Biology 12 Name KEY

From Genes to Proteins – Protein Synthesis Block _____

1. One major function of DNA is to direct the synthesis of PROTEINS. Since the DNA is located in the NUCLEUS and proteins are synthesized at the RIBOSOMES in the cytoplasm, an intermediate molecule called mRNA (or messenger RNA) is required.
2. Protein synthesis can be broken down into two major processes: TRANSCRIPTION, which happens in the nucleus and TRANSLATION, which happens at the ribosomes.

Transcription

3. A section of the DNA called a GENE is used as a template to produce a single-stranded mRNA molecule. This involves three main steps.

a) The DNA is UNWOUND and UNZIPPED by the enzyme helicase.

b) Complementary base pairing occurs between the exposed DNA bases and the RNA nucleotides in the nucleus and the base URACIL is used instead of thymine.

c) A new backbone is formed when the PHOSPHATE of one nucleotide is bonded to the sugar of the adjacent nucleotide. The last two steps are carried out by the enzyme RNA POLYMERASE.

4. Once the mRNA is transcribed, it will undergo post-transcriptional processing to remove the INTRONS and join together the EXONS to produce the mature mRNA.
5. The mRNA will now leave the nucleus and enter the cytoplasm and will soon be attached to a RIBOSOME, either in the cytoplasm or on the rough ENDOPLASMIC RETICULUM.

Translation

1. Once the mRNA enters the cytoplasm, it will attach to the RIBOSOMES which "translate" the sequence of NUCLEOTIDES on the mRNA into a sequence of AMINO ACIDS.
2. On the mRNA, 3-nucleotide sequences called CODONS specify a particular AMINO ACID. This can be determined using a chart of CODONS such as the one on page ~~511~~ 496 of your textbook

3. Translation also requires several other components, each with its own function:

a) tRNA which CARRIES AMINO ACIDS TO THE RIBOSOMES and has two special sites – an ANTICODON ✓ which is complementary to the mRNA codon and an amino acid binding site where the correct amino acid will be attached.

b) tRNA synthetase whose function is to attach the correct AMINO ACID ✓ to the appropriate tRNA.

c) peptidyl transferase whose role is to form a PEPTIDE bond between two amino acids which are attached to the tRNA molecules present at the ribosome at that time.

4. Translation can also be broken down into three steps:

a) INITIATION - involves the binding of the small and then the large subunit of the RIBOSOME ✓ to the mRNA. It then moves along the mRNA looking for the start codon AUG, which also codes for the amino acid METHIONINE. Once this signal is found, the first tRNA attaches to the ribosome by complementary base pairing between the mRNA CODON and the tRNA ANTICODON. Now the second tRNA ✓ carrying the next AMINO ACID comes in and also attaches to the ribosome.

b) Elongation – the AMINO ✓ ACID on "top" of the first tRNA is bonded to the amino acid on top of the second tRNA. The first tRNA dissociates and the ribosome "moves along" to the next codon. Another tRNA carrying the next amino acid specified by the mRNA CODON attaches to the ribosome. The "chain" of amino acids on the previous tRNA is bonded to the AMINO ACID on the "new" tRNA. The previous tRNA dissociates and the ribosome moves along the mRNA ✓, opening up a spot for another tRNA at the next codon. This process continues until one of the three stop CODONS is reached.

c) TERMINATION ✓ will occur when the ribosome reaches a stop CODON. At this time, RELEASE factors will cause the polypeptide to be released from the last tRNA, the RIBOSOME subunits will dissociate from the mRNA and can find another mRNA to attach to.

5. While one ribosome is synthesizing a polypeptide on a mRNA, other ribosomes may FOLLOW the first one and also synthesize the same polypeptide from the same mRNA. These would look like a group of ribosomes in the cytoplasm and would be called a POLYSOME.

6. In this way, a single mRNA can be used to produce many POLYPEPTIDES ✓ in a very short time.