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

**DNA/RNA STUDY GUIDE**

Part A: DNA History

Match the following scientists with their accomplishments in discovering DNA using the statement in the box below.

* Used a technique called x-ray diffraction
* Experimented with mice to figure out how pneumonia made people sick
* Experimented with viruses called bacteriophages
* Found that the % of adenine was equal to % of thymine
* Concluded that some factor was transforming harmless bacteria into disease-causing bacteria
* Radioactively marked the protein coat of viruses with sulfur and the DNA core with phosphorus
* Found that the % of cytosine was equal to % of guanine
* Found that DNA was composed of 2 strands, was helical and that nucleotides were in the center
* Concluded that DNA was actually the factor that was passed down from organism to organism
* Concluded that DNA was actually in the form of a double helix

1. Frederick Griffith (1928)

* Experimented with mice to figure out how pneumonia made people sick
* Concluded that some factor was transforming harmless bacteria into disease-causing bacteria

2. Hershey and Chase (1952)

* Experimented with viruses called bacteriophages
* Radioactively marked the protein coat of viruses with sulfur and the DNA core with phosphorus
* Concluded that DNA was actually the factor that was passed down from organism to organism

3. Chargoff (late 1940’s)

* Found that the % of adenine was equal to the % of thymine
* Found that the % of cytosine was equal to the % of guanine

4. Rosalind Franklin (1952)

* Used a technique called x-ray diffraction
* Found that DNA was composed of 2 strands, was helical and that nucleotides were in the center

5. Watson and Crick (1953)

* Concluded that DNA was actually in the form of a double helix

Part B: Structure of DNA

6. Where in a cell is the DNA located? nucleus

7. Does DNA ever leave this location? no

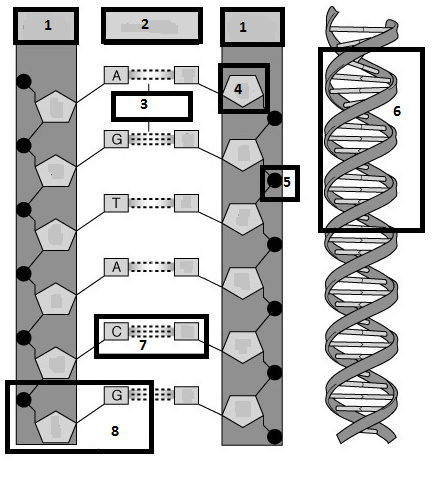
8. Do all living things contain DNA? All types of cells? yes

9. What are the complimentary base pairs that would be attached to the following ½ strand of DNA?

C G A T T A C G G C T T A A G C T

G C T A A T G C C G A A T T C G A

10. Use the following words to label 1-8 in the DNA structure below: double helix(6), hydrogen bonds(3), sugar-phosphate backbone (use twice)(1), base pairs (use twice)(2 AND 7), deoxyribose sugar(4), phosphate(5), and nucleotide(8). When you have finished labeling 1-8, fill in the complementary bases.

T

C

G

T

A

C

T

11. What are the 3 parts to a nucleotide? Deoxyribose sugar, phosphate, nitrogen base (A,T,G,C)

12. What are the 4 nitrogenous bases? Guanine, cytosine, adenine, thymine

13. How do the bases pair? A-T,

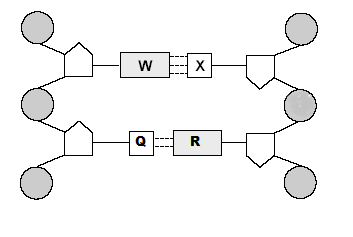
G-C

14. What type of bond holds the bases together? Weak hydrogen

15. What makes up the sides of the DNA ladder? Deoxyribose sugar and phosphate

16. What makes up the steps of the DNA ladder? Base pairs (A with T and G with C)

17. What is the shape that Watson and Crick called DNA? Double helix

Nitrogen Bases:

Which letters represent purine?

W and R (Larger Double Ring)

Which letters represent pyrimidines?

X and Q (Smaller Single Ring)

Which bases are bonded by a triple bond?

Cytosine and Guanine (W and X)

Which bases are bonded by a double bond?

Adenine and Thymine (Q and R)

**Label W, X, Q, and R**. W = Guanine and X = Cytosine

R = Adenine and Q = Thymine

Part C: DNA Replication

18. Why does a cell go through the process of DNA replication? To make a copy of the DNA before the cell goes through mitosis

19. Where in the cell does DNA replication take place? Nucleus

20. What part of the cell cycle does DNA replicate? S phase of interphase

21. What enzyme unwinds and unzips DNA to begin replication? Helicase

22. What enzyme brings in the new nucleotides on both sides of the DNA? DNA polymerase

23. DNA replication is described as being semi-conservative. This means that both of the copies of DNA are composed of ½ original strand and ½ new strand.

