Nucleic Acids: DNA

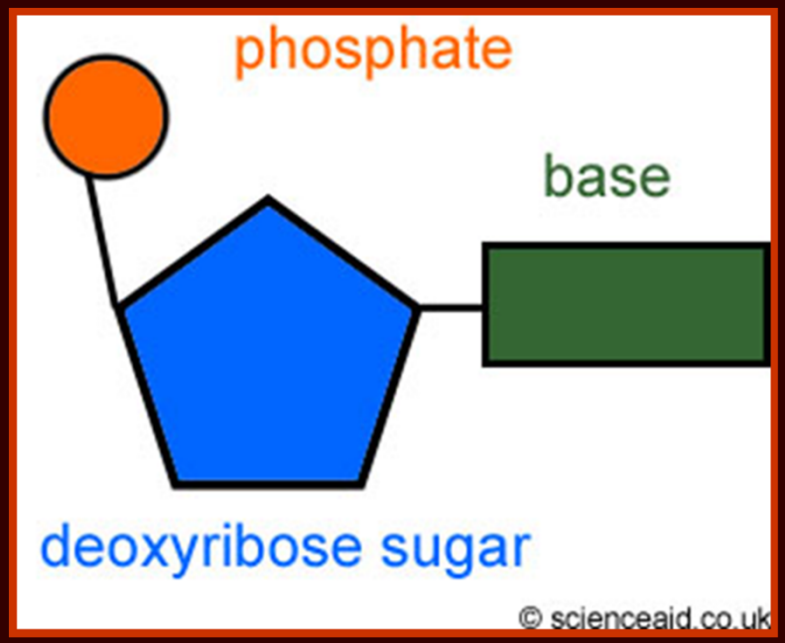
Types of Nucleic Acids

- ***Deoxyribonucleic Acid (DNA):*** heredity material that carries the blueprint for the sequence of amino acids in polypeptides.
- ***Ribonucleic Acid(RNA):*** involved in the production of polypeptides in the cell.
- ***There are three types of RNA:***
  - ✓ m RNA (messenger RNA)
  - ✓ r RNA (ribosomal RNA)
  - ✓ T RNA (transfer RNA)

Nucleotides

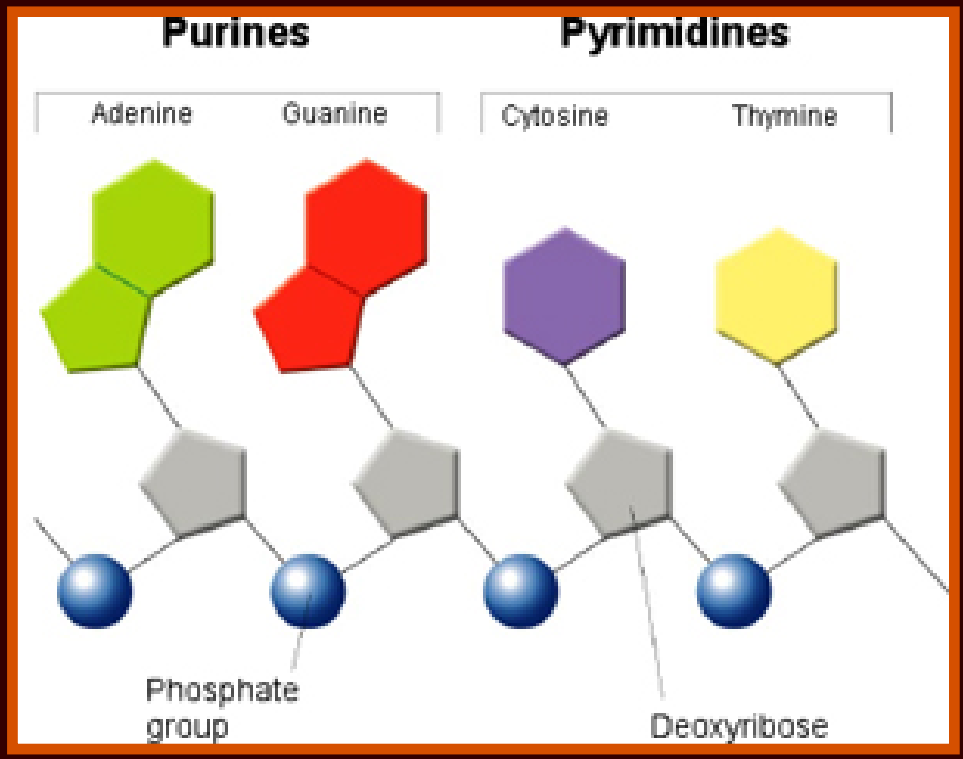
- The nucleotide is the basic building block of DNA.
- The nucleotide is constructed of a phosphate group (P), a deoxyribose 5 carbon sugar (S), & a nitrogenous base.
- There are 4 different nucleotides; each one differs only by the type of nitrogenous base.
- The four nitrogenous bases are adenine (A), thymine (T), cytosine (C), & guanine (G).
- The bases come in pairs, A-T & C-G (remember: AT Garden City)

