BIO 1305 – Modern Concepts in Bioscience I – Campbell Textbook
Week 13 – Chapter 17

Hi everyone! Welcome back to another resource. I hope you're ready to finish the semester super strong! These next few weeks in biology are super important if you plan to continue taking more bio classes. They are also super fun and interesting! Let's jump right in because we have a lot to cover in chapter 17! Don't forget that Gabriel and I hold weekly group tutoring sessions on Thursdays from 5-6 pm. Sign up to join us here: https://baylor.edu/tutoring. We would love to see you there!

Keywords for this week: Transcription, Translation, RNA Processing, Mutations

As usual, watch the linked **videos** to review concepts as you read them!

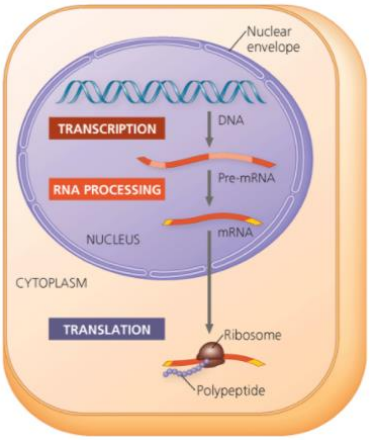
Chapter 17: From Gene to Protein

Have you ever wondered just how your DNA *becomes* you? We've all heard that DNA is genetic material, but what does that really mean? The answer lies in **gene expression**, the process through which the information stored in *DNA* is turned into *proteins*, which compose you. Gene expression is comprised of two main phases: **transcription and translation.**

Basic Principles

Before jumping into the specifics of transcription and translation, there are some things we need to talk about first…

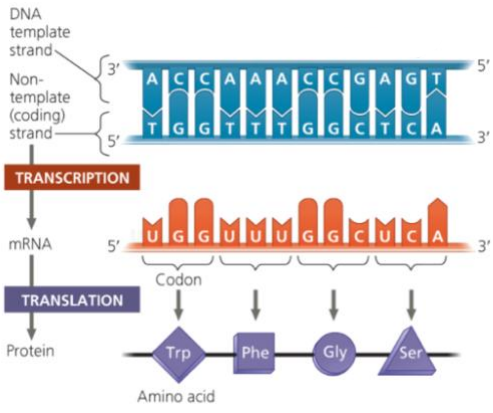
- **mRNA** – Remember RNA from a few resources back? RNA is the "*bridge*" between DNA and protein. Specifically, mRNA is the molecule used. mRNA is "*messenger*" RNA, because it is a "message" that comes from the DNA to be made into a protein.
- **Transcription** – creation of the mRNA molecule from the DNA template.
- **Translation** – creation of a polypeptide from the mRNA. Occurs on ribosomes



Video: Transcription, translation and genetic code

Here are a few more basic principles about the genetic code to understand before moving on:

- **Triplet code:** the mRNA is read by a ribosome using a triplet code language. "Codons" are read by the ribosome and specify for specific amino acids to be added to the polypeptide chain. Codon tables are used to match up codons with their amino acids.
- **Template strand:** the strand that is transcribed from the DNA



Transcription

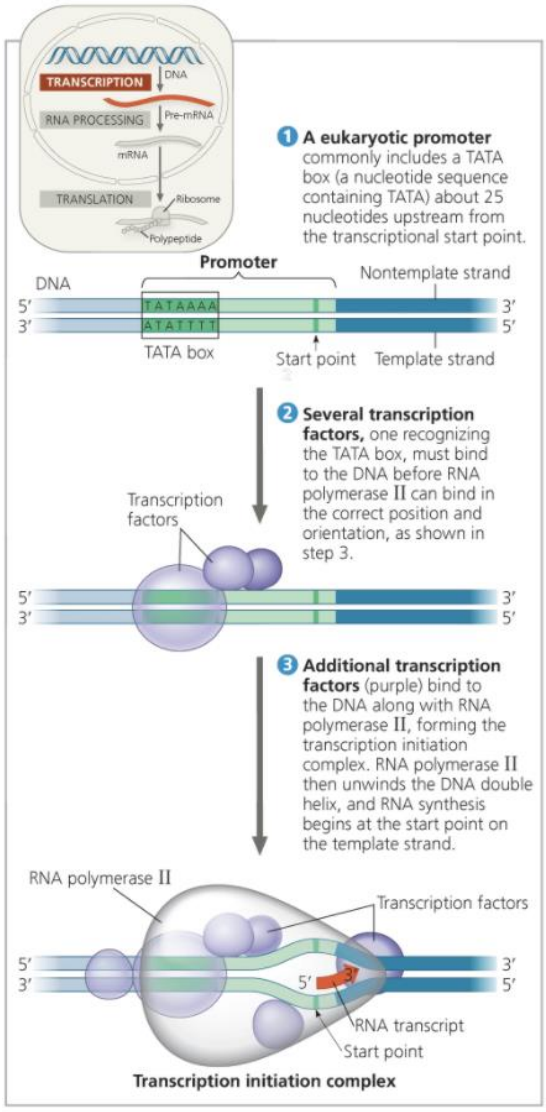
In **transcription**, mRNA is created from DNA. This process involves several pieces:

