Chapter 17 - From Gene to Protein

Translation

* Translation is when the cell interprets the genetic message and builds the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. \_\_\_\_\_\_\_\_\_ acts as the interpreter.
* tRNA transfers \_\_\_\_\_\_from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the ribosome where they are added to the growing polypeptide.
* All \_\_\_\_\_\_ molecules are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

tRNA Structure and Function

* tRNA , like mRNA, is made in the \_\_\_\_\_\_\_\_\_\_ and is used over and over again.
* tRNA has an \_\_\_\_\_\_\_\_\_ at one end and an \_\_\_\_\_\_\_\_\_\_ at the other end. The anticodon acts to base pair with the complementary code on the mRNA molecule.
* As tRNA reads the mRNA transcript, it brings an \_\_\_\_\_\_ to the ribosome and adds it to growing polypeptide.
* The 2D shape is similar to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

tRNA

* tRNA is about \_\_\_\_ nucleotides long and full of complementary stretches of bases that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to one another giving it a 3D shape like an “L.”
* From this, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_loop comes out of one end and at the other end protrudes the 3’ end that carries the aa.

2 Recognition Steps in Translation

* There must be a correct \_\_\_\_\_\_\_\_\_\_between tRNA and an aa.
* The accurate translation of the \_\_\_\_\_\_\_\_\_ molecule.

The Correct Match

* Each aa gets joined to a tRNA by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_--there are 20 of these, one for each amino acid.
* This enzyme \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the attachment of aa to tRNA.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ aa is now ready to deliver the aa to the growing polypeptide.

Accurate Translation

* The tRNA must correctly \_\_\_\_\_\_\_\_\_\_\_\_\_\_ up the tRNA anticodon with an mRNA codon.
* There is \_\_\_\_\_\_\_ a 1:1 ratio of the tRNA molecules with mRNA codons.
* Some tRNA’s can bind to \_\_\_\_\_\_\_\_\_\_ than one codon.
* This versatility is called “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”
* Wobble \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tRNA to bind differently in one of its base pairs.
* This is why codons for some aa’s differ in their \_\_\_\_\_\_ base.
* For example: the \_\_\_\_\_\_\_\_\_\_\_ at the 5’ end of a tRNA anticodon can pair with an A or a G in the third position of the 3’ end of the mRNA codon.

Translation

* [Movie](http://www.travismulthaupt.com/page1/page5/files/17_18TranslationIntro_A.swf)

Ribosomes

* These are the sites of protein \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* They consist of a large and a small subunit and are comprised of \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The RNA is ribosomal RNA (\_\_\_\_\_\_\_\_\_\_).
* Bacterial (70s, 50S + 30s)
* Eukaryotic (80s, 60S + 40s)
* rRNA genes are found on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DNA and are transcribed and processed in the nucleolus.
* They are assembled and transferred to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as individual subunits.
* The large and small subunits form \_\_\_\_\_\_\_ large subunit when they are attached to the mRNA.
* The structure of ribosomes fit their function.
* They have an mRNA binding site, a \_\_\_-site, an \_\_\_-site and an \_\_\_-site.
* P-site (peptidyl-tRNA) holds the tRNA carrying the growing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ chain.
* A-site (aminnoacyl-tRNA) holds the tRNA carrying the next \_\_\_\_\_ to be added to the chain.
* E-site is the exit site where the tRNAs \_\_\_\_\_\_\_\_\_\_\_\_ the ribosome.
* Each of these are binding sites for the \_\_\_\_\_\_\_\_\_\_\_\_\_.

rRNA

* rRNA is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form of RNA in the cell because there are thousands of ribosomes within a cell and about \_\_\_\_\_\_\_\_ the mass of a ribosome is rRNA.

The 3 Stages of Protein Building

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* All three stages require factors to help them “\_\_\_” and GTP to power them.

Initiation

* Initiation brings \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mRNA, tRNA and the 2 ribosomal subunits.
* Initiation factors are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for these things to come together.
* \_\_\_\_\_ is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ source that brings the initiation complex together.

Elongation

* The elongation stage is where aa’s are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ one by one to the growing polypeptide chain.
* Elongation factors are involved in the addition of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_ energy is also spent in this stage.

Termination

* Termination occurs when a \_\_\_\_\_\_\_\_ codon on the mRNA reaches the “\_\_\_\_\_\_\_\_\_\_\_” within the ribosome.
* Release factor then binds to the stop codon in the “\_\_\_\_\_\_\_\_\_\_” causing the addition of water to the peptide instead of an aa.
* This signals the end of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Polypeptide Synthesis

* As the polypeptide is being synthesized, it usually \_\_\_\_\_\_\_\_\_\_\_ and takes on its \_\_\_\_ structure.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ modifications are often required to make the protein function.
* Adding fats, sugars, phosphate groups, etc..
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of certain proteins to make the protein functional.
* Separately synthesized polypeptides may need to come together to form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein.

Eukaryotic Ribosomes

* Recall the 2 types: \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* They function exactly the same and can switch from free to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* This switch can occur when the protein that is being translated contains a \_\_\_\_\_\_\_\_\_\_\_\_\_ peptide instructing the ribosome to attach to the ER.
* Once attached to the ER, synthesis will continue to completion and can then be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the cell.

Signal Peptide Recognition

* The signal peptide is recognized as it emerges from the ribosome by a protein-RNA complex called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particle.
* The particle functions by bringing the ribosome to a receptor protein built into the ER where synthesis continues and the growing peptide finds its way into the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Once in the lumen of the ER, the newly synthesized polypeptide is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The signal peptide is cut out by an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The protein then undergoes further processing and is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where it needs to go.

3 Useful Properties of RNA

* It can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to other nucleic acids.
* It can form a specific \_\_\_\_\_ shape by H-bonding on itself.
* It has functional groups that allow it to act as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Differences in Prokaryotic and Eukaryotic Gene Expression

* Prokaryotic and eukaryotic RNA polymerases are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but perform the \_\_\_\_\_\_\_\_\_\_ function.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is terminated differently.
* Prokaryotic and eukaryotic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are different.
* Transcription and translation are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in prokaryotes, it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in eukaryotes.
* Eukaryotic cells have a complex system of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ proteins for their final destination.

Mutations

* Mutations are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in genetic material.
* They can cover \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ portions of DNA or they can be a \_\_\_\_\_\_\_\_\_\_\_\_ mutation.
* There are 2 broad categories of point mutations:
  + Base-pair \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Mutations can be caused by a number of things:
  + \_\_\_\_\_\_\_\_\_\_\_\_\_ in replication, recombination, or repair
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_--X, γ, UV radiation, chemicals
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Base-Pair substitutions

* One base pair gets \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for another.
* Sometimes these are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ because of the redundancy of the genetic code.
* Other times they are silent because the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ codes for an aa/protein that is not essential to the protein’s function.
* Also, there are times when the two aa’s behave the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ even though they are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Missense Mutations Vs. Nonsense Mutations

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mutations code for an aa, usually the wrong aa.
* In a nonsense mutation, the wrong aa is encoded and it usually results in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ codon and the production of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein.

Insertions and Deletions

* These are often referred to as “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” mutations because they alter the reading frame of the mRNA.
* They almost always result in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein.