DNA

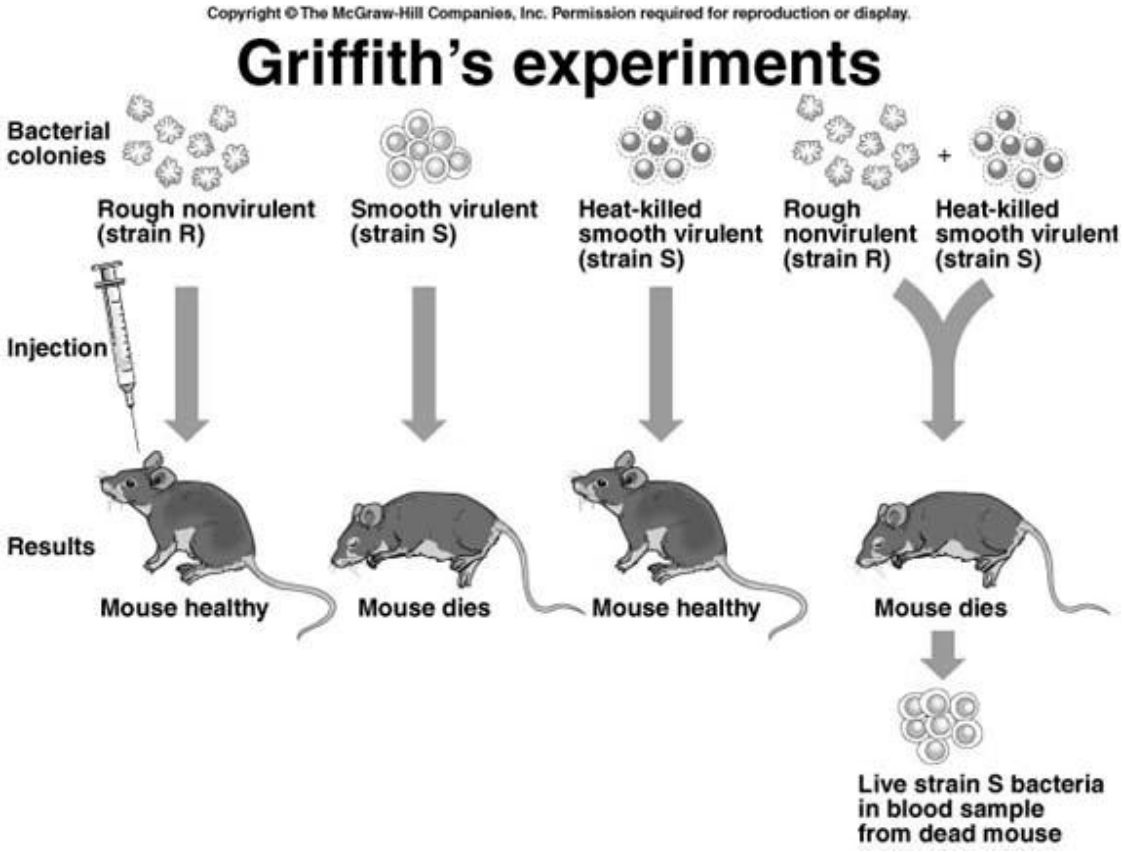
I. Bacterial Transformation

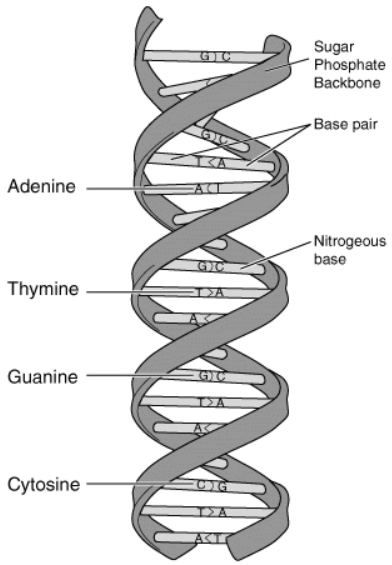
A. Pneumococcus

1. Several strains that are genetically different
2. Rough & Smooth (Smooth caused Pheumonia)

B. Fred Griffin 1928

1. Injected mice with heat killed smooth cells & live rough cells
   a. Thought all mice would remain healthy
   b. Some of the mice died of pneumonia
   c. Culture of dead mice blood showed smooth cells
   d. Bacterial transformation - change in heredity traits in one bacterium caused by another bacterium
2. Proof of chemical causing transformation
   a. Smooth cells were grown & and an extract from the bacterium was removed
   b. Extract put with culture of rough cells
   c. When culture observed smooth cells were found
      1) Those smooth cell reproduced smooth cells
3. Transforming principle - the chemical responsible for transformation is DNA (Deoxyribonucleic acid)





II. DNA Model

A. DNA is a complex molecule composed of 3 smaller parts
   1. Sugar (Deoxyribose)
   2. Phosphate group PO_4
   3. And base group (Nitrogen Compound)

B. These together make up nucleotides and nucleotides together form DNA

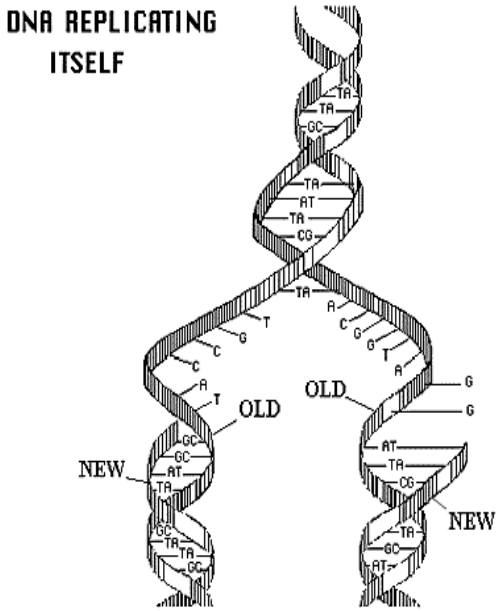
C. Four different bases
   1. Adenine
   2. Guanine
   3. Thymine
   4. Cytosine

D. James Watson & Francis Crick came up with the structure of DNA molecule 1953

1. Like a ladder
   a. Uprights are the sugars and phosphates
   b. Rungs are the nitrogen bases
      1) The bases fit together in certain ways
         a) Adenine with Thymine
         b) Cytosine with Guanine
      2) Double helix - a twisted ladder
         a) The twisting makes it more stable

III. DNA Replication

A. DNA molecule unwinds and then unzips when ti is ready to replicate
   1. Weak hydrogen bonds hold the bases together are broken and the two strands separate
   2. Bases become exposed to contents of the nucleus
   3. New nucleotides join with exposed bases only in certain ways A-T, G-C
   4. Nucleotides added to each strand from a sequence exactly like the original strand
   5. Nucleotides are joined



together by phosphates

B. Results in two DNA molecules exactly like the original
   1. Fits with the process of mitosis & meiosis

IV. Protein in Cells are determined by DNA sequence
   A. Proteins are made of amino acids
      1. Amino acids are determined by the sequence or arrangements of 3 bases on the DNA called a codon
      2. Proteins are determined by the sequence or arrangement of amino acids which is determined by the arrangement of codons
      3. Proteins are coiled and folded giving a 3 dimensional shape
   B. Kinds of proteins
      1. Enzymes
         a. Control a cells metabolism
         b. Combination of enzymes give uniqueness to a cell
      2. Structural proteins
         a. Cell membrane, ornganelles and chromosomes
      3. Carrier molecules - active transport and hemoglobin

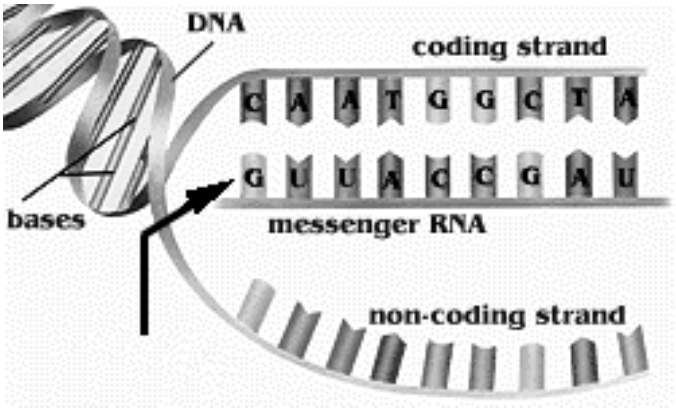
V. Genes & Proteins
   A. Theory of relationship of genes to proteins
   B. 1941 Beadle & Tatum provide evidence to the DNA protein link
   C. DNA provides the code to proteins
      1. Determined by the sequence of base pairs in a DNA molecule
      2. Code and order of code determine the amino acid
         a. There are more than 20 amino acids
         b. 3 base pairs act as the code for the amino acid
            1) Codon - are three base pairs that determine what the amino acid is page 241
   D. DNA does not leave the nucleus to make proteins at the ribosome
      1. RNA (Ribonucleic Acid) is formed in the nucleus from the DNA to take the code to where the protein is made
      2. RNA is similar to DNA
         a. Contains ribose instead of deoxyribose
         b. Uracil instead of Thymine
            1) All other bases are the same
         c. Single strand instead of double strand

