

Check your knowledge

How many bases are in each codon?

What is the anticodon for AAU? What amino acid is coded for by the codon?

What happens when a stop codon is reached?

Answer: three, UUA and ASN (asparagine), the polypeptide chain is released from the ribosome

The Mechanism of Protein Synthesis

Just as with mRNA synthesis, protein synthesis can be divided into three phases: initiation, elongation, and termination. The process of translation is similar in prokaryotes and eukaryotes. Here we will explore how translation occurs in *E. coli*, a representative prokaryote.

Protein synthesis begins with the formation of an initiation complex. In *E. coli*, this complex involves the small ribosome subunit, the mRNA, three initiation proteins, and a tRNA carrying the amino acid methionine (Figure 10.32). The tRNA has a region called the **anticodon**. The anticodon complements and interacts with the AUG start codon on the mRNA and delivers the first amino acid, methionine. Once the anticodon of tRNA base pairs with the AUG codon of the mRNA, the large ribosomal subunit binds to the complex. This step completes the initiation of translation.

The next step, elongation, takes place as the ribosome moves along the mRNA. Again, the basics of elongation are the same in both prokaryotes and eukaryotes, so we will review elongation from the perspective of *E. coli*. The large ribosomal subunit consists of three compartments: the A site, the P site, and the E site. The A site is responsible for binding incoming charged tRNAs. A charged tRNA is one that is attached to its specific amino acids. The P site binds charged tRNAs carrying the amino acids that are connected by peptide bonds. These amino acids are part of the growing polypeptide chain but have not yet dissociated from their corresponding tRNA (Figure 10.32).

