**How does the DNA code use RNA to make a protein?**



There are 2 (kinda 3) stages in the process of making a protein from DNA

1. **Transcription** - happens in the \_\_\_\_\_\_\_\_\_\_\_\_

 **mRNA modification** - happens in the \_\_\_\_\_\_\_\_\_\_\_\_

2. **Translation** - happens in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Transcription – initiation**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_joins with several transcription factor proteins at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which is a special sequence of base pairs on the DNA template strand that signals the beginning of a gene.

The transcription factor proteins, along with the RNA polymerase, is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This moves along the DNA template strand at about 40 base pairs per second producing pre-mRNA.



**Transcription – elongation**

During elongation, RNA polymerase adds free floating \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (A, U, G, C) to the DNA template strand, reading the DNA in the 3’ to 5’ direction.



**Transcription – termination**

When the RNA polymerase reaches the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of base pairs on the DNA template strand, it completes the production of pre-mRNA and releases it into the nucleoplasm.



**mRNA Modification**

Before mRNA is ready to leave the nucleus there needs to be a 5’ \_\_\_\_\_\_\_ (methyl group) and a 3’ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Introns are spliced out and exons are left to be \_\_\_\_\_\_\_\_\_\_\_\_.



**Breaking the mRNA Code**

The mRNA is now carrying the instructions to make a protein! To read the code, each ribonucleotide corresponds to a specific amino acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ribonucleotides ‘letters’ make \_\_\_\_\_\_\_\_\_\_ amino acid ‘word’.     This words are called \_\_\_\_\_\_\_\_\_\_

Remember…there are 21 amino acids.

What is the corresponding amino acid sequence for an mRNA molecule that reads like this?

AUGCCUCCGCAUGAGUGA



**Translation**

Translation occurs at the ribosome.  The ribosome is a large complex of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_. It consists of two subunits. Several ribosomes can attach to an mRNA molecule simultaneously. This allows for many polypeptide chains to be synthesized at once.

**Translation – Initiation**

The large and small ribosomal subunits binds to form the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.   Once this has occurred, the transfer RNA carrying methionine amino acid is bound to the \_\_\_\_\_\_\_\_\_\_on the ribosome.  The \_\_\_\_\_\_\_\_\_\_\_is aligned with the next codon which will bind to the incoming tRNA.

The 3 letter sequence on the tRNA is referred to as the \_\_\_\_\_\_\_\_\_\_\_\_\_. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_allows for some flexibility ultimately allowing the mRNA to be translated by fewer tRNAs

 

**Translation – Elongation**

In this stage, amino acids are brought to the ribosome by tRNAs and linked (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) together to form a chain, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Once the peptide bond is formed, the mRNA is pulled onward through the ribosome by exactly one codon. This shift allows the first, empty tRNA to drift out via the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It also exposes a new codon in the A site, so the whole cycle can repeat.



**Translation – Termination**

Termination happens when a \_\_\_\_\_\_\_\_\_\_ in the mRNA enters the A site. Stop codons are recognized by proteins called\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which fit into the P site. Release factors mess with the enzyme that normally forms peptide bonds: they make it add a water molecule to the last amino acid of the chain. This reaction separates the chain from the tRNA, and the newly made protein is \_\_\_\_\_\_\_\_\_\_\_\_\_.



**What next?**

Translation "equipment" is very \_\_\_\_\_\_\_\_\_\_\_\_. After the ribosomal subunits \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_from the mRNA and from each other, each element takes part in another round of translation. Polypeptides often need some \_\_\_\_\_\_\_\_\_\_. During and after translation, amino acids may be chemically altered or removed. The new polypeptide will also \_\_\_\_\_\_\_\_\_\_\_\_\_ into a distinct 3D structure, and may join with other polypeptides to make a multi-part protein.