Section 18.2 Review Answers

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1. The "central dogma" describes how genetic information in DNA is used to make RNA, and how RNA then directs the synthesis of proteins. Transcription is when the sequence of nitrogen bases in DNA is "transcribed" to make RNA. The RNA directs the sequential assembly of amino acids into a chain called a polypeptide, or a protein, in a process called translation.

2. The amino acid that corresponds to each of the mRNA codons is

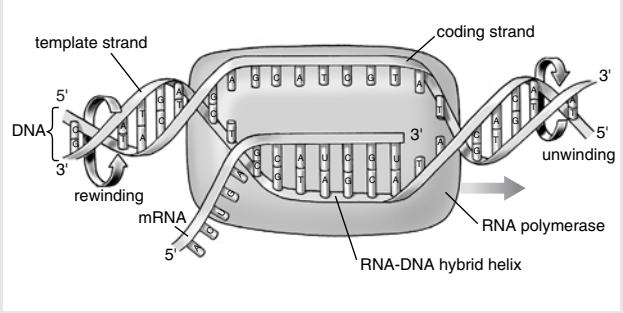
(a) UCC – serine **(b)** ACG – threonine

(c) GUG – valine **(d)** CAC – histidine

3. The codons that code for serine are UCU, UCC, UCA, UCG, AGU, and AGC.

4. Almost all living organisms have the same genetic code. A gene that is taken from one species and inserted into another will produce the same protein.

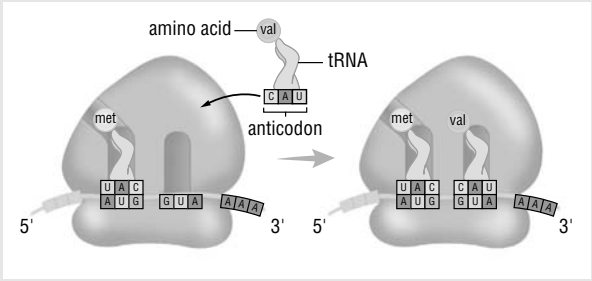
5. Student diagrams should resemble Figure 18.13, which illustrates the process of transcription.



6. Because DNA is double stranded, DNA polymerase is able to recognize whether hydrogen bonding is taking place between a base in the newly synthesized strand of DNA and its complement in the original strand. The absence of hydrogen bonding indicates a mismatch between bases, and DNA polymerase excises the incorrect base and inserts the correct one. This proofreading ability reduces the incidence of mutation in the genetic code and the possible translation of a nonfunctional protein. Other suggestions may be provided. Accept any reasonable answer.

7. The ribosomes provide the machinery for translation. Ribosomes are located both freely in the cytoplasm, and bound to the endoplasmic reticulum.

8.



- Translation is activated when an mRNA molecule binds to an active ribosome complex. The mRNA binds in such a way that two adjacent codons are exposed. The first tRNA molecule carrying the amino acid methonine temporarily bonds with the exposed mRNA start codon. Once the tRNA and mRNA are in place, translation follows a cycle of three steps:
- A second "loaded" tRNA molecule arrives at the codon adjacent to the first tRNA.
- Enzymes catalyze the formation of a peptide bond that joins the amino acid carried by the first tRNA to the amino acid carried by the second tRNA. At the same time, the amino acid chain is transferred from the first tRNA to the second tRNA.
- The ribosome moves a distance of one codon along the mRNA strand. The first tRNA molecule detaches from the mRNA, and picks up another amino acid. The second tRNA now holds a growing amino acid chain. A third tRNA molecule arrives at the newly-exposed codon next to the second tRNA, and the cycle repeats.

9. Ribosomal RNA (rRNA) is found in the ribosomes, which is where the messenger RNA (mRNA) is read and the amino acids are assembled to form a polypeptide. Messenger RNA (mRNA) transcribes the genes—the sequence of nitrogen bases in a strand of DNA—and carries this "message" from the DNA in the nucleus to the ribosomes in the cytoplasm. Transfer RNAs (tRNA) in the cytoplasm bond to individual amino acids and take them to the complementary codons of the mRNA at the binding site on the ribosome, where a growing polypeptide chain is built.

10. (a) In a eukaryotic cell transcription occurs in the nucleus and translation occurs in the cytoplasm. In a bacterial cell, the DNA is in the cytoplasm; there is no nucleus.

(b) The main advantage is that protein synthesis can occur faster because the mRNA does not have to leave the nucleus as it does in a eukaryotic cell. A possible disadvantage is that in bacterial cells, DNA is not protected by a a nucleus and the chance of DNA mutation may be increased.