Supplemental Instruction – Biology 2300

SI Leader – Philipp Orbe

Session: 6 – Test Prep 1

1. List the different types of enzymes and their functions.

- helicase: unwind DNA
- primase: add a RNA primer to the unwound DNA
- DNA polymerase: add nucleotides (synthesis of DNA)
- DNA ligase - joins together the okazaki fragments
- Telomerase - adds a telomere sequence to the lagging strand
  - avoid a loss of nucleotides due to replication or degradation.
- Phosphatase - removes phosphate group from protein
- Kinase - adds phosphate group ~~to~~ protein.
  - ADP (A) - P - P
  - ATP (A) - P - P - P

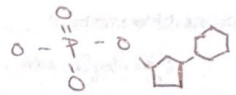
- Protease - breaks down proteins
- ~~Ligase~~
- Nuclease - breaks down nucleotides
- Lipase - breaks down lipids
- Topoisomerase - relieves tension from DNA being unwound.

2. The bonds that holds nucleotides together in a single strand of DNA are phosphodiester bonds.

a) The phosphate backbone is negatively charged.

3. What are 3 parts to a nucleotide? Draw it.

- nitrogenous base
- phosphate
- pentose sugar
  - Penta = 5

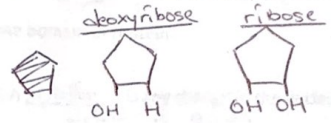


- adenine, thymine, guanine cytosine, uracil.
- single ring
  - pyrimidines
    - C, T, U
- double ring
  - purines
    - Adenine, guanine

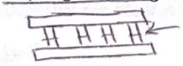
opur as gold
all girls are pur

4. What is the difference in ribose and deoxyribose?

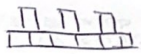
~~ribose~~ ~~deoxyribose~~



5. Why is it important that there is hydrogen bonding and not covalent bonding in between the complementary strands of DNA?

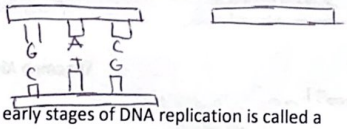


a). Knowing this, why is it important that nucleotides are bound using phosphodiester bonds?



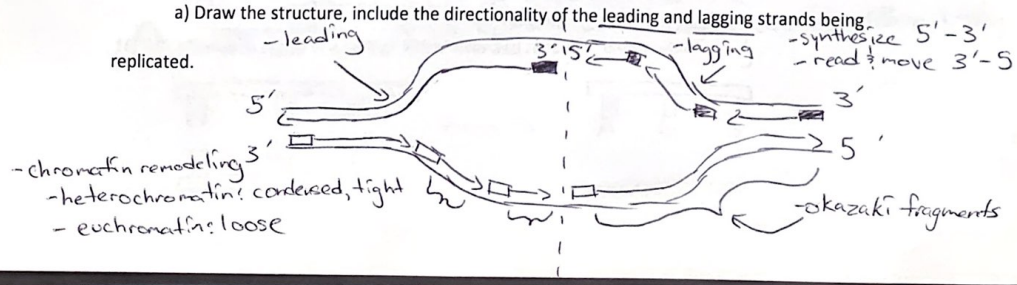
6. How many hydrogen bonds are present between each nucleotide pair?

• GC: 3 • AT: 2



7. The Y-shaped junction formed during early stages of DNA replication is called a replication fork.

a) Draw the structure, include the directionality of the leading and lagging strands being replicated.



8. New strands of DNA are synthesized in the 5'–3' direction.
- DNA polymerase reads or moves in the 3'–5' direction.

9. What is a primer? What enzyme is responsible for the addition of primers?
- Made up of RNA single-stranded, acts as a starting point for DNA synthesis.
- primers added by primase

10. During DNA replication, both a leading and lagging strand are formed. The lagging strand is synthesized in okazaki fragments which are later mended back together by the enzyme DNA ligase (does the ligating)

11. Along with polymerization, DNA polymerase also has proof-reading functions

12. True or (False): Polymerization and editing functions are tightly coordinated, thus they occur on the same domain of protein.

13. A mutation is any change in the nucleotide sequence of DNA.
- can be good
- can be bad

14. What are the 4 types of mutations that can occur in DNA? Also list the two categories in which they fit.

- Nucleotide Substitutions
  - Missense
    - produces different amino acid, and thus a different protein
  - Nonsense
    - produce a stop codon UAA, UAG, UGA
  - Silent
    - no change, no effect

- Insertion / Deletion
  - frameshift mutation

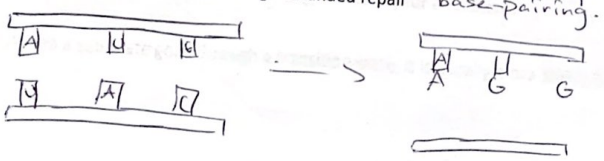
5'-AUGAAACGA-3'
5'-AUGAAACAGA-3'

start codon is AUG, Met, Methionine

15. What are three things that cause DNA damage?
- Mismatched bases
- UV radiation
  - thymine dimer
- Hydrolysis
  - Depurination - removal of Adenine / Guanine
  - Deamination - replace cytosine with uracil, causes different base-pairing.