- **RNA polymerase:** the enzyme that separates the DNA strands and brings complementary RNA nucleotides to the strand, creating the RNA strand.
    - Creates RNA strand in a 5' → 3' direction. Nucleotides are added to the *3' end*.
    - Doesn't require a primer but requires a **promoter** for RNA polymerase to recognize and bind to.
    - A terminator tells the RNA polymerase to stop

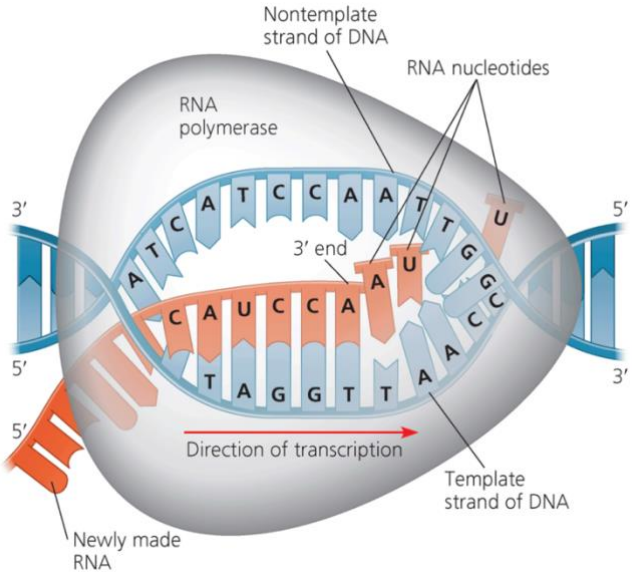
Video: Molecular components of transcription

There are three stages of transcription: initiation, elongation, termination. I think that these pictures describe the stages well:

Initiation



Elongation



Termination

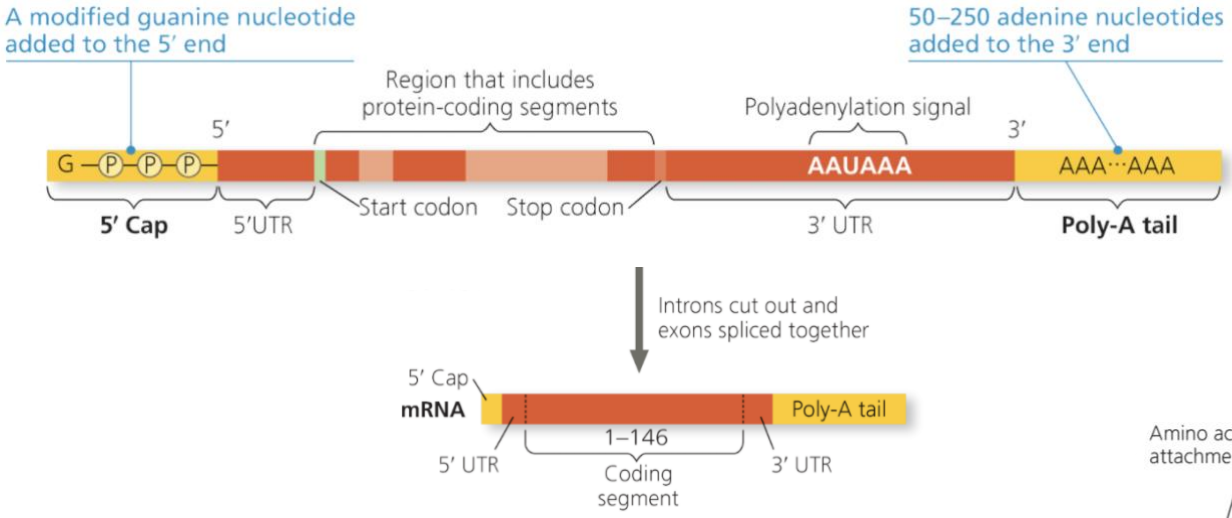
This stage is different for bacteria and eukaryotes.
In *bacteria*, a terminator sequence stops the RNA polymerase.
In *eukaryotes*, the RNA polymerase transcribes a polyadenylation signal. Proteins bound to this area cut the mRNA from the polymerase.

