DNA Synthesis

1. DNA synthesis occurs before meiosis and mitosis, during Interphase
2. Each new strand is identical to the original.
3. DNA synthesis is semi –conservative because each new strand contains half of the original strand and half new DNA.
4. DNA synthesis is semi-discontinuous because the leading strand is replicated without interruption, but the lagging strand is copied in the opposite direction from the leading strand (the strands are antiparallel, DNA polymerase moves only from 5' to 3' along the DNA strand).
5. The process
    a. A signal for cell division is received from outside the cell.
    b. In the nucleus, Helicase begins unwinding the double strand: the double helix is uncoiled and the double strand is separated between the nitrogenous bases (A-T; G-C).
    c. DNA polymerase binds to the leading strand, and begins adding new DNA nucleotides according to base pairing rules.
    d. DNA polymerase binds to the lagging strand and begins adding new DNA nucleotides according to the base pairing rules, moving in the opposite direction (antiparallel) to the leading strand.
    e. The lagging strand is synthesized in fragments (Okazaki fragments) which will need to be joined at the end of the process by another enzyme (DNA ligase). The leading strand is synthesized continuously throughout the process.
    f. At the end, there are two strands of DNA, each composed half from the original strand and half from new DNA. Mendelssohn and Stahl proved this, the semi-conservative method of DNA replication, using radio-labeling. http://www.sumanasinc.com/webcontent/animations/content/meselson.html

Protein Synthesis

1. Central dogma: A region of DNA contains information (codes) for one protein. This is called a GENE.
2. The gene is expressed when the information in the DNA in the nucleus is TRANSCRIBED into a messenger molecule (mRNA). The messenger is then TRANSLATED by a ribosome (rRNA) in the cytoplasm to make a protein molecule using transfer molecule (tRNA) which places a series of amino acids into a chain according to the instructions in the gene and therefore in the messenger.
3. The process:
    a. Transcription
        i. http://www.youtube.com/watch?v=WgvnFYyJGZQ
        ii. A signal is received by the cell that a certain protein is needed.
        iii. An enzyme, RNA polymerase, attaches to the double DNA strand (often at a region called the PROMOTER) and it unwinds. RNA polymerase moves along one of the separated strands of DNA, the "sense" strand, and begins adding RNA nucleotides against the DNA template according to base pairing rules (A-U, T-A, G-C, C-G). This is called TRANSCRIPTION and the part of the gene being transcribed is called the CODING REGION. RNA nucleotides are different from DNA nucleotides in two ways: RNA contains the Uracil (U) rather than the Thymine (T) nitrogenous base; each RNA nucleotide is made with Ribose as the sugar, rather than Deoxyribose as in DNA.
        iv. Transcription stops at the TERMINATOR SEQUENCE and the RNA polymerase drops off the DNA.
        v. The messenger molecule resulting from transcription may be processed by enzymes in the cell, some parts may be cut or edited out, before it proceeds to the next part of the process.
        vi. Transcription occurs in the nucleus, where the DNA is stored.
    b. Translation
        i. http://wwwclass.unl.edu/biochem/gp2/m_biology/animation/gene/gene_a3.html
        ii. The messenger molecule—mRNA—leaves the nucleus and enters the cytoplasm where it is bound by a ribosome (made of rRNA or ribosomal RNA).
        iii. At the ribosome, smaller "transfer" molecules (tRNA) bring individual amino acids and add them to the growing protein one at a time.
        iv. The ribosome reads the mRNA 3 nucleotides at a time… each triplet is called a CODON.
        v. Each tRNA has a triple nucleotide "ANTICODON" which binds to the mRNA codon.
        vi. The amino acid that each tRNA is carrying is specific to the anticodon that it has.
        vii. The chart below lists each mRNA codon with the amino acid that will be attached to the protein.

	U	C	A	G
U	UUU = phe UUC = phe UUA = leu UUG = leu	UCU = ser UCC = ser UCA = ser UCG = ser	UAU = tyr UAC = tyr UAA = stop UAG = stop	UGU = cys UGC = cys UGA = stop UGG = trp
C	CUU = leu CUC = leu CUA = leu CUG = leu	CCU = pro CCC = pro CCA = pro CCG = pro	CAU = his CAC = his CAA = gln CAG = gln	CGU = arg CGC = arg CGA = arg CGG = arg
A	AUU = ile AUC = ile AUA = ile AUG = met	ACU = thr ACC = thr ACA = thr ACG = thr	AAU = asn AAC = asn AAA = lys AAG = lys	AGU = ser AGC = ser AGA = arg AGG = arg
G	GUU = val GUC = val GUA = val GUG = val	GCU = ala GCC = ala GCA = ala GCG = ala	GAU = asp GAC = asp GAA = glu GAG = glu	GGU = gly GGC = gly GGA = gly GGG = gly

viii. This process of matching mRNA codons to tRNA anticodons and adding individual amino acids to the growing protein is called TRANSLATION.

ix. Translation always begins at the codon for Methionine, called the START CODON (AUG).

x. Translation always finishes with one of the three STOP codons: UAA, UAG, UGA.

xi. The protein that results from translation of the messenger (mRNA) may be processed in the cell (in the ER and/or golgi apparatus) before it is released and used.