24. 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.

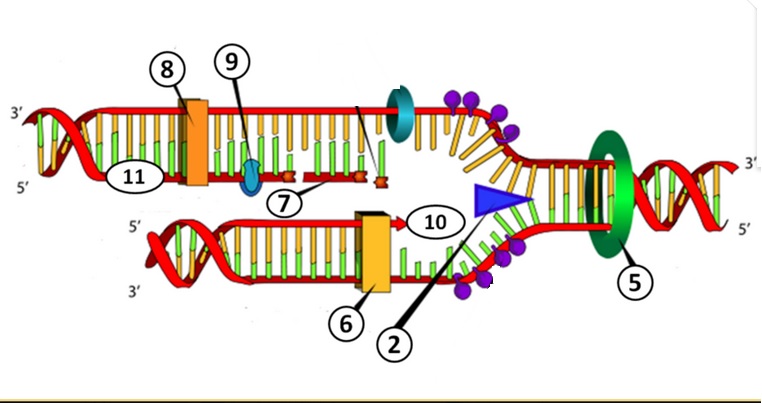
Parent: A T G C C C A T T T T A C C G Parent: A T G C C C A T T T T A C C G

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

Daughter: A T G C C C A T T T T A C C G

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

Label each step number provided (you should be able to describe each step in the process)



Helicase (2) breaks the weak hydrogen bonds between the two nitrogen bases, this creates a leading (10) and lagging strand (11).

As this occurs, the Topoisomerase (5) helps to relieve the increasing strain on the rest of the molecule by breaking and rebinding the unzipped portion of the strand.

Now DNA Polymerase III will bond new nucleotides to both strands. The leading strand (bottom strand) is a continuous motion, the lagging stand will occur in fragments called Okazaki Fragments (7). These fragments on the lagging strand will be bonded together in an additional step by Ligase and DNA polymerase I (9 and 8).

The final product is two identical stands that we created in a semi-conservative process, meaning that each of the double strands is ½ of the original genetic information and ½ of the newly created genetic information.

Part D. RNA

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

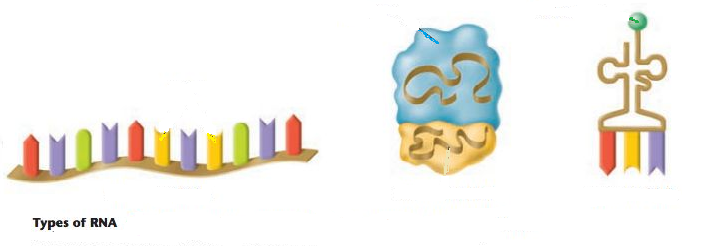
|  |  |  |
| --- | --- | --- |
|  | **DNA** | **RNA** |
| Number of Strands | 2 | 1 |
| Nitrogen Bases | Adenine, Thymine, Guanine, Cytosine | Adenine, Uracil, Guanine, Cytosine |
| Sugar Present in nucleotide | Deoxyribose | Ribose |

35. 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? mRNA

37. Which type of RNA makes up ribosomes? rRNA

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



tRNA

rRNA

mRNA

39. Where in the cell is RNA found? Nucleus, ribosomes, cytoplasm

40. What are the 3 parts to an RNA nucleotide? Ribose sugar, phosphate group, nitrogen base (A, U, C, or G)

41. Can RNA leave the nucleus? yes

42. Why, then, do cells need RNA? To make proteins which carry out the directions initially coded in the DNA

43. What does making a protein have to do with your genetic traits coded by your DNA? It is a protein that expresses the trait coded by the DNA or carries out the directions of the DNA.

44. What is the monomer unit for a protein? Amino acid

45. What bases pair together when RNA matches up with DNA? A with U and C with G

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

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

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

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

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

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

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

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

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

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

Review Topic: Genetics

Concepts:

Mendel’s Laws

|  |  |  |
| --- | --- | --- |
| Law of Dominance  The presence of a dominant allele in a genotype will mask a recessive allele | Law of Segregation  Alleles from the parental genotype will separate during gamete formation. | Law of Independent Assortment  Alleles for different genes(traits) will separate independent of each other during gamete formation.  (Easily seen in a dihybrid cross) |

Compare the genotypic and phenotypic ratio for complete dominance, incomplete dominance, and codominance:

Complete dominance will have two possible phenotypes for three possible genotypes so the ratios will be different from each other. (Only two phenotypes possible) Incomplete and codominance each genotypes has its own phenotype, so the genotypic and phenotypic ratio will match each other.(Three phenotypes possible)

Which blood type is the universal donor? \_\_O\_\_\_\_ Universal receiver? \_\_AB\_\_\_

Which sex is most likely to be impacted by a sex-linked disorder? \_\_Male\_\_ why? They only have one X chromosomes, none of the disorders we discussed are found on the Y. This means that a recessive allele cannot be masked and will always be expressed.

