Chromosome, Frameshift, Inversion, change, substitution, silent, insertion, deletion.

 **Mutations**—A \_\_\_\_\_\_\_\_\_\_\_\_\_ in the DNA

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Abnormalities/Mutations- affects large portions of DNA

\_\_\_\_\_\_\_\_\_\_\_\_ Mutations- a change in a small DNA sequence

\_\_\_\_\_\_\_\_\_\_ Mutations- DNA is incorrect on only one location due to the \_\_\_\_\_\_\_\_\_\_ of a base. If the substitution does not code for a different amino acid, these are sometimes called \_\_\_\_\_\_\_\_ mutations.

\_\_\_\_\_\_\_\_\_\_ Mutations- the addition or deletion of a single base changes the reading of all DNA triplets.

\_\_\_\_\_\_\_\_\_\_\_- a portion of a chromosome is missing

\_\_\_\_\_\_\_\_\_\_\_- a portion of the chromosome is turned around

\_\_\_\_\_\_\_\_\_\_\_\_\_- a portion of a chromosome has incorrectly attached to another chromosome

\_\_\_\_\_\_\_\_\_\_\_\_- there is too much of a portion of a chromosome

\_\_\_\_\_\_\_\_\_ when a base is removed

 \_\_\_\_\_\_\_\_ when a base is added

2. Gene Mutation Examples:

|  |
| --- |
| **Original DNA Sequence**: T A C A C C T T G G C G A C G A C T**mRNA Sequence:** **Amino Acid Sequence:**  |

|  |
| --- |
| Mutated DNA Sequence #1: **T A C G A C C T T G G C G A C G A C T** What’s the mRNA sequence? (Circle the change) What will be the amino acid sequence? Will there likely be effects? What kind of mutation is this (insertion, deletion or substitution)? Was it frameshift mutation, silent, or neither? |

|  |
| --- |
| Mutated DNA Sequence #2: **T A C A C C T T A G C G A C G A C T** What’s the mRNA sequence? (Circle the change) What will be the amino acid sequence? Will there likely be effects? What kind of mutation is this (insertion, deletion or substitution)? Was it frameshift mutation, silent, or neither? |

|  |
| --- |
| Mutated DNA Sequence #3: **T A C A C C T T G G G A C G A C T** What will be the corresponding mRNA sequence? What will be the amino acid sequence? Will there likely be effects? What kind of mutation is this (insertion, deletion or substitution)? Was it frameshift mutation, silent, or neither?  |

3. Chromosome Mutation Examples: What types of chromosome mutations are shown below?



4. A picture of chromosomes taken from an organism’s cells is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

5. When multiple copies of chromosomes are present in plants, resulting in large fruits, it is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

6. When only one chromosome of a pair is present in a person’s cells, it is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that pair.

7. When three copies of a chromosome are present in a person’s cells, it is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that pair.

8. A person should have \_\_\_\_\_\_\_ chromosomes, or \_\_\_\_\_\_\_ pairs.

9. The sex chromosomes are \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_.

10. The other chromosomes (pairs 1 – 22) are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



11. Look at the karyotype to the right and answer the questions below.

12. Is this individual a male or a female? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. Is there an abnormality in this individual? If so where? \_\_\_\_\_\_\_\_\_

14. What is this kind of abnormality called? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. Is this mutation affecting a small or a large portion of DNA? \_\_\_\_\_\_

Part F: Genetic Technology – Gel Electrophoresis

1. What are some applications for gel electrophoresis?

2. What causes the segments of DNA to move from one end to the other of the gel?

3. Which segments will move the furthest?

4. Which lane has the shortest segment of DNA?

5. If these letters A-D represent different species, which

 one might be most closely related to A?

6. If A is the mother’s DNA and B is the father’s DNA, which

 one is the only one that could be his kid?

Part G: Pedigree

1. a. How many generations are there in the pedigree? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b. How many marriages are there? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. How many children did the first couple (couple in row I) have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

 d. How many children did the third couple (couple in row III) have? \_\_\_\_\_\_\_\_\_\_\_\_\_

2. a. How many males are there? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b. How many males have hemophilia? \_\_\_\_\_\_\_\_\_\_\_\_

 c. How many female are there? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 d. How many females have hemophilia? \_\_\_\_\_\_\_\_\_\_

 e. What is the genotype of the male and female in

 generation 1?

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_