Week 13

BIO-1305 - Biology 1 – Campbell Textbook

Hello and welcome to the weekly resources for BIO-1305 - Biology 1 – Campbell Textbook!

This week is Week 13 of class, and typically in this week of the semester, your professors are covering the topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel, or any tutoring services we offer, please visit our website www.baylor.edu/tutoring **or call our drop in center during open business hours (M-Th 9am-8pm on class days at 254-710-4135).**

Keywords: Transcription, Translation, RNA Processing, Post-translational Modification

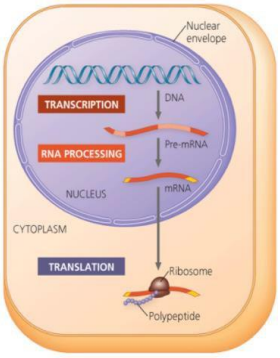
Topic of the Week: Transcription and Translation Basics

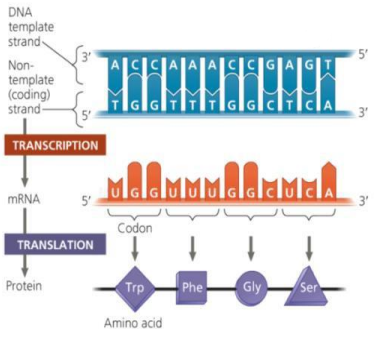
Have you ever wondered just how your DNA *becomes* you? We've all heard that DNA is genetic material, but what does that really mean? The answer lies in **gene expression**, the process through which the information stored in *DNA* is turned into *proteins*, which compose you. Gene expression is comprised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





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

Highlight #1: Transcription

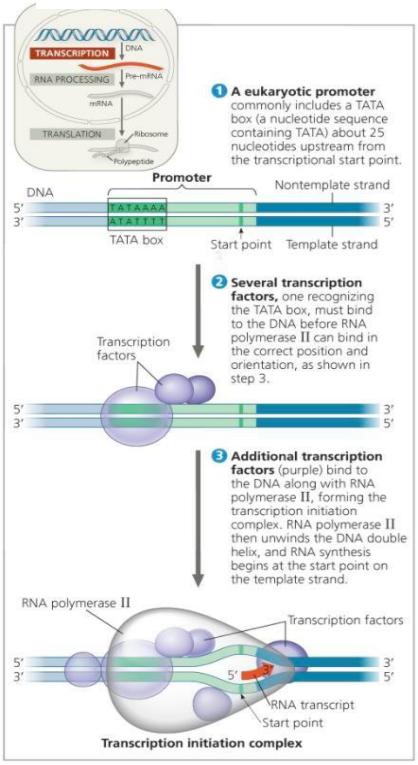
Transcription

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

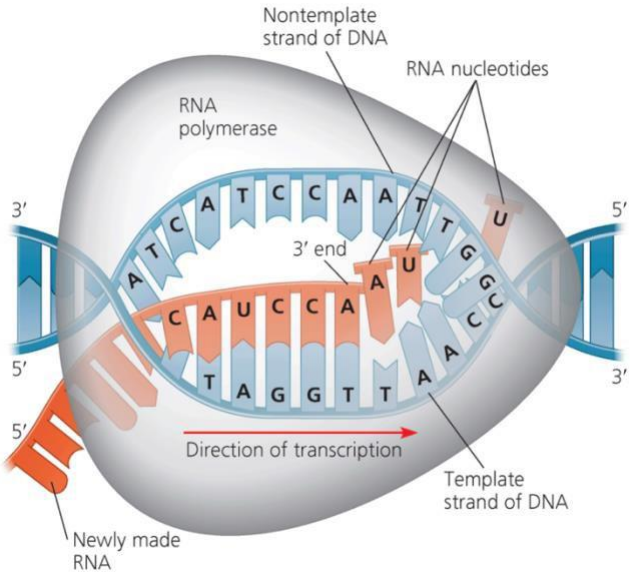
- **RNA polymerase:** the enzyme that separates the DNA strands and brings complementary RNA nucleotides to the strand, creating the RNA strand.
  - Creates RNA strand in a 5' ➔ 3' direction. Nucleotides are added to the *3' end*.
  - Doesn't require a primer but requires a **promoter** for RNA polymerase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

There are three stages of transcription: initiation, elongation, termination.