Nucleotides (cont'd)



Structure of a nucleotide

Nitrogenous bases are divided into two types of molecules, based on their structure:



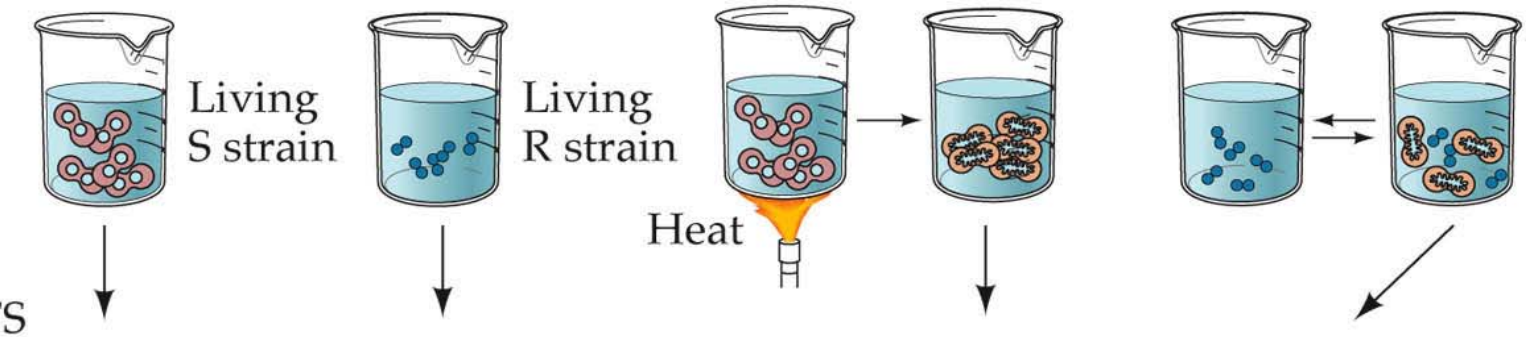
DNA Pioneers

- **Fredrick Griffith (1928):** conducted one of the first experiments suggesting that bacteria are capable of transferring DNA through a process called ***TRANSFORMATION.***
- He found there were two different types of the bacterium *Streptococcus pneumoniae*
- Through his experiments on injecting mice with these two different strains of bacteria, Griffith found that bacteria can take foreign DNA from another bacterial cell and incorporate into its own DNA.
- However, Griffith did not know that material being transferred was DNA.

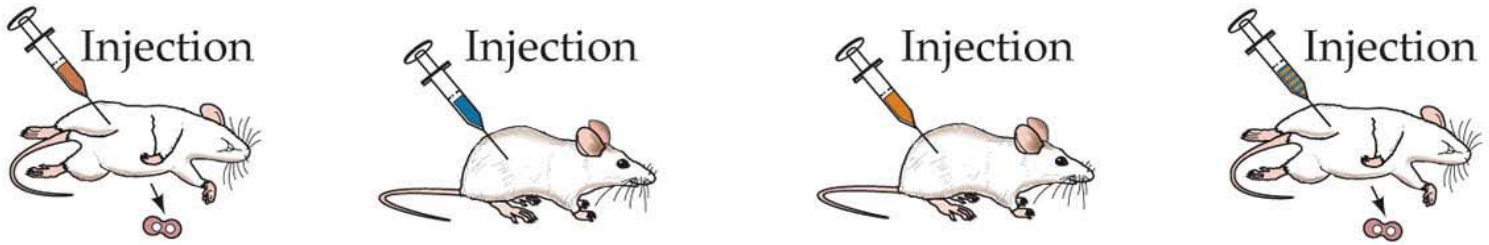
EXPERIMENT

Question: Can the presence of dead bacterial cells genetically transform living bacterial cells?