Protein Synthesis

I. Protein Synthesis (The making of proteins)
   A. Three types of RNA are involved in protein synthesis
      1. Messenger RNA (mRNA)

2. Transfer RNA (tRNA)
3. Ribosomal RNA (rRNA)

B. *Transcription* - Protein synthesis begins with the DNA code order of codons being transferred to the mRNA



1. The DNA molecule unzips
2. The mRNA copies the base codons (3bases together) from the DNA
3. The specific sequence of the mRNA bases are determine by DNA bases
4. After mRNA molecule is complete it breaks away from the DNA
5. The mRNA goes from the nucleus through the ER to the ribosomes
6. The two DNA strands rejoin and recoil
7. This process of transferring the order of the codons from the DNA to the mRNA is called *Transcription*

C. *Translation* – the process of the tRNA bringing the amino acids (AA) to the mRNA to be put in the correct order

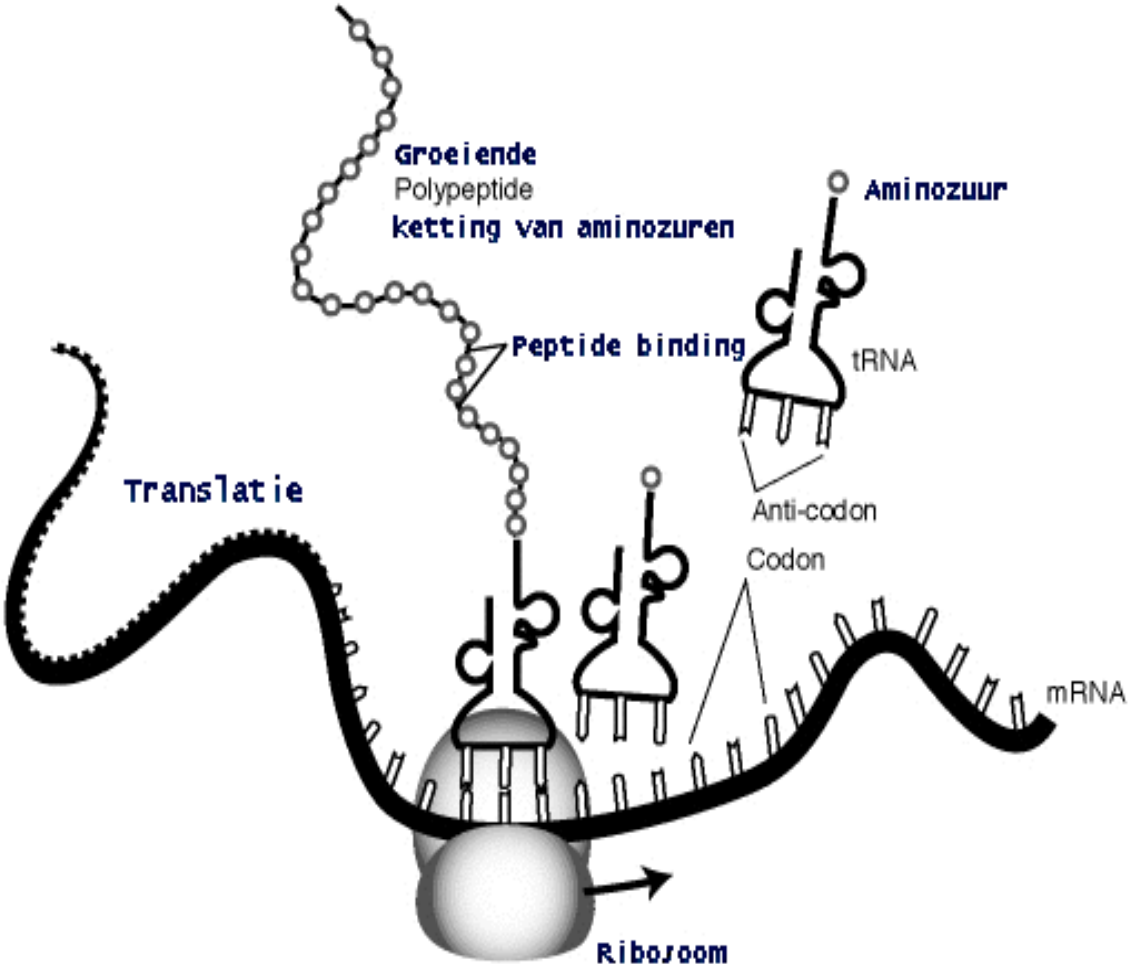
1. The tRNA are already in the cytoplasm
2. There are many different kinds of tRNA to match the mRNA codons
3. One end of the tRNA attach to a specific AA that is coded for by the its bases (1AA/tRNA)
4. The other end is the anticodon which matches to the mRNA codons
   a. If the mRNA codon is CCG, then the tRNA anticodon is GCC
   b.