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.

Highlight #2: Translation

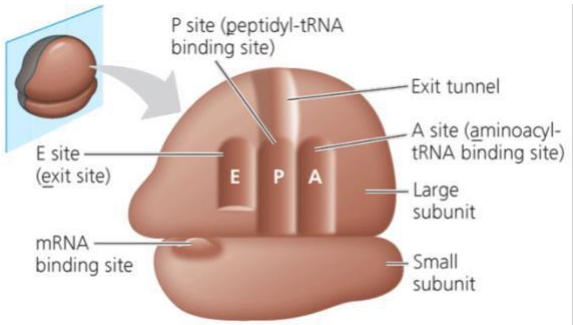
Translation

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

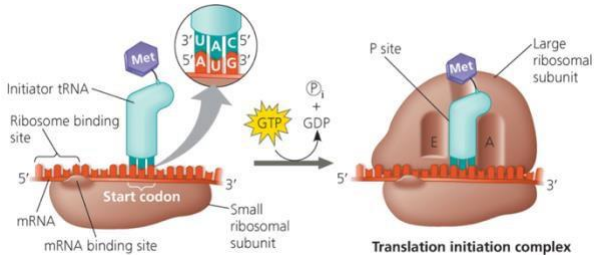
There are also important terms to know before examining the process of translation:

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

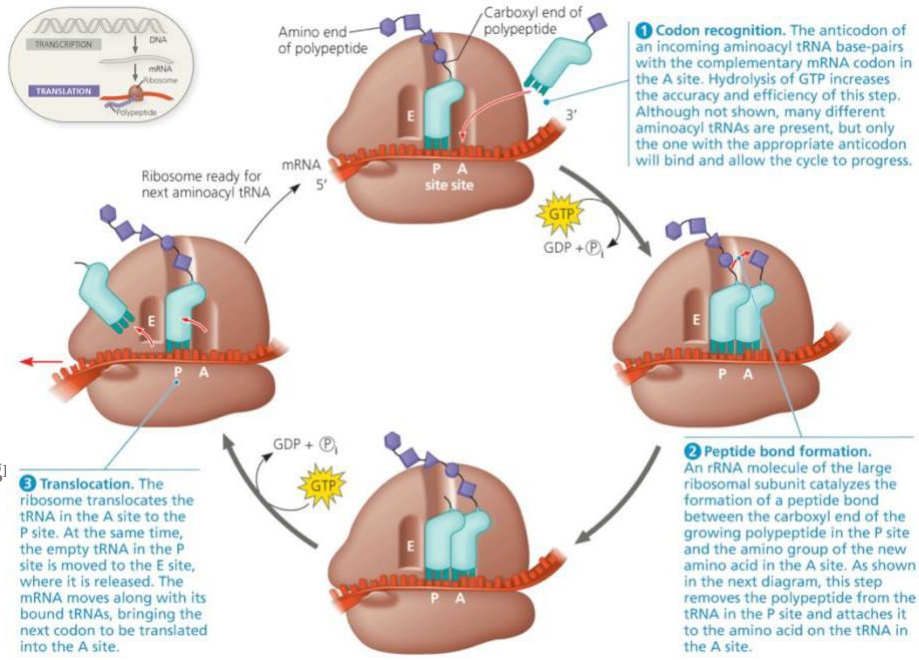


The stages of translation are complex but looking at photos in your book and watching videos is very helpful in understanding exactly how it happens. Like with transcription, there are three stages: initiation, elongation, and termination. Here are some diagrams that will be helpful:

