

Heredity Test Key- SSSS 2018

(Focus on DNA, RNA, and proteins)

Answers are bolded and underlined.

Starred problems (*) are worth 2 points and double starred problems (**) are worth 4 points!

Team Name: _____

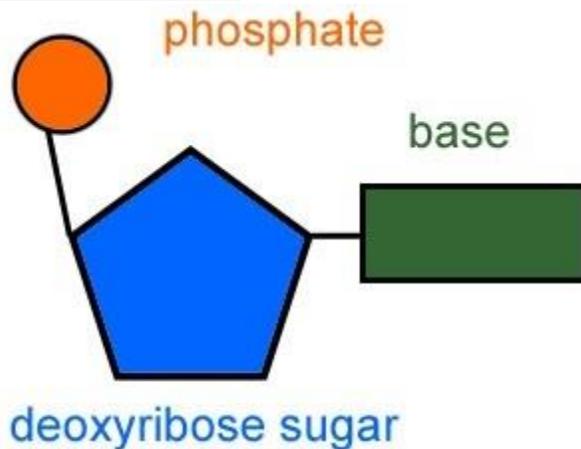
Team Number: _____

Competitor Names: _____

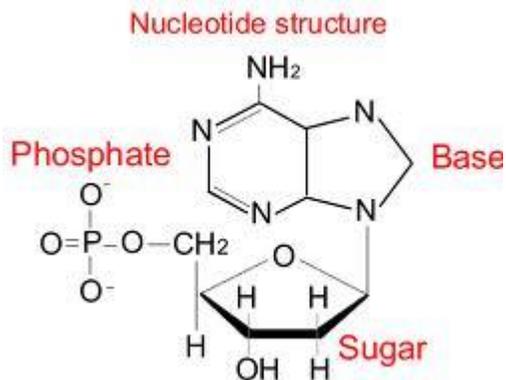
- What is the purpose of DNA ligase?
 - To replicate the strand and move it to the needed location
 - To assist in DNA unwinding
 - To connect Okazaki fragments**
 - To attract RNA primers
- What is the purpose of histones?

For DNA strands to wrap around so they can activate and deactivate genes.
- * Draw the structure of one nucleotide and label it. ** Bonus: Draw the individual molecules

Should be similar to:

