

## Section 7.3: Translation: Nucleic Acid to Polypeptide

### Mini Investigation: Computer Simulation of Protein synthesis, page 330

**A.** Answers may vary. Sample answer: The steps in the simulation were the same as the ones in the textbook: transcription, including initiation and elongation; and translation, including formation of the ribosome, the work of tRNA, and the formation of a polypeptide. The simulation did not show termination of transcription, and did not show as much detail as the textbook did.

**B.** The codons on mRNA that signal a ribosome to stop building a polypeptide are UAA, UAG, and UGA.

**C.** Answers may vary. Students may suggest providing opportunities to slow or pause the motion, labelling the cell components shown on the screen, or allowing the viewer to zoom in or out to see more detail or get a wider view of the process.

**D.** Answers may vary. Sample answer: Based on my experience with this simulation, I think simulations can provide a valuable perspective on a process that written words alone cannot provide. I understand more about protein synthesis because I could both read about it and examine details of it on a page and watch the process happening in three dimensions in the simulation. Both experiences merge to build a fuller understanding of how proteins are synthesized.

### 7.3 Section Questions, page 331

**1.** In both eukaryotes and prokaryotes, the key steps in the initiation of translation are the association of an initiator methionine-tRNA with the small ribosomal subunit. The complex binds the mRNA at the 5' cap and scans for the AUG start codon. The large ribosomal subunit then binds, completing the ribosome, and translation proceeds.

**2.** The role of tRNA in translation is to shuttle the appropriate amino acid into place in the growing peptide by recognizing the mRNA code.

**3.** There is not a specific tRNA molecule for each possible codon because several codons code for the same amino acid. If one tRNA recognizes each amino acid, then it can work efficiently by recognizing all the codons that code for it. There are many more codons than there are amino acids, but a unique tRNA molecule is not needed for each one.

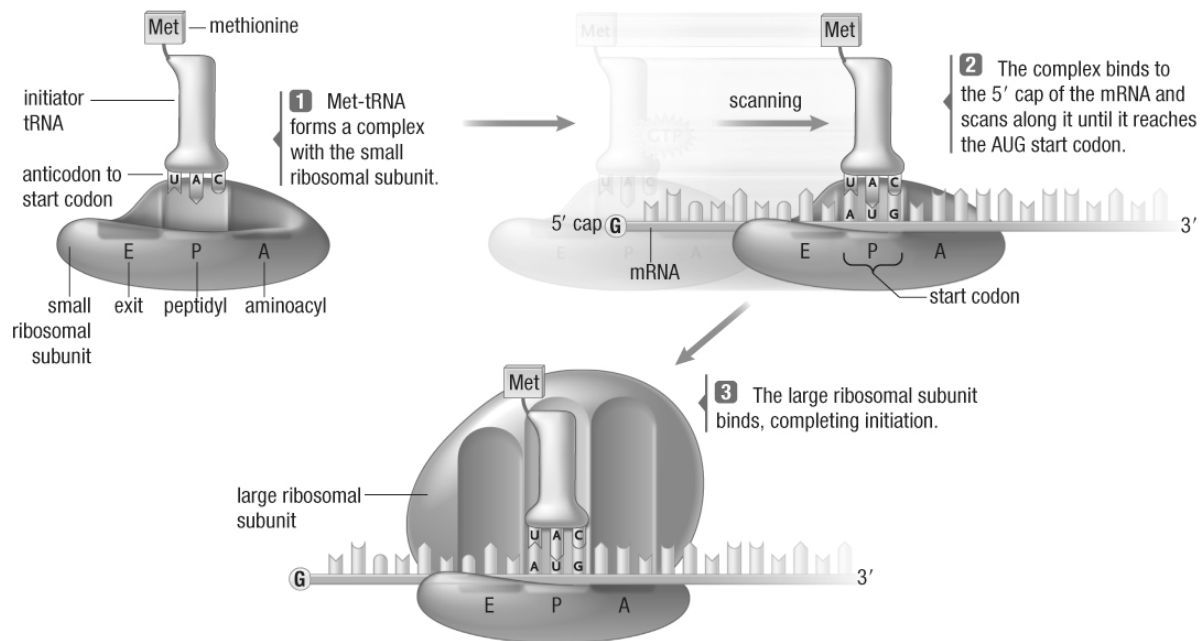
**4.** The anticodons for phenylalanine include: AAA and AAG. The anticodons for alanine include: GCU, GCC, GCA, and GCG. The anticodons for tyrosine include AUA and AUG.

**5.** This does not lead to frequent mistakes because mutations in the third nucleotide of a codon may not affect the binding of the proper tRNA anticodon. If there is an error in transcribing the third nucleotide in a codon, in most cases it will not affect the protein being produced.