Video: Stages of transcription

RNA Processing

There is a small "substage" that occurs in eukaryotic gene expression. During RNA processing, the mRNA transcript that has just been created is modified. Here are the ways it is changed:

- **Addition of 5' cap:** a modified guanine is added to the 5' end
- **Poly-A tail:** 50-250 adenines are added at the 3' end
- **RNA splicing**: segments of the transcript are excised in a "cut and paste" fashion



Video: **RNA processing**

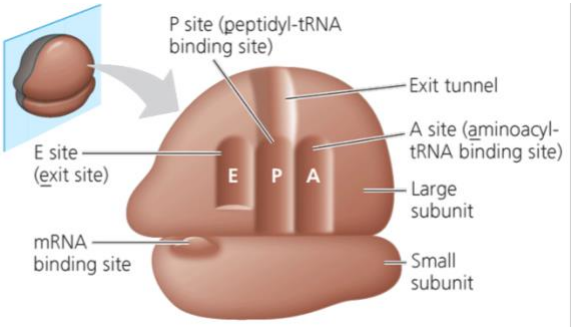
Translation

In this portion of gene expression, the message of mRNA is turned into a *functional protein*. Like before, here are some terms to be familiar with before going forward:

- **tRNA:** this is transfer RNA. It brings amino acids from the cytoplasm to the polypeptide in the ribosome.
- **Aminoacyl-tRNA synthetases**: join the amino acids to the appropriate tRNA

There are also important terms to know before examining the process of translation:

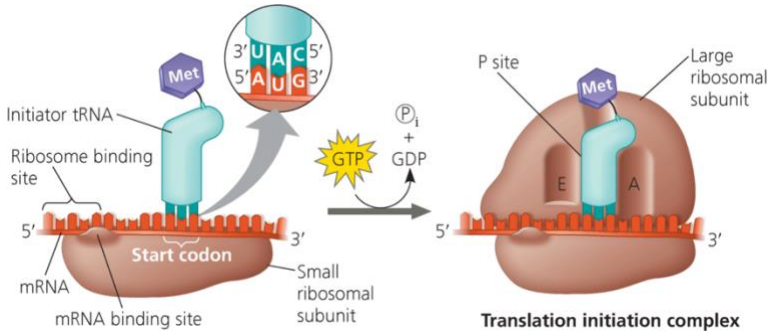
- **P site:** holds tRNA with growing chain
- **A site:** holds tRNA that has the next amino acid
- **E site:** where tRNA leaves



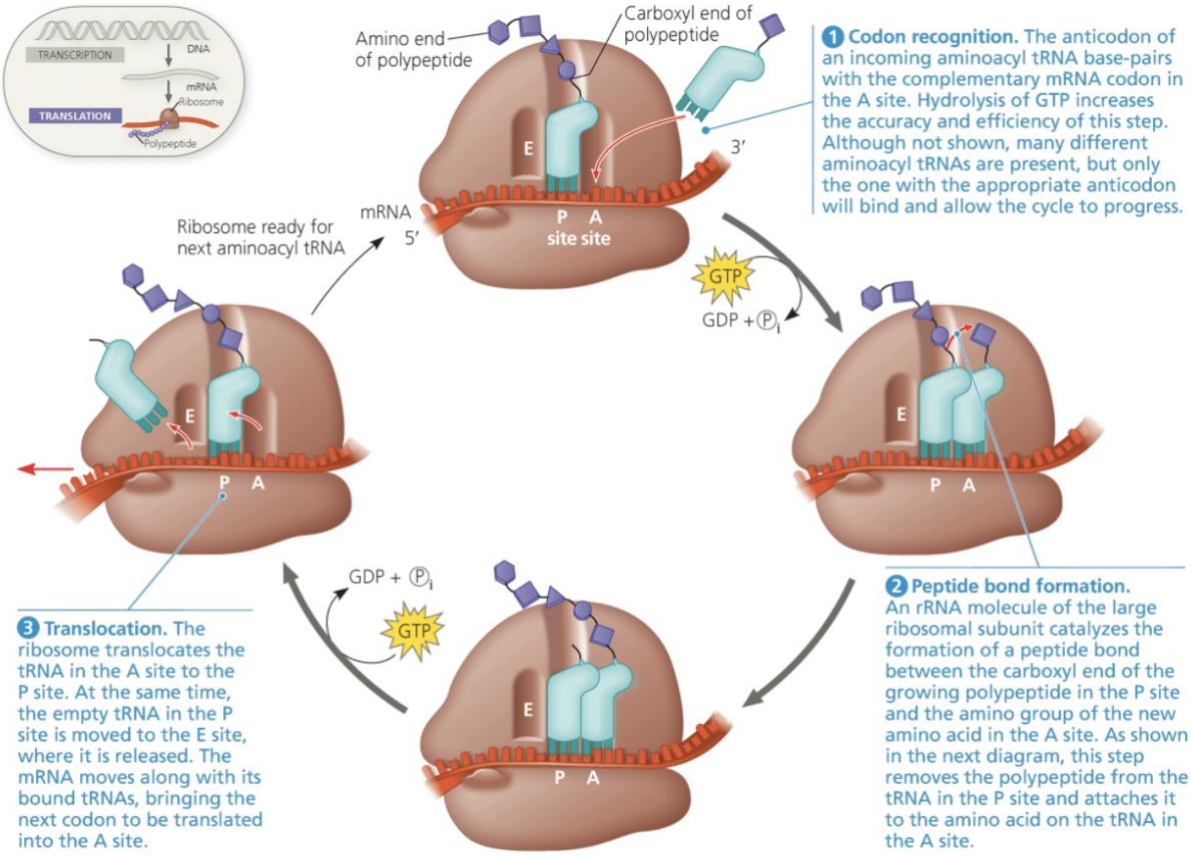
Video: Molecular components of translation