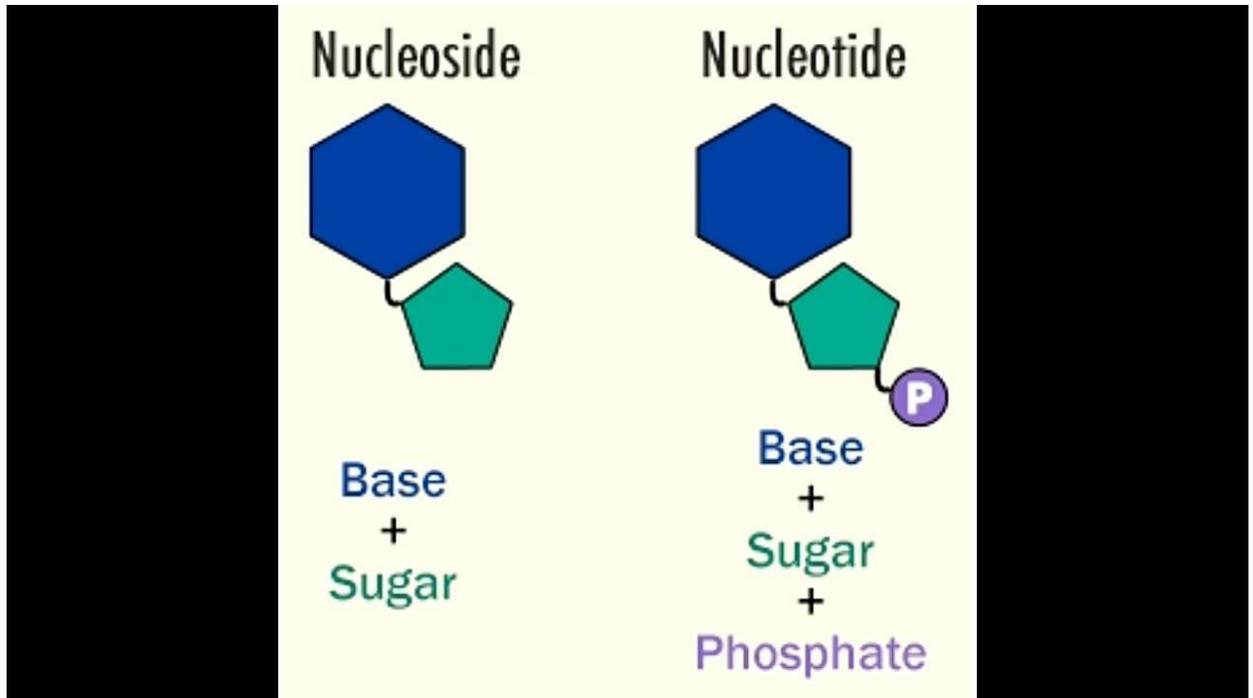


Bonus (note that the base shown is an example):



- Describe what a nucleoside is.

The base and sugar in DNA. Can be thought of as a column of nucleotides without the phosphate backbone. For clarification:



5. * What are linked genes and how are they affected by the law of independent assortment?
Sample: linked genes are genes on the same chromosome. The law of independent assortment states that the chance of getting a certain gene will not affect the chance of getting another gene on another chromosome. However, this does not hold true for linked genes as they are on the same chromosome and will come together or not at all.
6. In protein synthesis, what is the difference between translation and transcription?
Transcription is the creation of mRNA while translation is the creation of proteins from the mRNA.
7. * What is the difference between a polypeptide and a protein? Include the levels of protein structure in your answer.
Sample: A polypeptide is many peptides strung together. A protein is one or more polypeptides folded into a shape such that it has certain emergent properties and certain effects on its surroundings. They share the first 3 structures of protein structure, but only proteins with multiple subunits will have quaternary structure.
8. * What is the difference between a ribose and a deoxyribose sugar? Be specific.
A ribose sugar has an oxygen molecule on it's 2 carbon, while deoxyribose does not.
9. Describe how the karyotypes appear in the following disorders:
 - 9.a. Patau Syndrome
There is a trisomy of the 13 chromosomes.
 - 9.b. Klinefelter's Syndrome
There is a trisomy of the sex chromosomes with it becoming XXY.
 - 9.c. Down Syndrome
There is a trisomy of the 21 chromosomes.
10. How do epigenetic factors affect gene accessibility and activation? Be specific.
Sample: They change the accessibility of genes by making DNA wrap more or less around histones, making some genes appear or disappear.

11. How many hydrogen bonds exist when adenine and thymine bond?

A. 24

B. 2

C. 6

D. 3

12. How are DNA strands separated? Be specific.

Topoisomerase unwinds the backbone, helicase breaks hydrogen bonds between base pairs, and single-strand binding proteins prevent rewinding.

13. Where does tRNA go through in ribosomes? Include the site passage in your response.

Sample: It enters in the A site where it waits for a tiny bit of time while the next tRNA leaves its amino acid and leaves. The new tRNA then enters the P site, where it will match its base pairs with the codons found on the mRNA being read. It will then move to the E site, leaving the amino acid behind while more tRNA comes from behind.

14. * Draw a diagram of translation, labeled. Be specific.

Should be something like this:

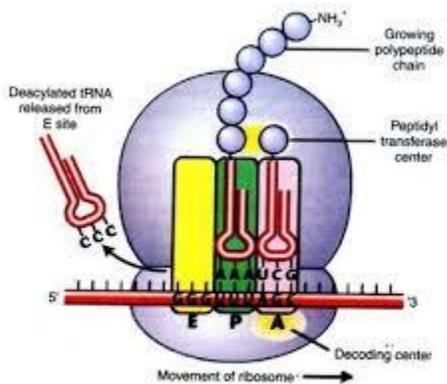


Image 4.8. Translation-making protein

15. If Bob examined a sperm cell's nucleus, how many chromosomes would he find? Also, how many alleles for each trait would he find?

He would find 23 chromosomes and 1 allele for each trait.

16. What is the difference between DNA polymerase I and III?

Polymerase III adds on to RNA primers while Polymerase I replaces primers.

17. List 3 differences between DNA and RNA.

Sample:

1. DNA has thymine

2. RNA has uracil

3. RNA is single stranded

18. How long was the Human Genome Project, when was it, and what was it?

Sample: 13 years, from 1990 to 2003. It was a project to map all of the human genes, known as the genome.

19. Whose innovation helped discover the structure of DNA but did not receive the Nobel Prize alongside Watson and Crick?

