Evolution and Heredity:

DNA, Genes, Sexual Reproduction and Mutations

Pre-Test Review Sheet :

1. What is DNA short for?

2. What is RNA short for?

3. What does the m in mRNA stand for?

4. What does the t in tRNA stand for?

5. How many nitrogenous bases are there in one mRNA codon?

**Consider the following template strand DNA sequence for Q6-Q11:**

**GGC AGT TTA CCC CAT …**

6. Which of the following shows a FRAMESHIFT mutation caused by an INSERTION? Circle all that apply.

 A. GGA CAG TTT ACC CCA …

 B. GGA AGT TTA CCC CAT…

 C. GGA GAG ACC GTT CCA…

 D. CCG UCA AAU GGG GUA…

 E. GGA GTT TAC CCC ATC…

 F. CCG TCA AAT GGG GTA…

 G. GGC AGT TTT ACC CCA…

7. Which of the following shows a FRAMESHIFT mutation caused by a DELETION? Circle all that apply.

 A. GGA CAG TTT ACC CCA …

 B. GGA AGT TTA CCC CAT…

 C. GGA GAG ACC GTT CCA…

 D. CCG UCA AAU GGG GUA…

 E. GGA GTT TAC CCC ATC…

 F. CCG TCA AAT GGG GTA…

 G. GGC AGT TTT ACC CCA…

8. Which of the following shows a POINT mutation caused by a SUBSTITUTION? Circle all that apply.

 A. GGA CAG TTT ACC CCA …

 B. GGA AGT TTA CCC CAT…

 C. GGA GAG ACC GTT CCA…

 D. CCG UCA AAU GGG GUA…

 E. GGA GTT TAC CCC ATC…

 F. CCG TCA AAT GGG GTA…

 G. GGC AGT TTT ACC CCA…

9. Which of the following shows the corresponding coding DNA strand? Circle all that apply.

 A. GGA CAG TTT ACC CCA …

 B. GGA AGT TTA CCC CAT…

 C. GGA GAG ACC GTT CCA…

 D. CCG UCA AAU GGG GUA…

 E. GGA GTT TAC CCC ATC…

 F. CCG TCA AAT GGG GTA…

 G. GGC AGT TTT ACC CCA…

10. Which of the following shows the mRNA sequence after transcription? Circle all that apply.

 A. GGA CAG TTT ACC CCA …

 B. GGA AGT TTA CCC CAT…

 C. GGA GAG ACC GTT CCA…

 D. CCG UCA AAU GGG GUA…

 E. GGA GTT TAC CCC ATC…

 F. CCG TCA AAT GGG GTA…

 G. GGC AGT TTT ACC CCA…

11. What is the sequence of amino acids coded for by this sequence?

12. What amino-acid is coded for by the following mRNA sequences?

A. GCU

B. GGU

C. ACA

D. UGA

E. UUU

F. GAG

G. GGA

H. CGU

13. List all of the mRNA codons that code for the amino acid LEUCINE.

14. List all of the mRNA codons that code for the amino acid SERINE.

15. What are the possible anti-codons on a tRNA molecule that carries the amino-acid ASPARAGINE?

16. The shape of the DNA molecule is known as a DOUBLE HELIX. Describe what a double helix is and make a sketch of one.

17. Describe three different ways that a DNA mutation could have little or no effect on an organism.

18. Where in your cells is most of your DNA found?

 A. Cytoplasm B. Centromere C. Ribosomes D. Nucleus

 E. Cell Wall F. Cell Membrane G. Golgi Body H. Endoplasmic Reticulum

19. A DNA mutation refers to a change in what part of the DNA molecule?

 A. A phosphate is substituted with a sugar.

 B. A thymine is substituted with a uracil.

 C. A deoxyribose is replaced with a ribose.

 D. The sequence of nitrogenous bases is altered

E. A nucleotide is replaced by an oldleotard

20. An organism has 10 pairs of chromosomes for a total of 20. How many pairs of chromosomes will be in a daughter cell after MITOSIS?

21. An organism has 10 pairs of chromosomes for a total of 20. How many pairs of chromosomes will be in a daughter cell after MEIOSIS?

22. An organism has 10 pairs of chromosomes for a total of 20. How many chromosomes will be in a daughter cell after MITOSIS?

23. An organism has 10 pairs of chromosomes for a total of 20. How many chromosomes will be in a daughter cell after MEIOSIS?

24. A diploid organism has a total of 8 chromosomes in its tissue cells (2n=8). How many DIFFERENT gametes can be produced through meiotic cell division?

25. A diploid species has a total of 8 chromosomes in its tissue cells (2n=8). How many DIFFERENT offspring can be produced through sexual reproduction between 2 individuals of this species?

26. Which of the following best describes CROSSOVER in genetics?

 A. When a DNA nucleotide crosses over to the RNA molecule during transcription

B. When a segment of a paternal chromosome and the homologous maternal chromosome switch places during meiosis

C. When a segment of a paternal chromosome and the homologous maternal chromosome switch places during mitosis

D. When a skater brings their rear leg forward and crosses it over their front leg to make a turn.

27. What is the name of the enzyme that “unzips” the DNA double helix by breaking the hydrogen bonds between the bases?

28. What role do DNA polymerases play in DNA replication?

29. When does DNA replication usually occur?

30. What are the 4 bases in RNA?

31. Give 4 differences between DNA and RNA.

32. What is DNA transcription?

33. For each of the following sequences of bases along a single strand of DNA, write sequence of bases on the transcribed strand of mRNA.

 a. TCG AGC GGA

 b. CGT TCC AAC

 c. CCG ACA TTG

34. What is DNA translation?

35. What is a mutagen?

36. What is a carcinogen?

37. The diagram below shows the chromosomes in a parent cell after DNA replication.

 paternal

 maternal

Use the diagram to answer the questions below:

 A. How many chromosomes are in a regular tissue cell of this organism?

 B. How many pairs of chromosomes are in a regular tissue cell of this organism?

 C. Is this organism HAPLOID, DIPLOID or TRIPLOID?

 D. Which of the following best represents a possible daughter cell after MITOSIS? Circle all that apply.

E. Which of the following best represents a possible daughter cell after MEIOSIS? Circle all that apply.

38. Each DNA molecule is shaped like a long ladder that has been twisted into a spiral. This shape is known as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

39. A DNA molecule is made of many (tens or hundreds of millions) small pieces. Each of these pieces contains 3 parts. A phosphate, a sugar and a nitrogenous base. Each of these pieces is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

40. The backbones of the DNA (the 2 sides of the ladder) are made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

41. The rungs of the ladder, that join the two sides together, are made up of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

42. A DNA molecule has 4 possible bases. These are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

43. Write the rule for base pairing. (What base pairs with what base?)

44. The DNA in your body is broken into pieces. Human DNA is found in 46 pieces (23 pairs: 23 from your father, 23 from your mother). These pieces are coiled up into structures called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

45. A section of DNA that codes for a specific protein is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

46. Different versions of the same gene are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

47. Which of the following is the best estimate of the number of base pairs in all of the DNA in a single human cell?

 A. 1 B. 10 C. 23 D. 46 E. 100 F. 500

 G. 1000 H. 100 000 I. 5 000 000 J. 6 000 000 000 K. 70 000 000 000 000

48. For each of the following sequences of bases along a single strand of DNA, write sequence of bases on the corresponding DNA strand.

 a. GCA

 b. TTG

 c. TCA AAG

 d. TGG CGA ACT GTG CGT TAC

 e. CAA TCT GGG GAC TGG

 f. AAC CAA GGC ATC GAG TTT

49. Describe the role of tRNA in protein synthesis.

50. How many chromosomes did you inherit from your mother?

51. Tays-Sachs is a genetic disorder that causes a breakdown in the tissues in the central nervous system. It is an inherited genetic condition. Individuals with this disease die in infancy. Is the gene responsible for Tays-Sachs dominant or recessive? Explain how you know.