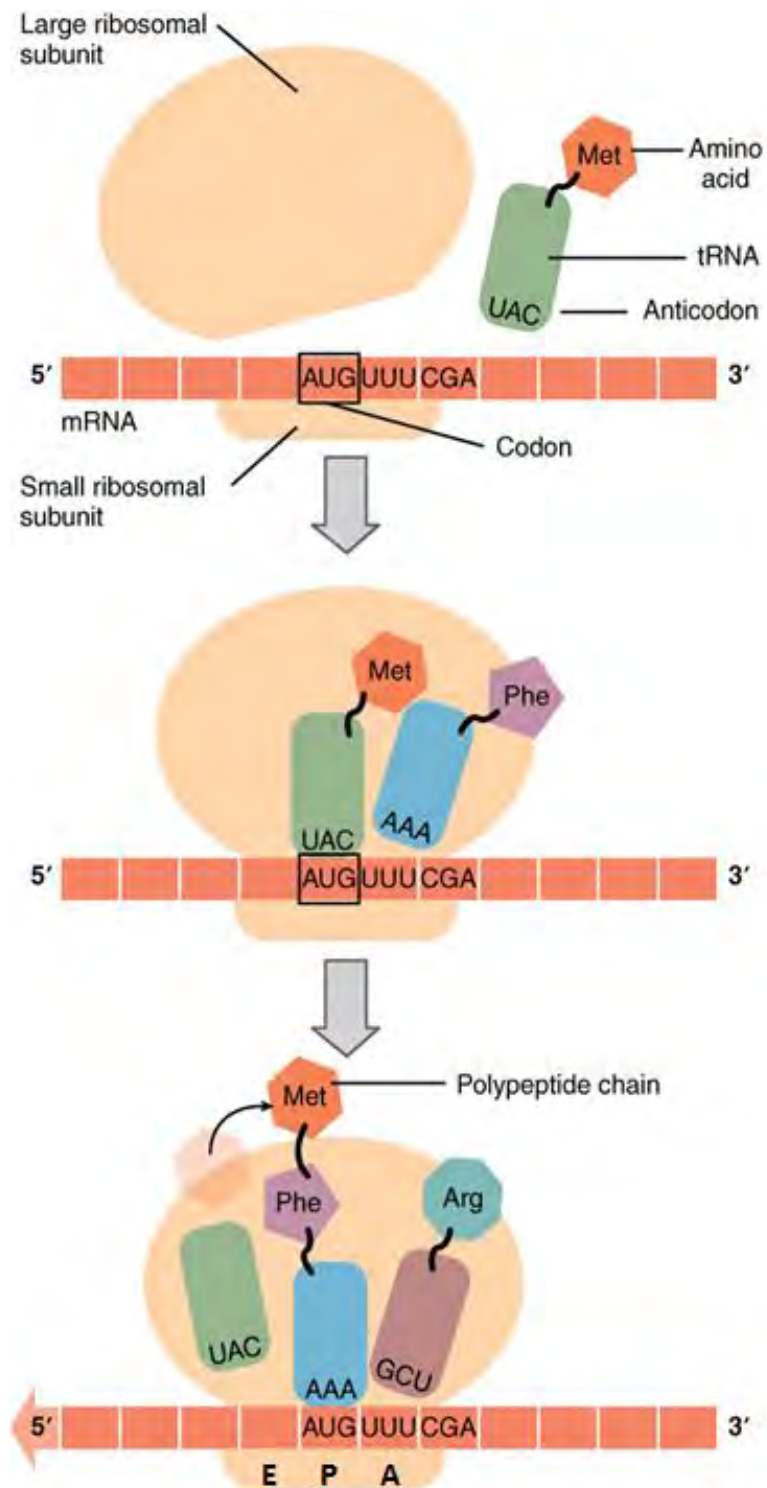


Figure 10.32 Translation begins when a tRNA anticodon recognizes a codon on the mRNA. The large ribosomal subunit joins the small subunit, and a second tRNA is recruited. As the mRNA moves relative to the ribosome, the polypeptide chain is formed. (credit: Modified by Elizabeth O'Grady original work of Betts et al. / [Anatomy and Physiology OpenStax](#))

Peptide bonds are special covalent bonds that exist between the amino group of one amino acid and the carboxyl group of a second amino acid (Figure 10.33). The E site releases uncharged tRNAs so they can be recharged with free amino acids (Figure 10.32).

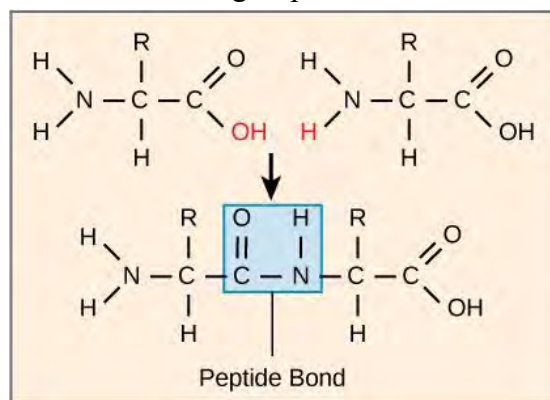


Figure 10.33 A peptide bond links the carboxyl end of one amino acid with the amino end of another, producing one water molecule during the process. This is a dehydration synthesis reaction. (credit: Clark et al. / [Biology 2E OpenStax](#))

The ribosome shifts one codon at a time, catalyzing each process that occurs in the three sites (Figure 10.32). With each step, a charged tRNA enters the complex, the polypeptide chain becomes one amino acid longer, and an uncharged tRNA departs. The energy for each bond between amino acids is derived from GTP, a molecule similar to ATP.

Termination of translation occurs when a stop codon (UAA, UAG, or UGA) is encountered. When a stop codon enters the ribosome's A site the growing polypeptide is released, and the ribosome subunits dissociate and leave the mRNA. After many ribosomes have completed translation, the mRNA is degraded so the nucleotides can be reused in another transcription reaction.

CONCEPTS IN ACTION- Learn more by watching the video on [translation](#).

Practice transcribing and translating genes by clicking [on this link](#)

Check your knowledge

The nucleotide code on a gene on DNA is GCT.
What is the mRNA codon?
What is the tRNA anticodon?
What amino acid is coded?

Answers: CGA, GCU, Arg (arginine)