DNA Structure and Gene Expression

1. Nucleus of the Cell
   1. Surrounded by a nuclear membrane
   2. The membrane contains proteins that form nuclear pores
   3. DNA – Deoxyribonucleic Acid is stored in the nucleus
2. DNA
   1. DNA is made up of two strands twisted together to form an alpha helix
   2. Nucleoside
      1. Deoxyribose sugar bonding with a base
      2. Bases in DNA include
         1. Adenine
         2. Thymine
         3. Cytosine
         4. Guanine
   3. Nucleotide
      1. Add a phosphate (PO4) to a nucleoside
   4. Complementary Base Pairs
      1. Adenine always bonds with Thymine
         1. The bond is a Hydrogen bond
      2. Cytosine always bonds with Guanine
         1. The bond is a Hydrogen bond
   5. Deoxyribose Sugar has a 3’ and a 5’ carbon
      1. Phosphate binds to the 5’ carbon on the sugar
      2. Antiparallel strands
3. Chromosome
   1. Diploid cells
      1. Have 23 pair of chromosomes found in a cell
   2. Haploid cells
      1. 23 chromosomes found in this type of cell
         1. Only found in the sperm or the egg
   3. When a cell duplicates the DNA winds around proteins called histones
4. DNA and Genes
   1. DNA contains genes
      1. Genes are the blueprints in DNA for building proteins
   2. Triplet
      1. Three nucleotides on DNA that correspond for the code of a single amino acid
   3. Codon
      1. Three nucleotides on mRNA that codes for a single amino acid
         1. A series of amino acids makes up a protein
   4. DNA consists of 3 billion base pairs
      1. Codes for about 100,000 genes
5. RNA – Ribonucleic Acid
   1. Contains the sugar ribose
   2. Is a single stranded copy of DNA
   3. Contains Adenine, Guanine, Cytosine and Uracil
      1. Uracil replaces Thymine in RNA
   4. Three types of RNA
      1. Messenger RNA (mRNA)
         1. Copy of DNA
         2. Carries genetic information from the nucleus to the Ribosome where proteins will be made
      2. Ribosomal RNA (rRNA)
         1. This is the ribosome where proteins are made
      3. Transfer RNA (tRNA)
         1. Transfers amino acids to the ribosome where proteins are synthesized
         2. Attachment site at one end for an amino acid
         3. Opposite end has three nucleotide bases called the anticodon
            1. The anticodon on tRNA is complementary to the codon on mRNA
6. Transcription
   1. The process of copying the sequence of one strand of DNA, the template strande
      1. The copy is called mRNA
      2. Requires the enzyme RNA Polymerase to make the copy
      3. Occurs in the nucleus of the cell
   2. During transcription RNA polymerase binds to DNA and separates the DNA strands
   3. RNA polymerase uses one strand of DNA as a template to assemble nucleotides into RNA
   4. RNA polymerase starts by binding to the TATA box
   5. RNA Processing
      1. Once DNA is transcribed into RNA editing must be done
         1. Introns
            1. Non-functional segments of DNA are snipped out of the chain
         2. Exons
            1. Segments of DNA that code for the proteins are rejoined
      2. A methylated cap is added to the 5’ end of mRNA
      3. A poly A tail is added to the 3’ end of mRNA
7. Translation
   1. The process of decoding the mRNA into a protein
   2. The mRNA leaves the nucleus and binds to a ribosome
   3. Ribosomes
      1. A ribosome is made up of a large and small subunit
8. Steps of Translation
   1. Initiation
      1. mRNA is sandwiched between the large and small ribosomal subunit
      2. a tRNA enters the P site carrying the first amino acid
      3. the anticodon on tRNA binds to the codon on mRNA
      4. a second tRNA enters the A site carrying the second amino acid
      5. the anticodon on tRNA binds to the codon on mRNA
      6. the two amino acids carried on the tRNA’s join forming a peptide bond
      7. The ribosome moves down one codon
         1. The tRNA that was in the P site leaves the ribosome
         2. The tRNA that was in the A site moves over to the P site
         3. A new tRNA carrying the third amino acid enters the A site
   2. Elongation
      1. Steps v – vii repeat until a stop codon is reached
   3. Termination
      1. At the stop codon the protein is finished