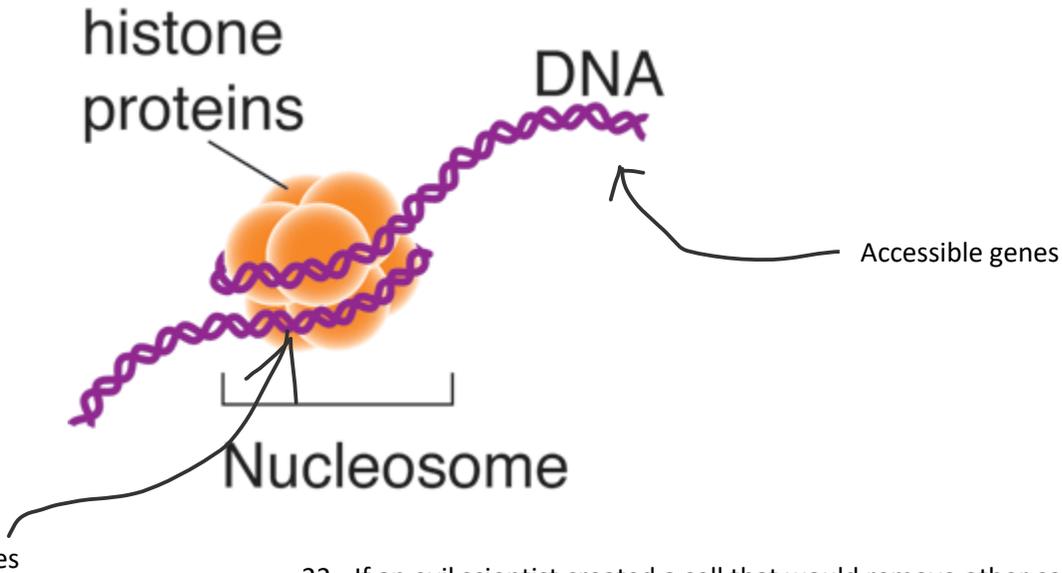
Rosalind Franklin

20. What is the function of RNA primers?

Sample: Because DNA Polymerase III can only replicate if RNA primers are present, these temporarily exist to start replication and are replaced by DNA Polymerase I later.

21. ** Draw a nucleosome and label activated and inactivated genes.

Should look like this:



22. If an evil scientist created a cell that would remove other cell's DNA, list 3 structures they could give the cell. Be creative!

Sample: Ability to infiltrate cell membrane, ability to infiltrate nuclear membrane, and some wrapping or engulfing structure to take the DNA.

23. How do viruses and their lytic and lysogenic cycles affect cells (specifically the nuclear DNA)?

Sample: They inject their DNA into the cell, which merges with the cell's DNA and becomes the prophage. This may continue to form more prophage-containing cells (lysogenic cycle) or create more viruses, causing the cells to release the viruses, thus causing the cycle to repeat.

24. Which 2 people created the Punnett square, and why is it so useful?

Sample: Reginald Punnett and William Bateson, and the Punnett square is useful because it allows you to see all the possible outcomes of the children's traits.

25. What is helicase and why is it vital to DNA replication?

Helicase is an enzyme that breaks hydrogen bonds between base pairs. It is vital because without it, you could not separate the strands to replicate them.

26. What is the purpose of single-strand binding proteins?

- A. To catalyze the replication
- B. To support the fragile replication fork
- C. To break hydrogen bonds between base pairs

D. To prevent rewinding

27. What functional group does the backbone of DNA and RNA contain?

It contains Phosphate groups.

28. List the structural levels of protein:

1st: (Primary): **amino acid sequence**

2nd: (Secondary): **local shape**

3rd: (Tertiary): **polypeptide shape**

4th: (Quaternary): this is only in the case of multiple polypeptides- how the polypeptides are linked with each other

29. List a way that proteins can denature, and why?

Sample: Heat, because it would disrupt hydrogen bonds within the protein and non-polar hydrophobic interactions.

30. * List 3 common types of proteins and describe them.

Sample:

Fibrous: an elongated protein that provides support, like collagen

Membrane: proteins in membranes; serve a variety of purposes like transporting ions

Globular: sphere shaped proteins that have a wide range of functions, like acting as enzymes

31. * List 3 proteins and describe them.

Sample:

Collagen: a fibrous protein that is very common and helps in support.