METHOD



RESULTS



Mouse dies	Mouse healthy	Mouse healthy	Mouse dies
Living S strain cells found in heart	No bacterial cells found in heart	No bacterial cells found in heart	Living S strain cells found in heart

Conclusion: A chemical component from one cell is capable of genetically transforming another cell.

LIFE: THE SCIENCE OF BIOLOGY, Seventh Edition, **Figure 11.1 Genetic Transformation of Nonvirulent Pneumococci**

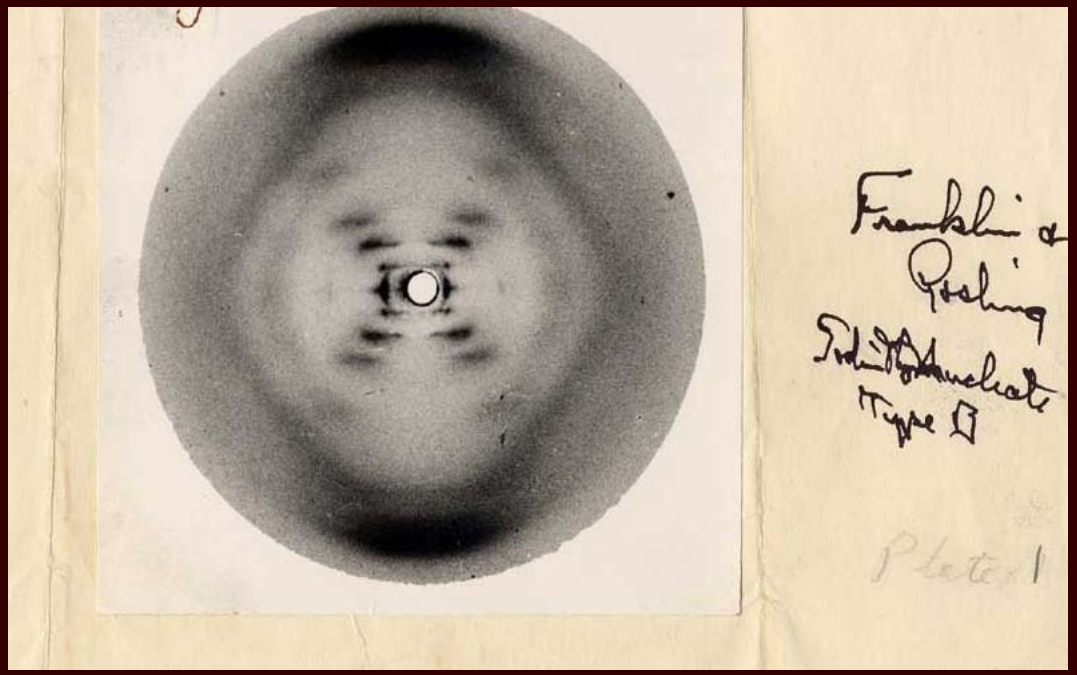
DNA Pioneers (cont'd)

- It was not until 1944 that **Oswald Avery, Colin MacLeod, and Maclyn McCarty** demonstrated the first evidence that DNA was the transforming material in Griffith's experiments.
- In 1952, **Alfred Hershey & Martha Chase** conducted isotope tracer experiments and found that bacterial viruses (bactriophages or phages) infect their host cells (bacteria) by injecting DNA in the bacterial cell, providing the genetic information for the replication of the virus.

hershey chase experiments

DNA Pioneers (cont'd)