The stages of translation are complex but looking at photos in your book and watching videos is very helpful in understanding exactly how it happens. Like with transcription, there are three stages: initiation, elongation, and termination. Here are some diagrams that will be helpful:

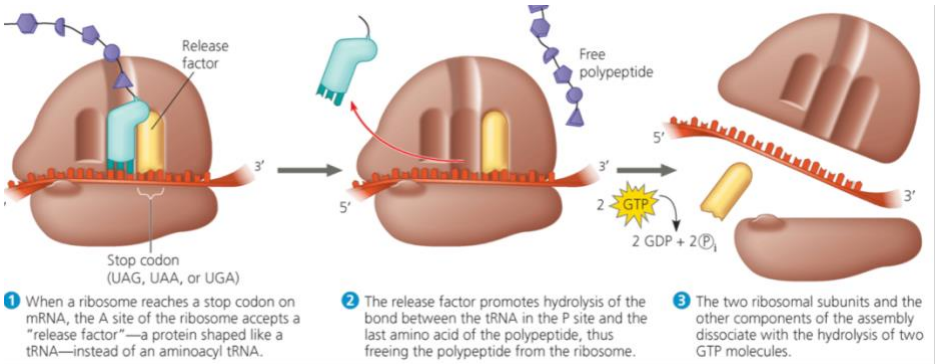
Initiation



Elongation



Termination



Video: Stages of translation

Wow! We made it through the main stages of gene expression. To finish up, here are a few more points that important to know about how proteins are *finalized*:

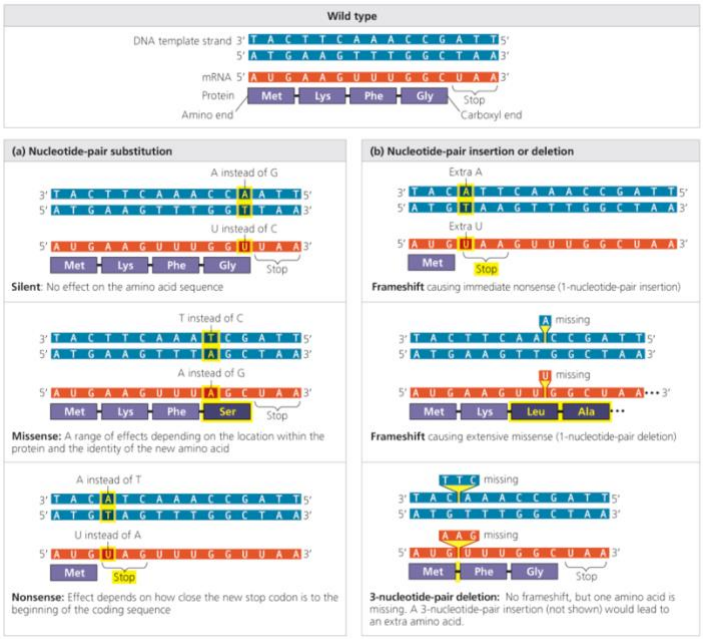
Post-translational modifications may be needed after the polypeptide is released from the ribosome. This specifies the protein's function and can involve addition of molecules or removal of amino acids from the chain.

Proteins also need specific markers that allow them to go to the right area of the cell. For example, for a protein destined to work at the endoplasmic reticulum, a **signal peptide** is added to the polypeptide. This signal peptide is eventually recognized by machinery that carries the protein to the appropriate location.

Video: Post-translational modifications and signaling mechanisms

Mutations

We have explored how genes are expressed and the materials required to make proteins. Now we can consider what happens when the genetic code is altered or damaged. This happens through **mutations**! There are several types of mutations shown in the diagram below:



Video: Mutations and protein structure

That's about it guys! I know this resource was based heavily on diagrams and pictures, but I really believe that is the best way to understand these concepts that have so many moving parts and pieces! My recommendation for studying is to learn the story of gene expression. Be able to talk about it & describe it to a friend! Once you can teach it to someone else, you know you REALLY know the information. Thanks for sticking with me!