Who does a female get a sex-linked disorder from? \_\_Mom and Dad\_\_\_\_\_ male ?\_\_Mom (Dad only provides the Y)\_\_\_

Practice Problems

* 1. In fruit flies, long wings are dominant to short wings. Complete a cross between a short winged male and a heterozygous female. Fill in the phenotypes of the genotypes below. Give the genotypic and phenotypic ratios of the cross. This is an example of \_\_complete\_\_\_\_ dominance.

w w Genotypic ratio: 0 WW: 2 Ww : 2 ww

Ww Ww

ww ww

WW = \_long\_\_\_ W Phenotypic ratio: 2 long: 2 short

Ww = \_\_long\_\_\_\_

ww = \_short\_\_ w

* 1. In certain flowers, blue and yellow flowers are incompletely dominant to each other. Show the cross between a pure blue flower and a pure yellow flower. Fill in the phenotypes of the genotypes below. Give the genotypic and phenotypic ratios of the cross.

B B Genotypic ratio: 0 BB: 4 Bb : 0 bb

Bb Bb

Bb Bb

BB = \_blue\_\_\_ b Phenotypic ratio: 0 blue: 4 green: 0 yellow

Bb = \_\_green\_\_\_\_

bb = \_yellow b

* 1. Using the same flowers as in #2, cross a green flower with a yellow flower. Give the genotypic and phenotypic ratios of the cross.

B b Genotypic ratio: 0 BB: 2 Bb : 2 bb

Bb bb

Bb bb

BB = \_blue\_\_\_ b Phenotypic ratio: 0 blue: 2 green: 2 yellow

Bb = \_\_green\_\_

bb = \_yellow b

* 1. In some species of wildcats, black stripes and tan spots are codominant. Show the cross between a male with stripes and a female with spots and stripes . Fill in the phenotypes of the genotypes below. Give the genotypic and phenotypic ratios of the cross.

B B Genotypic ratio: 2 BB: 2 BT : 0 TT

BB BB

BT BT

BB = \_black stripes\_\_\_ B Phenotypic ratio: 2 black stripes: 2 spots and stripes: 0 spot

BT = \_\_stripes and spots\_

TT = \_tan spots T

* 1. In humans, blood type is controlled by multiple alleles – A, B & O. Show the cross between a male with Type O blood and a woman with Type AB blood. What blood types will NOT show up in their offspring? You will not see type O or type AB in the

O O offspring.

AO AO

BO BO

A

B

* 1. In humans, male pattern baldness is a sex-linked recessive trait. Show the cross between a male that is not bald and a female that is a carrier. Fill in the male and female genotypes below using the letter b.

XB Y

XBXB XBY

XBXb XbY Bb

Male genotype = \_\_\_XBY\_\_\_\_ XB

Female genotype = \_\_XBXb\_\_\_ b

Xb

7. Look at the pedigree to the right and answer the questions.

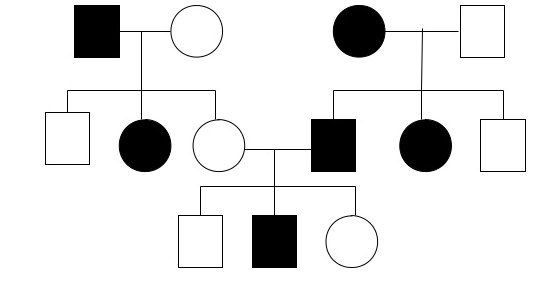
4 Aa

3 aa

2 Aa

1 aa

I.



a. Label the generations and individuals correctly.

II

b. How many males? \_7\_ How many females? 6\_\_

2 aa

6 Aa

5 aa

4 aa

3 Aa

1 Aa

c. How many affected males? \_3\_\_ How many affected females? \_3\_

III

d. Do you this trait is dominant or recessive? \_it could be either\_\_

3 Aa

2 aa

1 Aa

e. Assuming this trait is recessive, assign genotypes to each individual using the letter A.