- **Rosalind Franklin(1960-1953)** used x-ray crystallography analysis of DNA which demonstrated that the structure of DNA was in the shape of a ***double helix.***

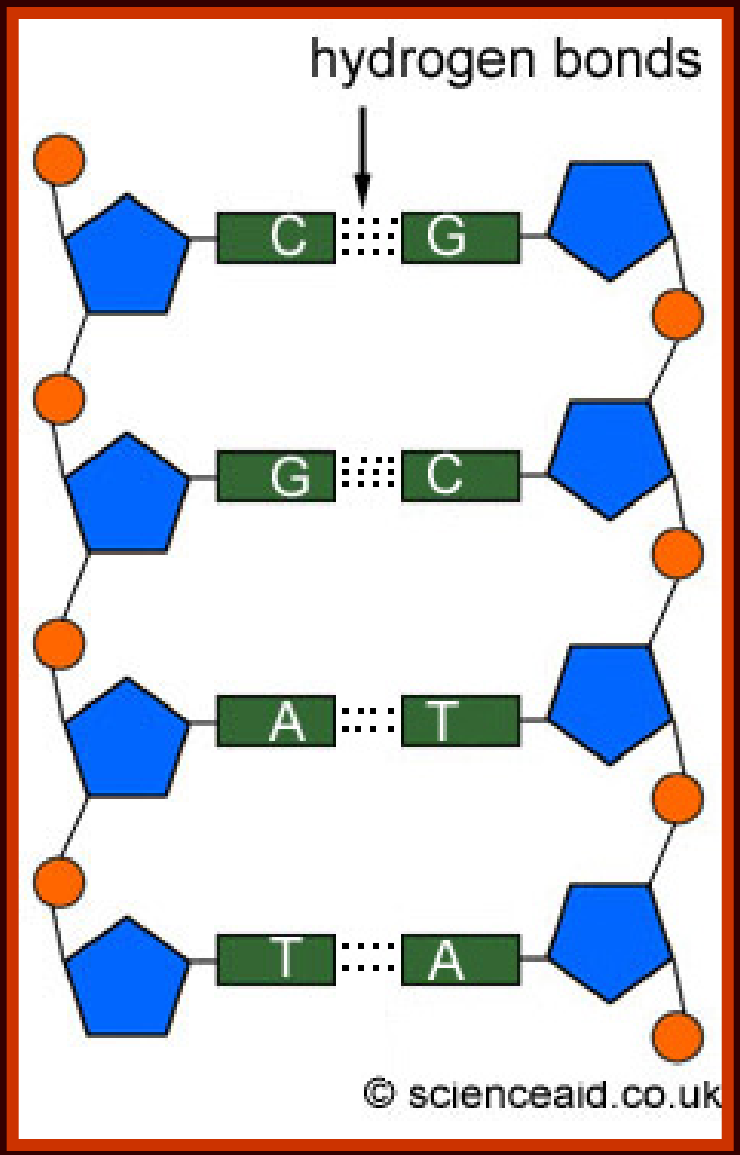


DNA Pioneers (cont'd)