Keratin: a fibrous protein that makes up hair, nails, and many other external features.

Myoglobin: a red protein in muscle cells that stores oxygen.

32. Let's say I have protein A. Let's say it was misfolded and became a dangerous prion- what harm could this do to the body, and how?

Sample: This protein would spread and soon many proteins would be misfolded. This occurs in the brain, and holes would appear and cause diseases such as kuru and mad cow disease.

33. * If 2 lizards had a baby, the mother giving green scales (G) and scaly scales (S) and the father gave brown scales (g) and smooth scales (s), create a Punnett square for all the possible outcomes. Also say whether this is a monohybrid or a **dihybrid cross** (circle one).

	GS	Gs	gS	gs
GS	GGSS	GGsS	GgSS	GgSs
Gs	GGsS	GGss	GgSs	Ggss
gS	GgSS	GgSs	ggSS	ggSs
gs	GgSs	Ggss	ggSs	ggss

34. ** Describe all the steps of protein synthesis. Be very specific.

Sample: First is transcription, where mRNA is formed. Here, RNA Polymerase adds complementary RNA nucleotides to the opposite side of unwound DNA strands, creating mobile mRNA.

Then is translation, where mRNA, tRNA, and ribosomes work together to form proteins. This happens when the newly formed mRNA goes through the lower subunit of the ribosome while corresponding tRNA goes through the top. As they match, each tRNA releases an amino acid as it leaves that forms a chain.

35. Give an example of a stop codon and how this works.

Sample: An example is UAA, and when these come in translation, it ends the protein synthesis.

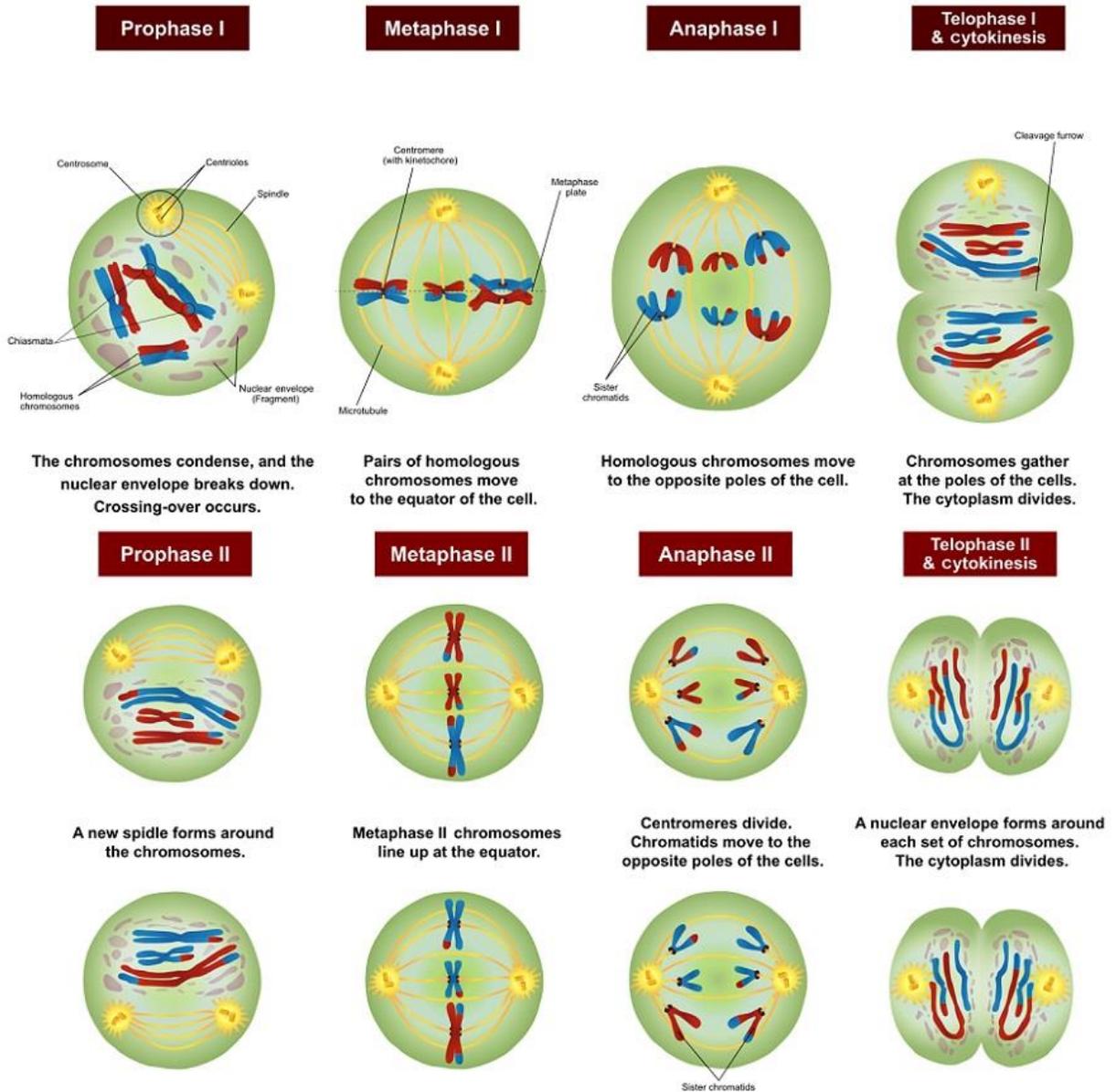
36. Give the name of the start codon in eukaryotes, the base pairs that code for it, and how this works.