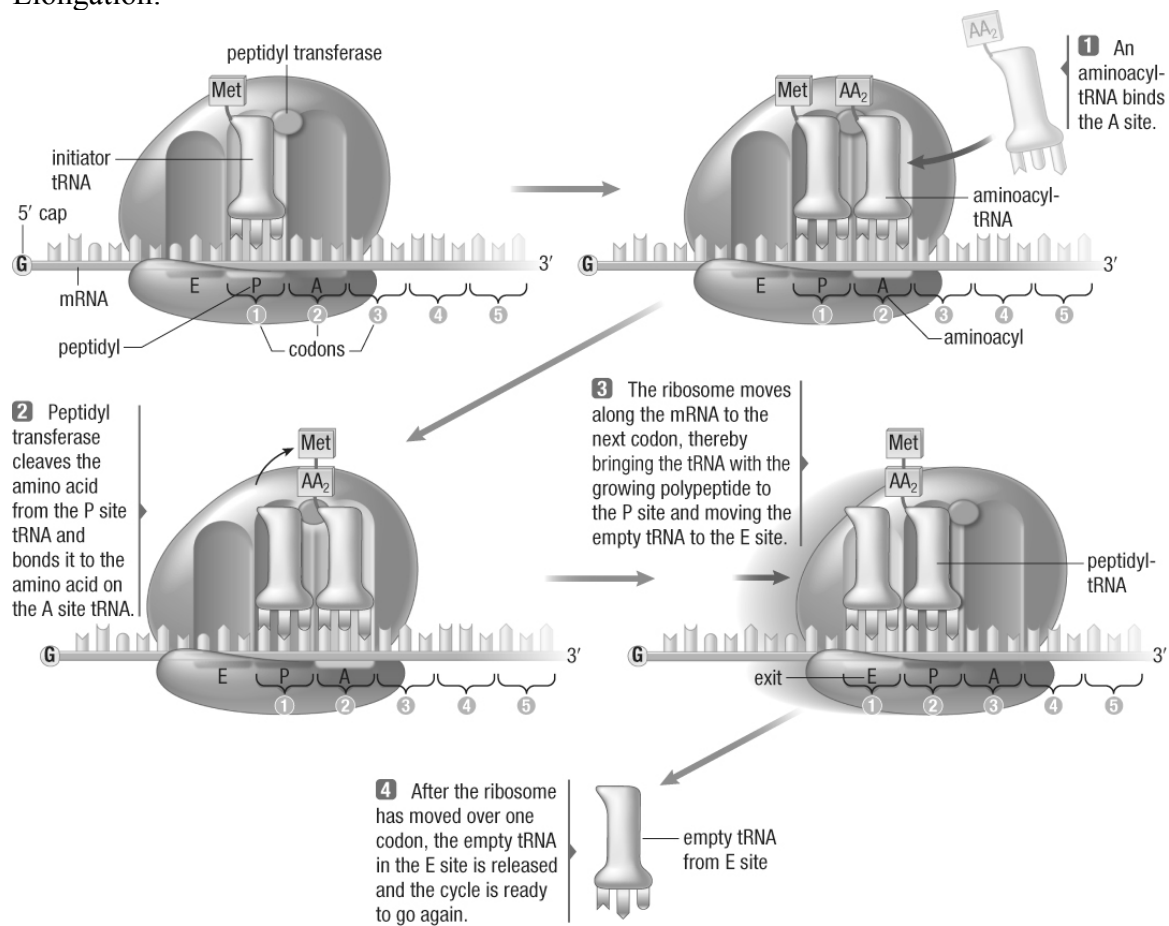
**6.** The A site is where the mRNA is recognized by the appropriate tRNA, which has an amino acid bound ready to add to the growing peptide chain. The P site is where translation is initiated by the association of the methionine tRNA with the mRNA and the ribosome. The P site is also the site of the formation of peptide bonds that are catalyzed by the polypeptide transferase, which uses the hydrolysis of GTP to drive the reaction. As the chain moves along, the empty tRNA exits the ribosome at the E site.

**7.** Answers may vary. Sample answer: Some examples of processes that demand high rates of protein production in humans include the production of new proteins in preparation for cell division and the production of digestive enzymes by the pancreas.

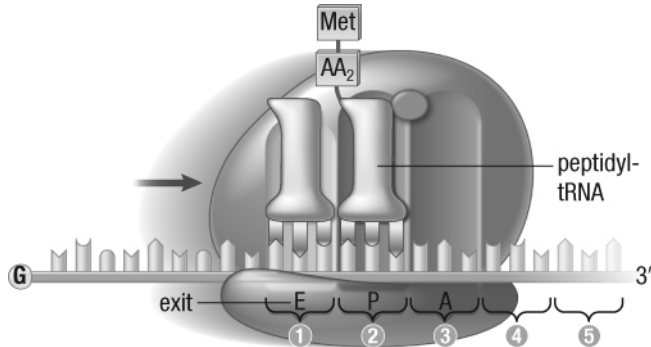
8. Answers may vary. Sample answer:  
Initiation:



Elongation:



Termination:



**9.** Answers may vary. Presentation of findings should include: The human proteome project aims to generate a map of the protein molecular architecture of the human body, leading to the development of advanced diagnoses and treatments of diseases. The Human Proteome Organization uses molecular biological techniques to help characterize the mRNA content of various cells and carries out bioinformatics analysis on the DNA code to determine characteristics of proteins coded by genes and patterns in their expression.

**10.** Answers may vary. Sample answer: Examples of proteins coded for by multiple genes include: glutamate-binding NMDA receptors composed of subunits manufactured by different genes; and chloroplast  $H^+$ -ATP synthase composed of CF1 and CF0 subunits coded by different genes.