Deoxyribonucleic Acid: Summary of its Discovery

- The discovery of the genetic role of DNA began with research by ***Frederick Griffith*** in 1928.
- He studied *Streptococcus pneumoniae*, a bacterium that causes pneumonia in mammals.
  - One strain, the R strain, was harmless.
  - The other strain, the S strain, was pathogenic.
- In an experiment Griffith mixed heat-killed S strain with live R strain bacteria and injected this into a mouse.
- The mouse died and he recovered the pathogenic strain from the mouse's blood.
- Griffith called this phenomenon **transformation**, a change in genotype and phenotype due to the incorporation of a foreign substance (now known to be DNA) by a cell.
- Further evidence that DNA was the genetic material came from studies that tracked the infection of bacteria by viruses.
- Viruses consist of a DNA (sometimes RNA) enclosed by a protective coat of protein.
- To replicate, a virus infects a host cell and takes over the cell's metabolic machinery.
- Viruses that specifically attack bacteria are called **bacteriophages** or just **phages**.
- In 1952, ***Alfred Hershey and Martha Chase*** showed that DNA was the genetic material of the phage T2, a virus that attacks *Escherichia coli* (E. coli), a common intestinal bacteria of mammals.
- Hershey and Chase concluded that the injected DNA of the phage provides the genetic information that makes the infected cells produce new viral DNA and proteins, which assemble into new viruses.
- By the mid 1900's, ***Erwin Chargaff*** had developed a series of rules, known as ***Chargaff's rules***, based on a survey of DNA composition in organisms.
- The number of adenines was approximately equal to the number of thymines (%T = %A).
- The number of guanines was approximately equal to the number of cytosines (%G = %C).
- By the beginning of the 1950's, the race was on to uncover the three-dimensional structure of DNA.

- Among the scientists working on the problem were ***Linus Pauling***, in California, and ***Maurice Wilkins*** and ***Rosalind Franklin***, in London.
- Maurice Wilkins and Rosalind Franklin used X-ray crystallography to study the structure of DNA.
- ***James Watson*** learned from their research that DNA was helical in shape and he deduced the width of the helix and the spacing of bases.
- Watson and his colleague ***Francis Crick*** began to work on a model of DNA with two strands, the **double helix**.
- Using molecular models made of wire, they first tried to place the sugar-phosphate chains on the inside.
- However, this did not fit the X-ray measurements and other information on the chemistry of DNA.
- The key breakthrough came when Watson put the sugar-phosphate chain on the outside and the nitrogen bases on the inside of the double helix.
    - The sugar-phosphate chains of each strand are like the side ropes of a rope ladder.
    - Pairs of nitrogen bases, one from each strand, form rungs.
    - The ladder forms a twist every ten bases.
- The nitrogenous bases are paired in specific combinations: adenine with thymine and guanine with cytosine.
- Watson and Crick also determined that chemical side groups of the nitrogen bases would form hydrogen bonds, connecting the two strands.
    - Based on details of their structure, adenine would form two hydrogen bonds only with thymine and guanine would form three hydrogen bonds only with cytosine.
    - This finding explained Chargaff's rules.
- In April 1953, Watson and Crick published a concise, one-page paper in *Nature* reporting their double helix model of DNA.
- Watson and Crick, along with Maurice Wilkins won the Nobel Prize for the discovery of DNA in 1962.
    - Rosalind Franklin was not included …….