52. Explain briefly why the genetic variation created by sexual reproduction provides an evolutionary benefit.

53. Consider the following DNA sequence:

CCTGAGTCTAACATTCGAAACT

A. Write the sequence of the transcribed mRNA molecule.

B. Write the sequence of tRNA anti-codons.

C. Write the sequence of amino acids that result from the translation of this DNA sequence.

54. Explain why not all mutagens are carcinogens.

55. A certain genetic disorder is carried by a dominant allele on chromosome 20. The result of this genetic disorder is the inability to taste bitter foods. Explain why, even though this mutation is on the dominant allele it remains within the human genome.

56. A certain disorder is carried by a dominant allele on chromosome 11. The result of this mutation is a degenerative muscle disorder that causes the sufferer to lose total muscular control such that they cannot eat, swallow or breathe without assistance. The symptoms of this disease generally first begin to appear at age 40-50years. Explain why this allele remains in the gene pool, even though it is dominant.

57. A certain mutation affects a gene on the X chromosome. 100% of males who inherit this allele are afflicted by the disease which causes an inability to digest certain carbohydrates. Only 25% of females who inherit this gene are affected. Explain how this is possible.

58. A certain genetic disorder results in death before age 1 year in 100% of sufferers. The disorder has been known since 1926 and continues to exist today. Is this mutation on a dominant or recessive allele? Explain.

Evolution and Heredity KEY

DNA, Genes, Sexual Reproduction and Mutations

Pre-Test Review Sheet:

1. **Deoxyribonucleic Acid**

2. **Ribonucleic Acid**

3. **Messenger**

4. **Transfer**

5. **3**

**Consider the following DNA sequence for Q6-Q11:**

**GGC AGT TTA CCC CAT …**

6. Which of the following shows a FRAMESHIFT mutation caused by an INSERTION? Circle all that apply.

 **A. GGA CAG TTT ACC CCA …**

 **G. GGC AGT TTT ACC CCA…**

7. Which of the following shows a FRAMESHIFT mutation caused by a DELETION? Circle all that apply.

 **E. GGA GTT TAC CCC ATC…**

8. Which of the following shows a POINT mutation caused by a SUBSTITUTION? Circle all that apply.

 **B. GGA AGT TTA CCC CAT…**

9. Which of the following shows the corresponding DNA strand? Circle all that apply.

 **F. CCG TCA AAT GGG GTA…**

10. Which of the following shows the mRNA sequence after transcription? Circle all that apply.

 **D. CCG UCA AAU GGG GUA…**

11. What is the sequence of amino acids coded for by this sequence?

 **Proline-Serine-Asparagine-Glycine-Valine**

12. What amino-acid is coded for by the following mRNA sequences?

A. GCU **Alanine**

B. GGU **Glycine**

C. ACA **Threonine**

D. UGA **STOP**

E. UUU **Phenylalanine**

F. GAG **Glutamic acid**

G. GGA **Glycine**

H. CGU **Arginine**

13. **UUA, UUG, CUA, CUC, CUG, CUU**

14. **AGC, AGU, UCA, UCC, UCG, UCU**

15. **UUA, UUG**

16. **A double helix consists of two long spiral molecules next to one another joined by cross links. It is often compared to a long twisted ladder. You could also visualize it as a very long spiral staircase.**



17. 1. **The mutation could be a simple substitution that results in the same amino acid being coded for.**

**2. The mutation may change a single amino acid, but the protein produced still performs the same function.**

**3. The mutation could occur on a section of DNA that is not a gene.**

**4. The mutation may affect a protein that performs a minor function, such that the change is insignificant. For example, there are hundreds of proteins responsible for our sense of taste, a mutation to one of these proteins would likely be undetectable.**

**5. The mutation may happen in one skin cell that is then sloughed off, or a hair cell or a fingernail cell.**

**6. The mutation could cause the creation of a new protein that performs a very similar function to the original function.**

18. **D. Nucleus**

19. **D. The sequence of nitrogenous bases is altered**

20. **10**

21. **0 (after meiosis the chromosomes ARE NOT PAIRED)**

22. **20**

23. **10**

24. **16**

25. **256**

26. **B. When a segment of a paternal chromosome and the homologous maternal chromosome switch places during meiosis**

27. **DNA Helicase**

28. **DNA polymerases bring the new DNA nucleotides and attach them to the template strand.**

