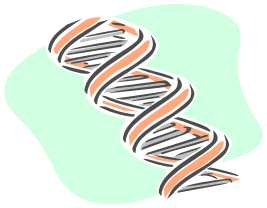
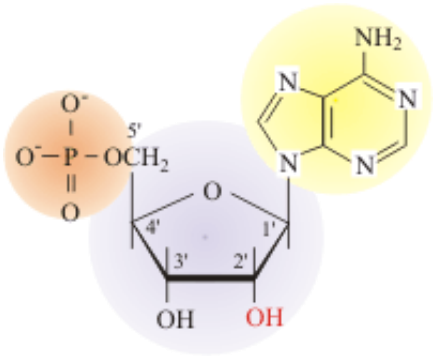


DNA STRUCTURE

- Nucleic Acids – Information carrying molecules
- DNA - Deoxyribonucleic Acid
- RNA - Ribonucleic Acid



- Nucleic acids are made up of **nucleotides**
  - pentose sugar (5C)
  - phosphate (PO_4^{3-})
  - nitrogen base
- A combination of pentose sugar and a nitrogen base is called a **nucleoside**

DNA vs. RNA

DNA	RNA
Double stranded	Single stranded
Sugar = deoxyribose	Sugar = ribose
Bases = A, **T**, G, C	Bases = A, **U**, G, C
In eukaryotes, found in nucleus only	In eukaryotes, found in nucleus and cytoplasm
Storage of Genetic information Replication Transcription (template)	Involvement in Protein Synthesis: Messenger (mRNA) Transporter (tRNA) Associated with Ribosomes (rRNA)

- In eukaryotes DNA is associated with proteins and is wound into chromosomes.
- In prokaryotes DNA is naked and is supercoiled into a series of small loops. In addition many bacteria have additional circular DNA called plasmids.

Nitrogen Bases

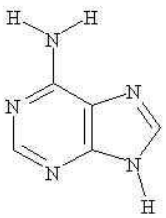
Adenine, Guanine } PURINES – large double ring structures

Thymine, Cytosine, Uracil (RNA only) } PYRIMIDINES – small single ring structures