mRNA Codon	tRNA Anticodon
UUC	AAG
GGU	CCA
AAU	UUA

5. Correct fitting of the codon and anticodon helps insure proper sequence of amino acids in a protein transferring DNA code to RNA

6. Each AA attaches to the previous in a continual chain by peptide bonds in the order set out by the mRNA
7. The process of bringing the amino acids (AA) by the tRNA to the mRNA and joining them is called translation

D. Ribosomes move along messenger RNA and are involved in the translation process
E. Stopping the translation process
    a. Certain codons stop Protein Synthesis
        1) UAG, UAA, UGA
        2) No tRNA fit these codons
    2. Several copies of the protein are made, then the mRNA is destroyed



II. Mutations – are mistakes in the DNA message or in whole chromosomes

A. Ways that mutations can occur and result in a abnormality in DNA (genes)
    1. Deletion – a nucleotide is left out resulting in different codon sequence and thus an amino acid sequence
    2. Insertion – an extra nucleotide is added during replication
    3. Point mutation – A base substitution occurs, and one nucleotide is substituted for another (one gene being altered can greatly change the outcome of the gene)

B. Chromosome mutations
    1. A part of a chromosome may be dropped off or lost during crossing over
    2. Chromosomes reattach backwards or upside down
    3. A pieces of chromosome attaches to the wrong chromosome

C. Nondisjunction – gametes with extra or missing chromosomes due to one of the above problems

D. Rate of mutations
    1. Radiation and high temperatures are external causes of mutation
    2. Mutagen – is a mutation causing chemical
        a. Example: formaldehyde

E. Lethal mutation – is a mutation that causes death

F. Mutations in sex cells can effect the population

G. Nonlethal mutation – is a mutation that doesn't cause death to the organism
    1. small percent of these may be beneficial

III. Cancer

A. usually the result of mutations of normal chromosomes
B. These abnormal cells reproduce making more cells like themselves
C. these cells reproduce in an uncontrolled way crowding out other cells
D. Malignant means that the cells spread to the rest of the body
E. Almost any body cell can become malignant
F. What causes normal genes to become malignant
    1. Mutant forms of genes result in abnormal proteins that disrupt the normal growth and reproduction patterns of cells.
    2. Such cancer causing genes are called oncogenes
    3. Some oncogenes are inherited
    4. Some oncogenes are transferred by a virus
    5. Some oncogenes are the result of normal genes (proto-oncogenes) mutating
    6. The changing over of normal genes to cancerous genes is many times caused by carcinogens (cancer causing chemicals) or harmful radiation

G. How oncogenes desrupt growth and development of cells
    7. code for abnormal growth factors
    8. Some produce defective recptors, precventing signals from being received by cells
    9. These set off a series of reactions within cells.
    10. some code for defective enzymes so that proper reactions don't procede properly
    11. Some prevent timely transcription

IV. DNA outside the nucleus

A. In Eukaryotic cells
    1. mitochondria & chloroplasts contain DNA
        a. Organelle DNA – also have mRNA, tRNA & rRNA
    2. Reproduce on there own

V. Technology of recombinant DNA p 68 & 269