Sample: Methionine and AUG. The moment that an AUG sequence is there in a ribosome, complementary tRNA will arrive and the cycle will begin until a stop codon comes along.

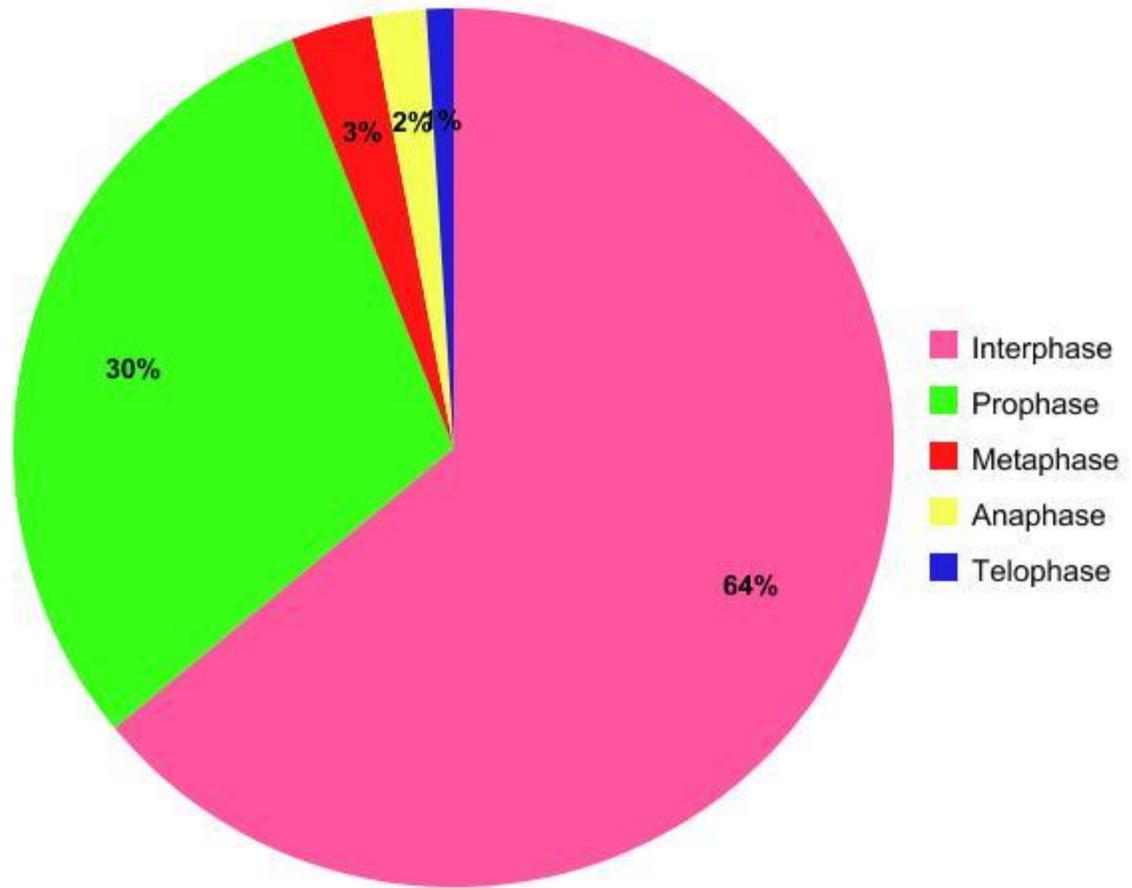
37. Describe the effects of hemophilia and the chromosomes it is found on.