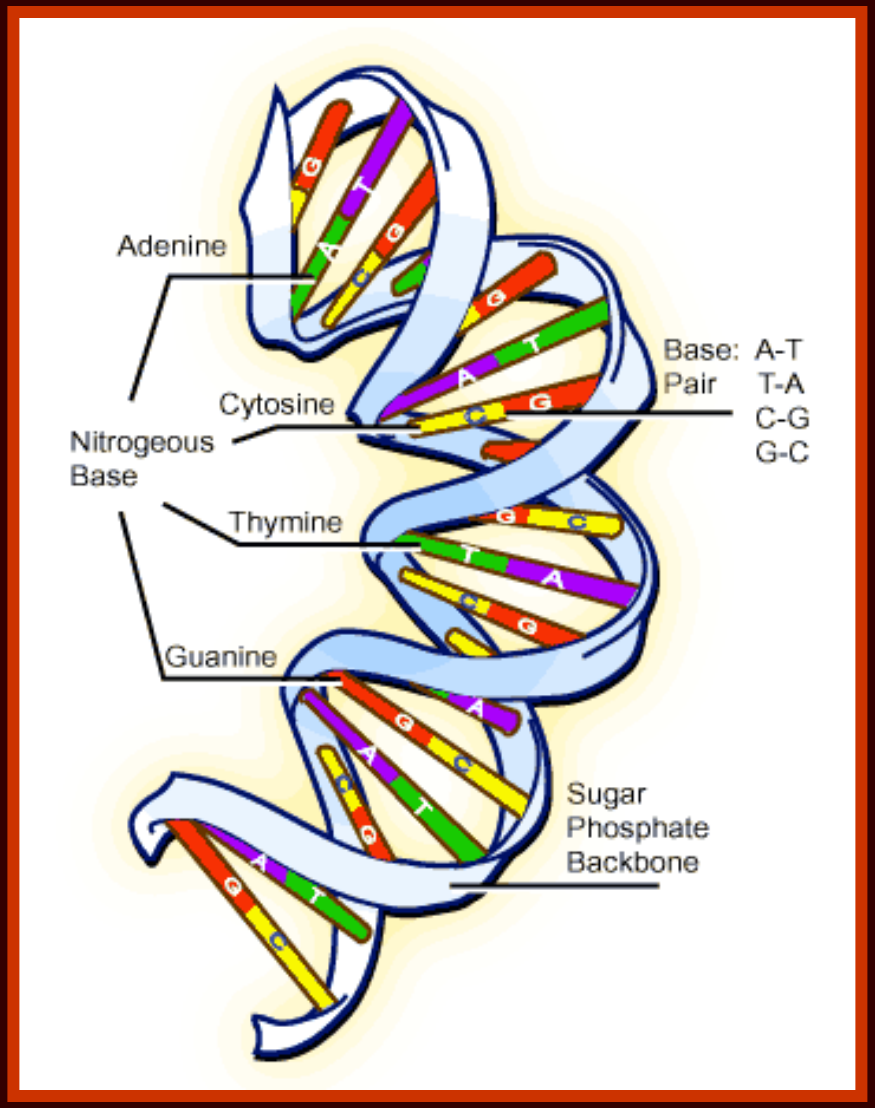
- **Chargaff's Rules: In 1949, Erwin Chargaff determined that the number of adenine molecules always equals the number of thymine molecules.**
- **Similarly, he found the same for cytosine and guanine, suggesting that DNA has a regular structure.**
- **In 1953, building on the work of Franklin & Chargaff, James Watson & Francis Crick developed our current model of the structure of DNA.**

The DNA “Ladder”

- The sides of the ladder are alternating phosphates (circles) and sugars (pentagons).
- The rungs of the ladder are the pairs of nitrogenous bases
- (A-T; C-G). The two strands of DNA are held together by weak hydrogen bonds.