Initiation



Elongation



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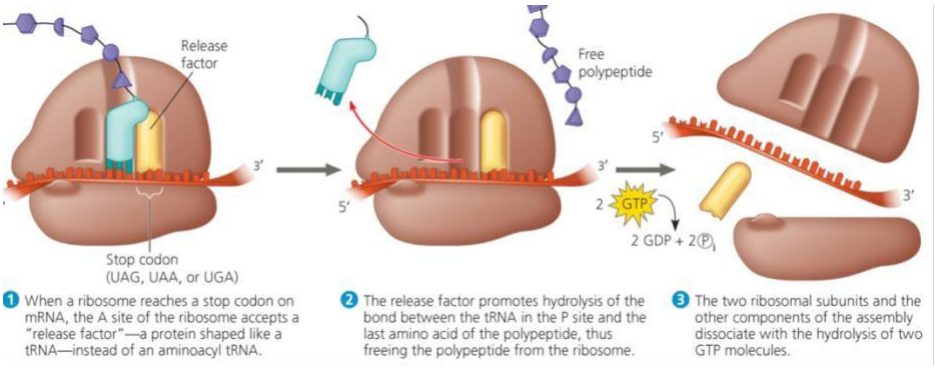
Termination

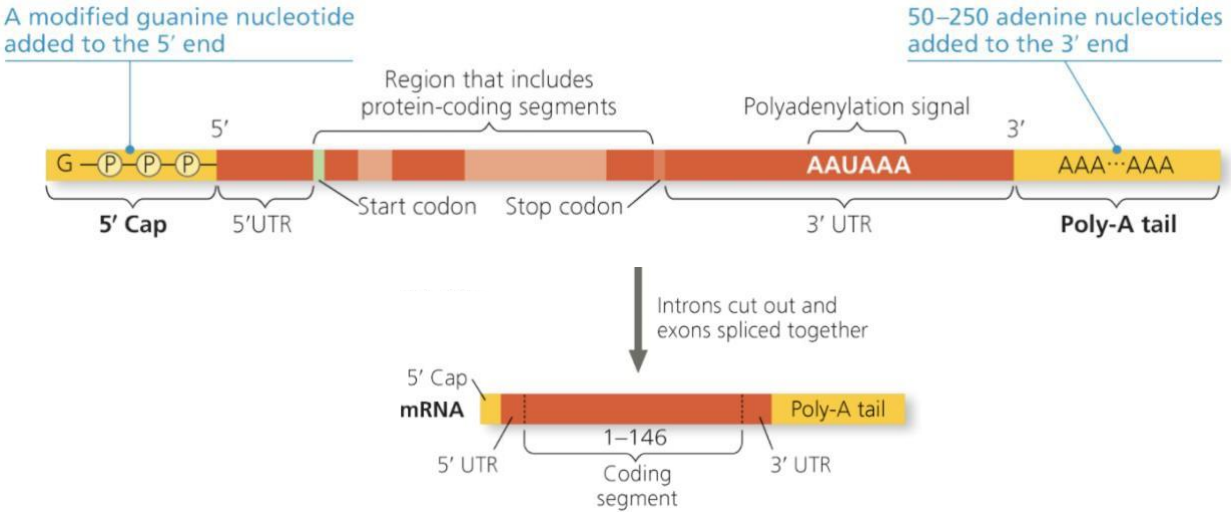


Highlight #3: RNA Processing and Post-Translational Modification

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



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.

CHECK YOUR LEARNING

1. True or false: The very first anticodon that binds at the beginning of translation will attach to the A site.
2. In what direction is an mRNA strand synthesized?

THINGS YOU MAY STRUGGLE WITH

1. Remember that transcription does NOT require a primer like replication! However, transcription requires a PROMOTER. These are easily confused since they sound similar, but the difference is key!
2. The words "transcription" and "translation" are easily confused when first learning about these processes. Remember that tranSCRIPTion makes a SCRIPT of the DNA while translation TRANSLATES the script!

Thanks for checking out these weekly resources!
Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring! Answers to *Check your Learning* questions are below!

Answers:

1. False. The very first anticodon technically binds to the P site. The codons that enter after this will enter through the A site.
2. 5' ➔ 3'