Hemophilia is a disease that prevents blood clotting. It is found on the sex chromosomes.

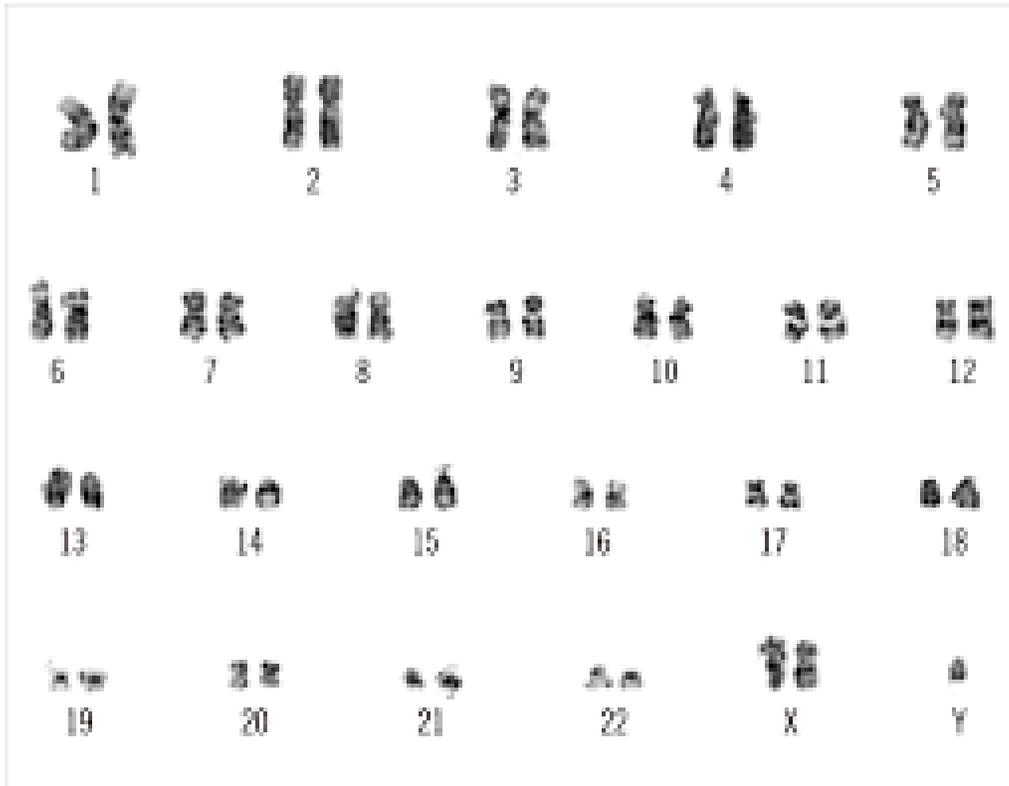
38. ** Draw, label, and describe the stages of meiosis.



39. ** Draw a pie chart showing the time length of interphase and its stages with the other stages of mitosis. Be sure to label the stages of interphase and describe what happens in each of them.



40. Give the gender of the person based off the karyotype. In your response include the name of the disorder this person has and the effects on their body and behavior.



The person's gender is male and they have Klinefelter's Syndrome, meaning they have and extra X chromosome. Some effects of this disorder include female secondary sexual features, such as breast enlargement.

41. Which base pairs are pyrimidines and which base pairs are purines, and what do each of these terms mean (include uracil in your response).

Sample:

Pyrimidines: Cytosine, Uracil, and Thymine. These have 2 heterocyclic rings.

Purines: Adenine and Guanine. These have 1 heterocyclic ring.

42. Name 4 epigenetic influences and what these do to your genes.

Sample: Diet, drugs, exercise, and disease exposure. These change the accessibility of certain genes.