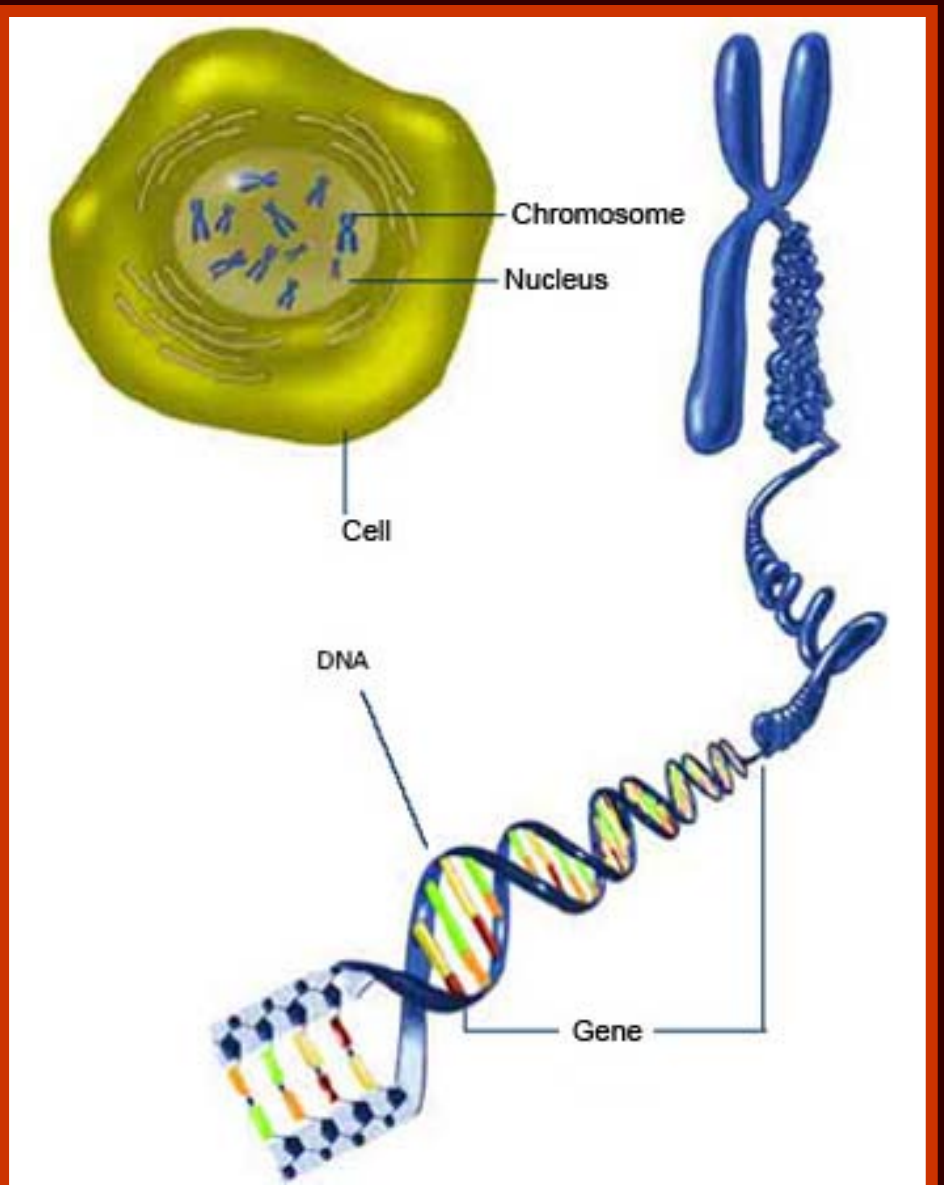


The DNA Double Helix

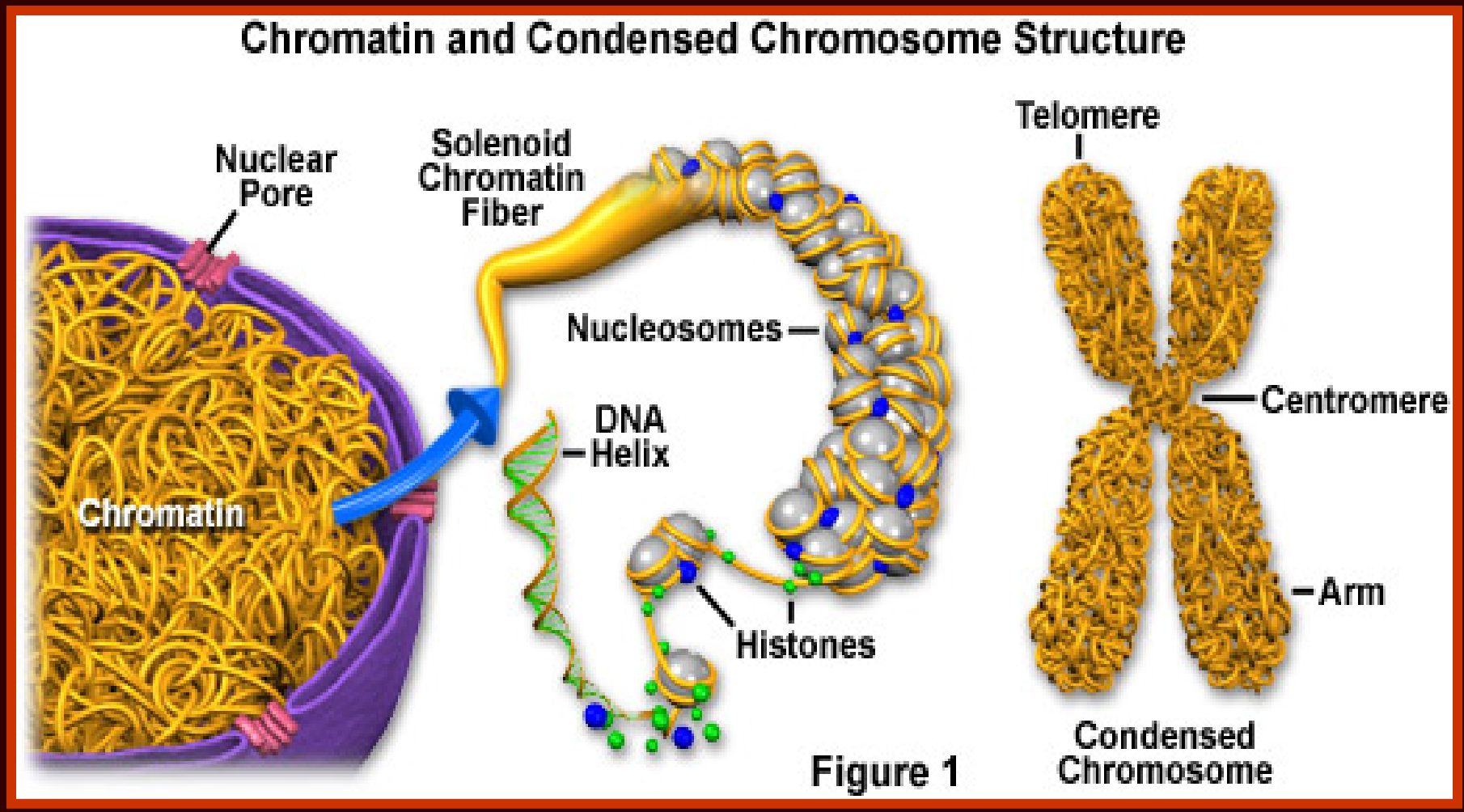


DNA, Genes, & Chromosomes

- **DNA is found in genes; genes are contained in chromosomes; chromosomes are found in the nuclei of cells.**



Chromosomes & Chromatin



Key Terms

- **Genome:** an organism's complete set of nuclear DNA.
- **Mitochondrial DNA:** In addition to nuclear DNA, DNA is found in the mitochondria (DNA is also found in chloroplasts as well).
- **Genes:** segments of DNA that carry the genetic information for the production of a polypeptide chain.
- **DNA template:** blueprint or set of instructions the DNA carries for the synthesis of polypeptides (proteins).
- **Chromatin:** a complex of DNA & proteins which appears as a mass of "string" in the nucleus.

Key Terms (cont'd)

- **Histones:** protein molecules around which the DNA wraps itself in order to condense the DNA strand.
- **Nucleosomes:** a length of DNA coiled around a core of histones
- **Solenoid:** the coiling of the nucleosomes, further condensing the DNA into a hollow tube
  - this complex compression allows the DNA to take up much less space in the nucleus
  - The overall negative charge of the DNA and neutralized by the positive charge of the histone molecules.

DNA FACTS

- DNA is found in every living organism
- Most DNA exists in the form of chromosomes in the nucleus of each cell
- Offspring inherit one half of their DNA from each parent in sexually reproducing organisms
- In asexually reproducing organisms, DNA is inherited from the parent cell.
- The number of chromosomes varies from species to species. For example, humans have 23 pairs of chromosomes found in the nucleus of every cell
- A DNA profile is unique to each living creature; only identical twins have identical DNA profiles.
- DNA can be used to identify people and establish paternity of children.
- DNA is made up of 2 strands that twist to form a DOUBLE HELIX.
- Basic building block is a nucleotide
- When untwisted, DNA resembles a ladder.
- Sides of the ladder are made up of alternating phosphates and sugars (deoxyribose)
- Rungs of the ladder are made up of nitrogenous bases (A-T, C-G)