cise 6 (Modules 10.7–10.15)

These modules explain how the information in genes is used to build proteins. Review the processes of transcription and translation by filling in the blanks that follow.

The first step in making a protein is transcription of a gene. This occurs in the [1]_____ of a eukaryotic cell. An enzyme called [2]_____ carries out the process of transcribing RNA from the DNA. It starts at a specific nucleotide sequence called a [3]_____, next to the gene. RNA polymerase attaches, and the two DNA strands separate. RNA polymerase moves along one strand, and as it does, RNA [4]_____ take their places one at a time along the DNA template. They form hydrogen bonds with complementary DNA bases, following the same pairing rules as in DNA—C with G, and U (replacing T in RNA) with A. As the RNA molecule elongates, it peels away from the DNA. Finally, RNA polymerase reaches the [5]_____, a base sequence that signals the end of the gene, and the enzyme lets go of the gene and the RNA molecule. In a prokaryote, the RNA transcribed from a gene, called [6]_____ (mRNA), can be used immediately in polypeptide synthesis. In a eukaryotic cell, the RNA is further modified, or [7]_____, before leaving the nucleus as mRNA. Extra nucleotides are added to the ends of the transcript, and noncoding regions called [8]_____ are removed. The remaining coding regions, called [9]_____, are spliced together to form a continuous coding sequence. The finished mRNA leaves the nucleus and enters the [10]_____, where translation into protein takes place.

Translation of the "words" of the mRNA message into the [11]_____ sequence of a protein requires an interpreter—[12]_____ (tRNA)—which matches the appropriate [13]_____ with each [14]_____ in the mRNA message. A tRNA molecule is a folded strand of RNA. At one end, a special [15]_____ links the tRNA to a specific amino acid. The other end of the tRNA molecule bears three bases called the [16]_____, which is complementary to a particular mRNA codon. During the translation process, the tRNA matches its amino acid with an mRNA codon.

[17]_____ are the "factories" where the information in mRNA is translated and polypeptide chains are constructed. A ribosome consists of protein and [18]_____ (rRNA). Each ribosome has a groove that serves as a binding site for mRNA. There are two binding sites for tRNA: The P site holds the tRNA carrying the growing [19]_____, while the A site holds a tRNA bearing the next amino acid.

Translation begins with initiation. An mRNA and a special [20]_____ tRNA bind to the ribosome and a specific mRNA codon, the [21]_____, where translation begins. The initiator tRNA generally carries the amino acid methionine (Met). Its anticodon UAC binds to the start codon, AUG. The initiator tRNA fits into the P site on the ribosome.

The next step in [22]_____synthesis is elongation—adding amino acids to the growing chain. The anticodon of an incoming tRNA, carrying its amino acid, pairs with the mRNA codon at the open A site. With help from the ribosome, the polypeptide attached to the tRNA in the P site separates from its tRNA and forms a

peptide bond with the [23]_____ attached to the tRNA in the A site. Then the "empty" tRNA in the P site leaves the ribosome, and the tRNA in the A site, with the polypeptide chain, is shifted to the P site. The mRNA and tRNA move as a unit, allowing the next codon to enter the A site. Another tRNA, with a complementary anticodon, brings its amino acid to the A site. Its amino acid is added to the chain, the tRNA leaves, and the complex shifts again. In this way, [24]_____ are added to the chain, one at a time.

Finally, a [25]_____ in the mRNA reaches the A site of the [26]_____, terminating the polypeptide. A stop codon causes the polypeptide to separate from the last tRNA and the [27]_____. The polypeptide folds up, and it may join with other polypeptides to form a larger [28]_____ molecule.