Depur-ination-
A, G

16. (T)/F: Mismatch repair is a type of single stranded repair



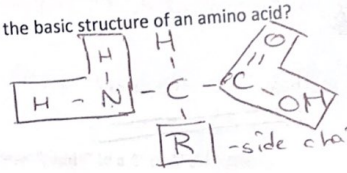
- Non-homologous end joining

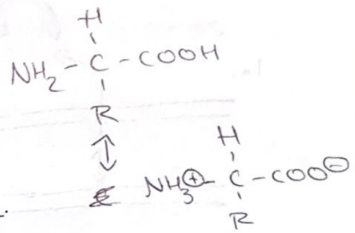
- Homologous recombination

17. Non-homologous (NHEJ) repairs the DNA break with some loss of nucleotides at the repair site

18. Homologous repairs the DNA break with no loss of nucleotides at the repair site

19. What is the basic structure of an amino acid?





20. Long chains of amino acids are called polypeptide.

21. What are some post-translational chemical modifications that a protein may undergo?

methylation - addition of methyl group (formation of heterochromatin)
acetylation - addition of acetyl group (formation of euchromatin)
phosphorylation - addition of phosphate group
ubiquitination - marks for degradation
proteolysis - break down of proteins by hydrolyzing peptide bonds

22. The proteins that help with protein folding are called chaperone proteins. ~~25. What are the four~~ levels of protein structure?

23. Disulfide bonds at cysteine residues help stabilize a favored protein conformation.

24. Define enzyme, substrate, active site.

enzyme - catalytic protein
substrate - a molecule on which enzyme acts
active site - a region on the surface of enzyme that binds to the substrate.

25. Enzymes lower the activation energy necessary for a reaction.

26. T (F) When a substrate goes through a transition state, it is usually more stable than the product.

27. What are the steps in DNA replication?
- chromatin remodeling
- helicase unwinds DNA
- primase adds a primer
- addition of nucleotides by DNA polymerase
- DNA ligase joins OF.
- Telomeres added by Telomerase

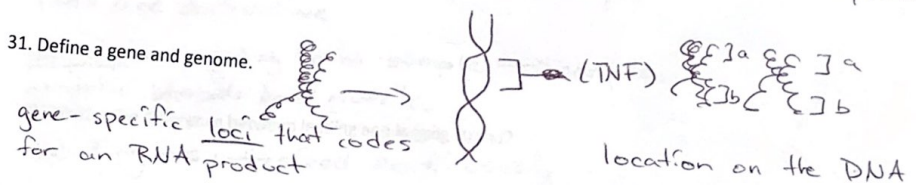
28. Which nitrogenous bases are known as pyrimidines?
- cytosine
- uracil
- thymine

29. Which nitrogenous bases are known as purines?
- adenine
- guanine

- All Girls are pur
- Pur As Gold

30. What is the purpose of the genetic code?
- contains a "set of rules" (Template) that states the genetic info #specific nucleotide sequence for RNA product → protein

31. Define a gene and genome.



gene - specific loci that codes for an RNA product

location on the DNA

32. T/F: Intergenic DNA does not encode for any known proteins

33. Which histone molecules form a protein core in a nucleosome? H1, H2A, H2B, H3, H4
- octameric protein core complex
- 2 of each of: H2A, H2B, H3, H4

4 x 2 = 8

34. Are the amino acids of histones positively or negatively charged?

35. What is the function of a H1 histone?
H1: Linker histone

36. Post-translational modifications of H3. What do these modifications cause?

a) Lysine methylation in gene 9

-addition of methyl (heterochromatin)

-gene suppression

b) Lysine methylation in gene 4 and Lysine acetylation in gene 9

- gene expression

c) Serine phosphorylation in gene 10 and serine acetylation in gene 14

-gene expression

37. Define heterochromatin and euchromatin.

heterochromatin -tightly bound, no way to access genes

euchromatin - loosely bound, access to ~~genes~~ genes

38. T/F: DNA polymerase "reads" in a 5' to 3' direction.

move vs synthesis

39. Define catabolism, anabolism. Provide an example.

catabolism - going from complex → simple
cats are destructive

anabolism - going from simple → complex
anabolic steroids build muscle

40. What is the difference between leading and lagging strand?

Leading - synthesized continuously

Lagging - synthesized discontinuously