29. **During cell division**

30. **Adenine, Cytosine, Guanine, Uracil**

31. 1. **RNA has the base Uracil while DNA has Thymine.**

 **2. RNA has the sugar ribose in its backbone while DNA has the sugar deoxyribose.**

 **3. RNA is single stranded while DNA is double stranded.**

 **4. RNA can easily move in and out of the nucleus while DNA cannot.**

32. **The “copying” of the DNA code by mRNA and then moving that mRNA template out of the nucleus.**

33. a. **AGC UCG CCU**

 b. **GCA AGG UUG**

 c. **GGC UGU AAC**

34. **The process of assembling amino acids into proteins using the mRNA template.** **The tRNA molecules carry amino-acids and attach to the mRNA template. The amino acids are then joined together to make a protein.**

35. **Any biological, chemical or physical agent that causes a mutation in a DNA molecule.**

36. **Any biological, chemical or physical agent that causes cancer.**

37. The diagram below shows the chromosomes in a parent cell after DNA replication.

 paternal

 maternal

Use the diagram to answer the questions below:

 A. **4**

 B. **2**

 C. **DIPLOID**

D. Which of the following best represents a possible daughter cell after MITOSIS? Circle all that apply.

E. Which of the following best represents a possible daughter cell after MEIOSIS? Circle all that apply.

38. **Double Helix**

39. **Nucleotide**

40. **Sugar and Phosphate**

41. **Nitrogenous Bases**

42. **Adenine, Cytosine, Guanine, Thymine**

43. **Adenine ⇔** **Thymine**

 **Cytosine ⇔ Guanine**

44. **Chromosomes**

45. **Gene**

46. **Alleles**

47. **J. 6 000 000 000**

48. a. **CGT**

 b. **AAC**

 c. **AGT TTC**

 d. **ACC GCT TGA CAC GCA ATG**

 e. **GTT AGA CCC CTG ACC**

 f. **TTG GTT CCG TAG CTC AAA**

49. **tRNA carries the amino acids to the mRNA template so they can be assembled into proteins.**

50. **23**

51. **Recessive. If it were dominant, 100% of individuals with the mutation would die before reproduction. Therefor the gene could not be passed on to the next generation.**

52. **The greater the number of genetic combinations that exist in a population, the greater the chances of a particular combination that will provide some advantage for survival.**

**The more genetic combinations, the greater the chance that some combination will provide immunity against some bacteria or virus that would otherwise cause extinction.**

**The more genetic combinations in a population the more adaptable that population will be to changes in the environment.**

**The more genetic combinations that exist in a population the more likely that some individual will be adapted to fill some new niche that has arisen due to changes in the environment.**

53. Consider the following DNA sequence:

CCTGAGTCTAACATTCGAAACT

A. **GGA CUC AGA UUG UAA GCU UUG A**

B. **CCU GAG UCU AAC AUU CGA AAC U**

C. **Glycine-Leucine-Arginine-Leucine-STOP (Alanine-Leucine…)**

54. **Simply because most mutations do not result in cancer.**

55. **This genetic disorder, for the most part, does not affect the ability of an individual to survive and to reproduce and to pass on their genetic information. In this case the effect of the mutation is minor, so the individual may not even know that they are affected.**

56. **In this case the effects of the disorder are severe. However, the symptoms do not appear until after most individuals have reproduced. The genes will be passed on before the individual (or anyone else) knows that there is anything wrong.**

57. **Certain genes appear only on the X chromosome and not on the Y. For these genes males get only one allele, while females get the usual 2 alleles because males have only one X chromosome and one Y chromosome, while females have 2 X chromosomes. Let us call the two alleles A (dominant) and a (recessive). Males get only one of these alleles. If they inherit the A allele, they do not have the disorder, if they inherit a single a allele they have the disorder. In females, they will inherit two alleles so the possible genotypes are: AA, Aa and aa. Only those females with two recessive a alleles will have the disorder.**

58. **It must be recessive. If it has been known since 1926, it must have existed since at least 1926, probably for much longer. If it were dominant, 100% of those with the mutation die before passing it on and it cannot exist past 1 generation.**