43. Break the levels of organization in chromosomes down... write from the closest to chromosomes to the farthest.

1. Chromatin

2. DNA

3. Genes

44. Describe cystic fibrosis and some of its symptoms and treatments.

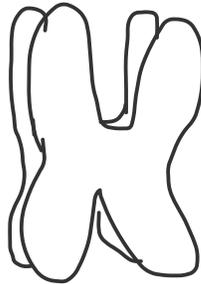
Sample: Cells that produce fluids produce more sticky and viscous fluids that clog passageways. Symptoms include lung infections, coughing, and fatty stools. Treatments include dietary supplements, Antibiotics, Penicillin antibiotics, and Cough medicine.

45. Describe Huntington's Disease and some of its symptoms and treatments.

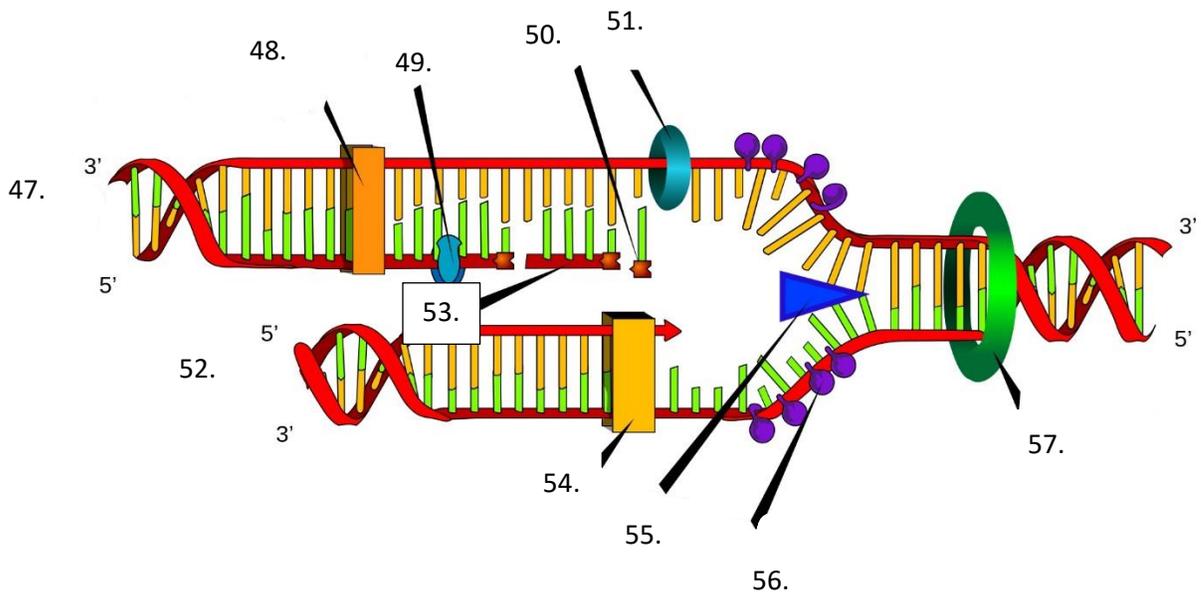
Sample: This is where the nerve cells in the brain break down over time. Symptoms include amnesia, depression, and anxiety. Treatments include counseling, though no cure exists.

46. Draw a simple chromosome tetrad. This does not need to be detailed.

Sample:



47.-57. **** Label the following, and for a ** bonus give all of the functions.**



47. **Lagging strand- purpose is to help create more DNA and code for proteins along with leading strand**

48. **DNA Polymerase I- it's purpose is to replace RNA primers**

49. **DNA ligase- fill gaps between Okazaki fragments**

50. **RNA primer- begin the new replicated DNA strand**

51. **DNA primase- places RNA primers**

52. **Leading strand- helps to create more DNA and conde for proteins along with lagging strand**

53. Okazaki fragment- purpose is to allow the start of the lagging strand replication
54. DNA Polymerase III- purpose is to add onto RNA primers with the actual DNA nucleotides
55. Helicase- separates hydrogen bonds between nucleotides to form replication fork
56. Single strand binding proteins- prevents rewinding of DNA
57. Topoisomerase- Unwinds and prevents supercoiling of DNA
58. Give the translated RNA strand from the following DNA strand:
3-A-T-T-G-C-T-G-A-A-C-T-G-C-T-T-G-A-C-G-T-C-G-G-A-A-A-G-C-T-5
5-U-A-A-C-G-A-C-U-U-G-A-C-G-A-A-C-U-G-C-A-G-C-C-U-U-U-C-G-A-3

Total Score: ___/75