

Chapter 2:

3. If only around 1% of all DNA in Eukaryotes encodes for proteins but approximately 80% of DNA is transcribed, is there any function for the remaining ~79% of transcripts?

Answer: Yes, it encodes for regulatory RNA, like miRNA and also functional RNA such as, tRNA and ribosomal RNA.

6. Sociologists often explain that a person is a combination of nature (the genes they are born with) and nurture (the environment they are exposed to). Is there a way for nurture to alter the nature?

Answer: Yes, many aspects of the environment are capable of inducing epigenetic modifications in genes – permanently affecting expression levels of proteins.

9. Single stranded DNA weighs approximately 304 Da per nucleotide, single stranded RNA weighs approximately 321 Da per nucleotide and the average amino acid in a protein weighs 110 Da. For a protein that is 20 amino acids long created from mRNA with no introns, which portion of the genetic message had the most mass in the cell?

Answer: ssDNA = $304 \times 20 \times 3 = 18.2\text{kDa}$, however, DNA is double stranded so the weight is again multiplied by 2 to 36.4kDa. RNA would be 19.3kDa and the protein only 2.2kDa.

12. What is the amino acid sequence that the following mRNA transcript codes for?

3' – AGUUUUAUCCCCGAUGUGCCGAAGUGGAGAGGAGUA – 5'

Answer: Met-Arg-Arg-Trp-Glu-Ala-Val-Stop

15. Researchers have recently began to use DNA and RNA sequences to generate functional conformations by relying on complementary sequences to bind and non complementary sequences to permit bending and folding, like a protein or ribosomal RNA, as opposed to solely carrying genetic information. For the following RNA based aptamer sequence identify what shape would be generated:

5' – AUUACGAUCAUGGAAAUCGUAU – 3'

Answer: A hairpin with the stem created by pairing 5'-AUUACGAU with AUCGUAU-3'

18. In the context of the chromosome, what is the region called that codes for the production of a protein?

Answer: A gene.

Chapter 3:

3. Double stranded DNA demonstrates a helical structure because of the bonding between two complementary strands. What type of bond is formed between complementary strands of DNA and how does the bond vary depending on the nucleotides present?
- a. Answer: Hydrogen bonding. A & T form two hydrogen bonds. C & G form three hydrogen bonds
6. The deamination of cytosine in DNA results in a separate nucleotide. Is this nucleotide normally found in DNA? If it is normally found in DNA, what challenge would the repair of this mutation present?
- a. Answer: Uracil is not normally found in DNA, which allows DNA glycosylases to easily recognize and repair the mutation. If uracil was normally found in DNA, this repair mechanism would be complicated because of the presence of appropriate and inappropriate uracils.
9. The three key polymers of biology are DNA, RNA and proteins; however, carbohydrates and lipids are also important. What are the key differences between carbohydrates and lipids?
- a. Answer: A few differences would be that carbohydrates have an oxygen to hydrogen ratio very similar to water, whereas, lipids have considerably more hydrogen. This results in lipids being very hydrophobic, which makes them useful for biological compartmentalization, e.g. the cell membrane. Additionally, carbohydrates are capable of polymerizing; whereas, lipids contain long hydrocarbon chains but do not polymerize with each other. A similarity between the two is that both are used for energy storage.
12. In proteins, an alpha helix and a beta sheet are examples of what?
- a. Answer: The secondary structure of the protein
15. The Krebs Cycle relies on the oxidation of multiple components. Oxidation results in the liberation of an electron, what is the most common electron acceptor in the Krebs Cycle?
- a. Answer: NAD^+
18. What is glucose converted to for entry into the Krebs Cycle?
- a. Answer: Glucose enters the Krebs Cycle as Acetyl-CoA.

Chapter 4:

3. If you are concerned that eukaryotic cells in culture may have become contaminated by prokaryotic cells, a typical first step would be to use a Gram stain to identify which cell wall the