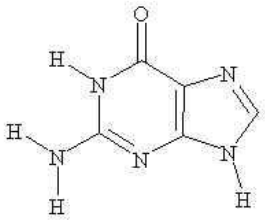
- Base paring is complementary

A = T (2 H-bonds)
G = C (3 H-bonds)
In RNA, A = U

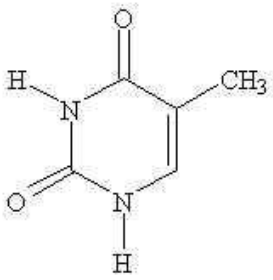
Adenine



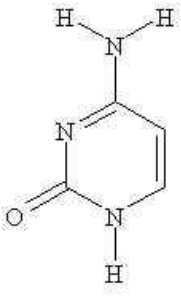
Guanine



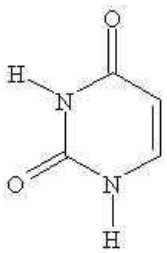
Thymine



Cytosine



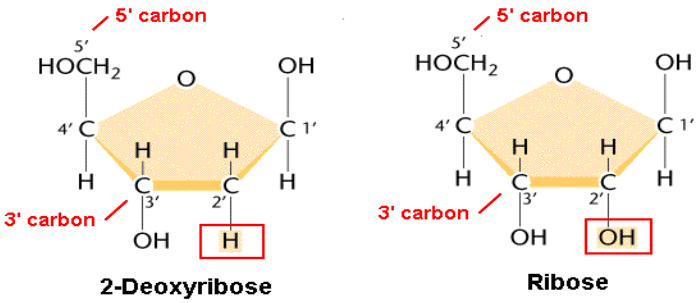
Uracil

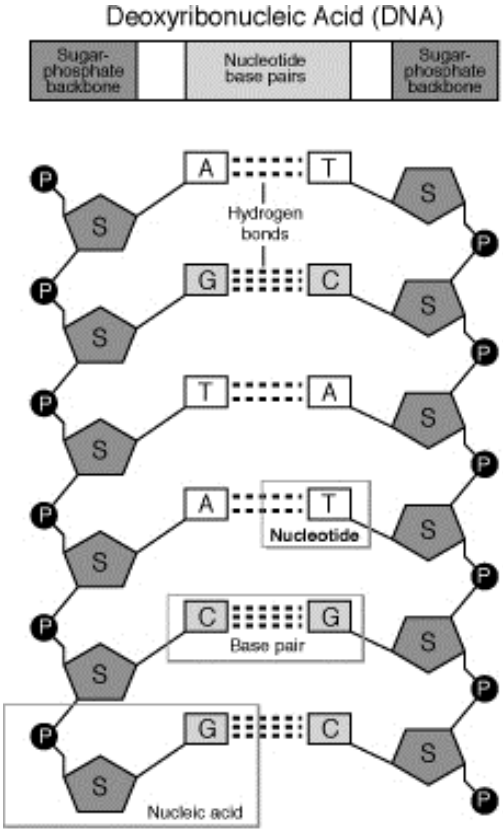


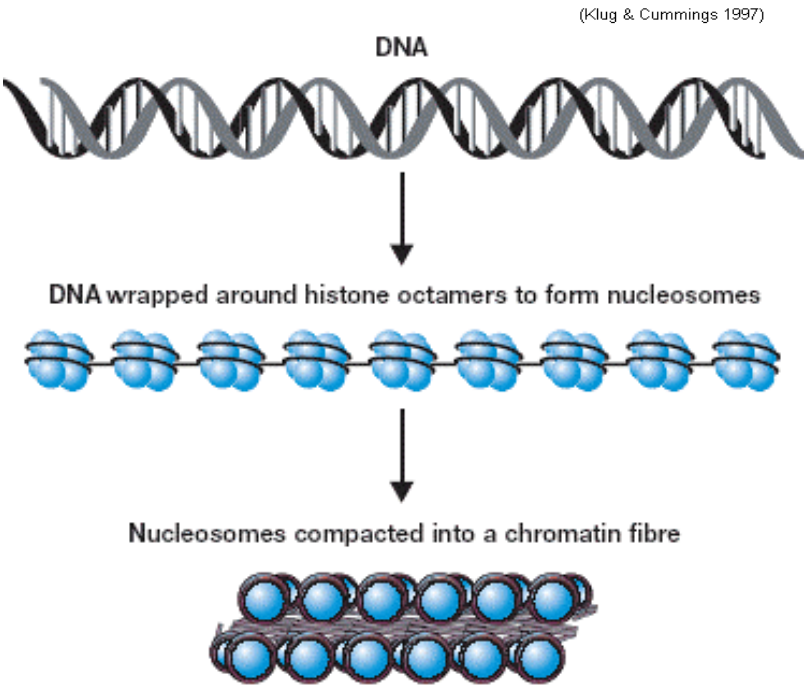
Chargaff's Rule:

- The amount of adenine is always equal to the amount of thymine. The amount of guanine is always equal to the amount of cytosine.
- The pairings of purines and pyrimidines allow for the constant width of a DNA molecule.

- DNA is a double helix.
- The backbone is alternating sugar and phosphate molecules connected by covalent bonds.
- The rungs are nitrogen bases connected by hydrogen bonds.
- DNA strands are **anti-parallel** (they run in opposite directions)
- A DNA strand is always read in the 5' to 3' direction







Organization of Genetic Material

- Eukaryotic cells contain more than 2 m of DNA (over 6 billion base pairs)
- DNA is wound twice around 8 histone proteins with an additional histone holding it all together. This is called a **nucleosome**
- This is further wound into chromatin fibres.
- Nucleosomes help to regulate transcription (expression of genes) by allowing or restricting access to the protein-coding region of DNA

DNA and genes

- **Genes** are sections of DNA that are located on chromatin/chromosomes that code for specific proteins. They are passed from parent to offspring.

- A region before the gene is called a **promoter** and it is like a switch that can turn a gene on.
    - Example: After you eat the insulin gene in pancreatic cells will be told to make insulin molecules (insulin moves sugars into the cell).

- A region after the gene is called a **terminator**.
    - Example: When you make enough insulin, it will turn the gene off.

- Eukaryotic genes contain sections of DNA referred to as **introns** and **exons.**

- Areas of DNA that do not code for genes are called **introns** (aka junk DNA). The function and importance of these areas is still being researched. They are like "bookends" to genes.

- Areas of DNA that code for genes are called **exons** (these are the parts that are *expressed).*

- Highly repetitive DNA accounts for 5%–45% of the human genome. They usually contain 5–300 base pairs that can repeat up to 100,000 times. The function of these sequences is still being researched, but it has been determined that they are transposable (can move from one location to another within the genome).

- The human genome contains 30,000 genes and they are carried by 46 chromosomes. All the DNA in one nucleus of a single cell adds up to 2.5 billion (2,500,000,000) nucleotides long.

- The insulin gene has 51 amino acids and it takes 3 nucleotides to code for 1 amino acid (more on this later), therefore it takes 153 nucleotides to code for an insulin molecule.