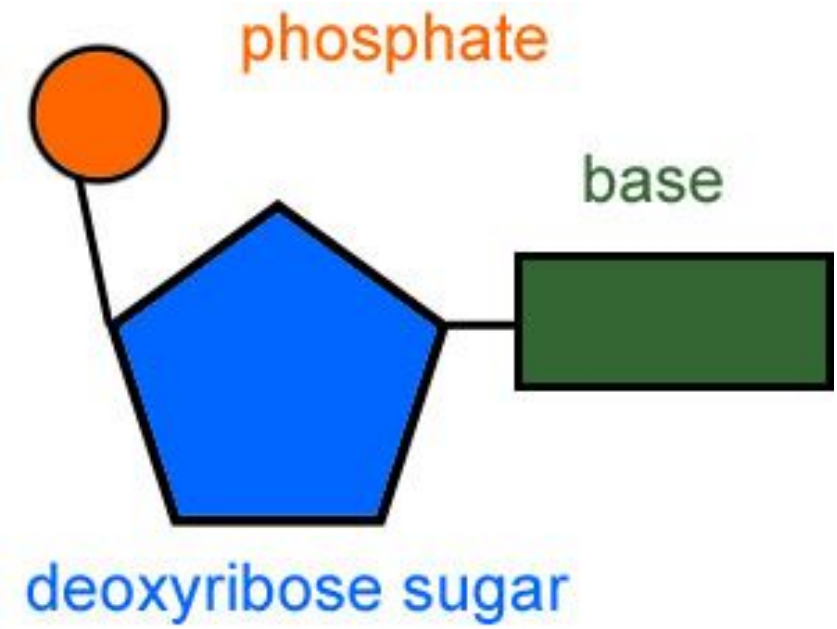
DNA

DNA = deoxyribonucleic acid

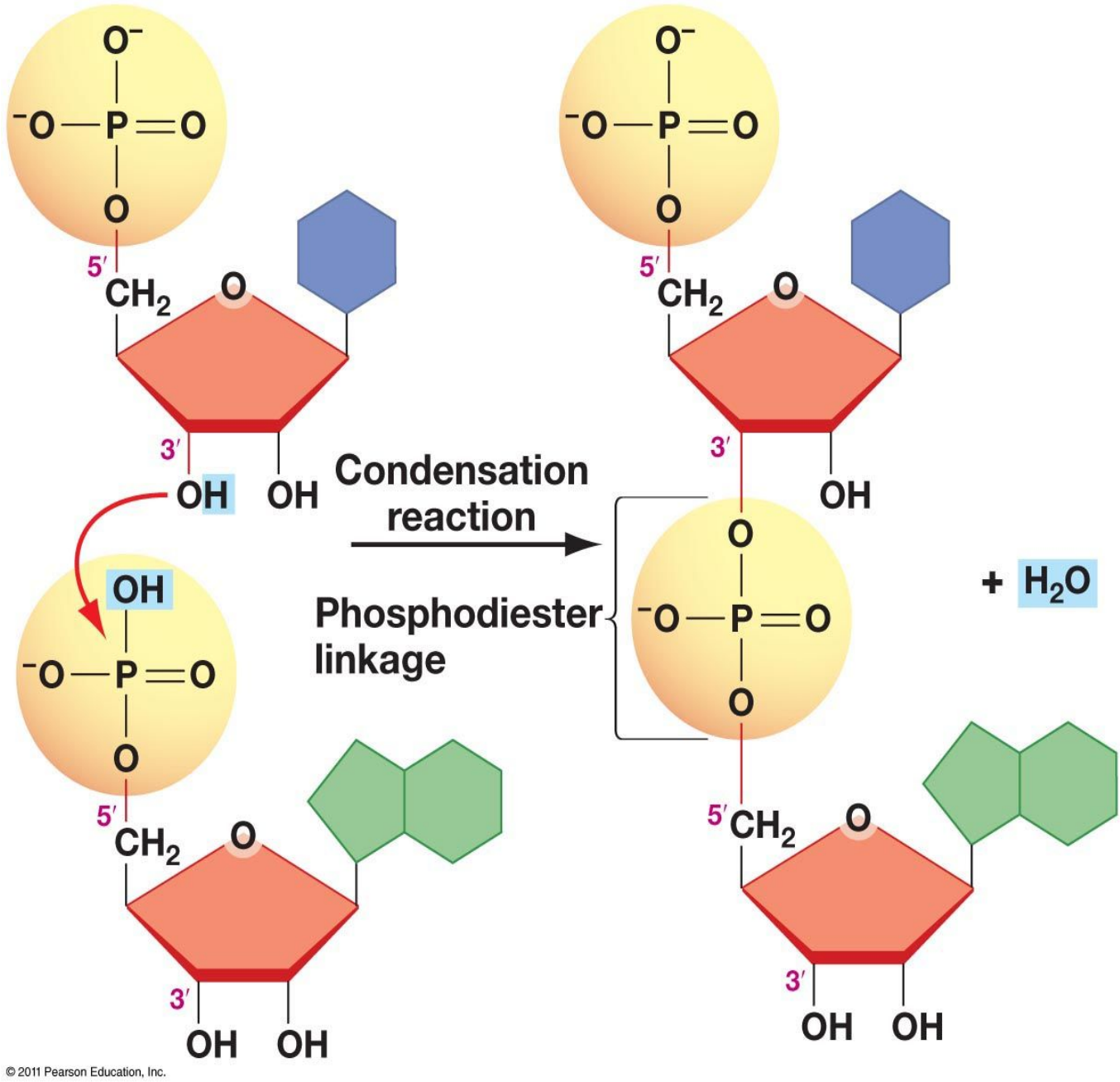
Elements: C,H,N,O,P

Monomer: Mononucleotide (page 36)



- Deoxyribose sugar (5 carbons - pentose)
- Nitrogen-containing base (organic base)
- Phosphate group (negatively charged)

Polynucleotide



Bond = phosphodiester bond

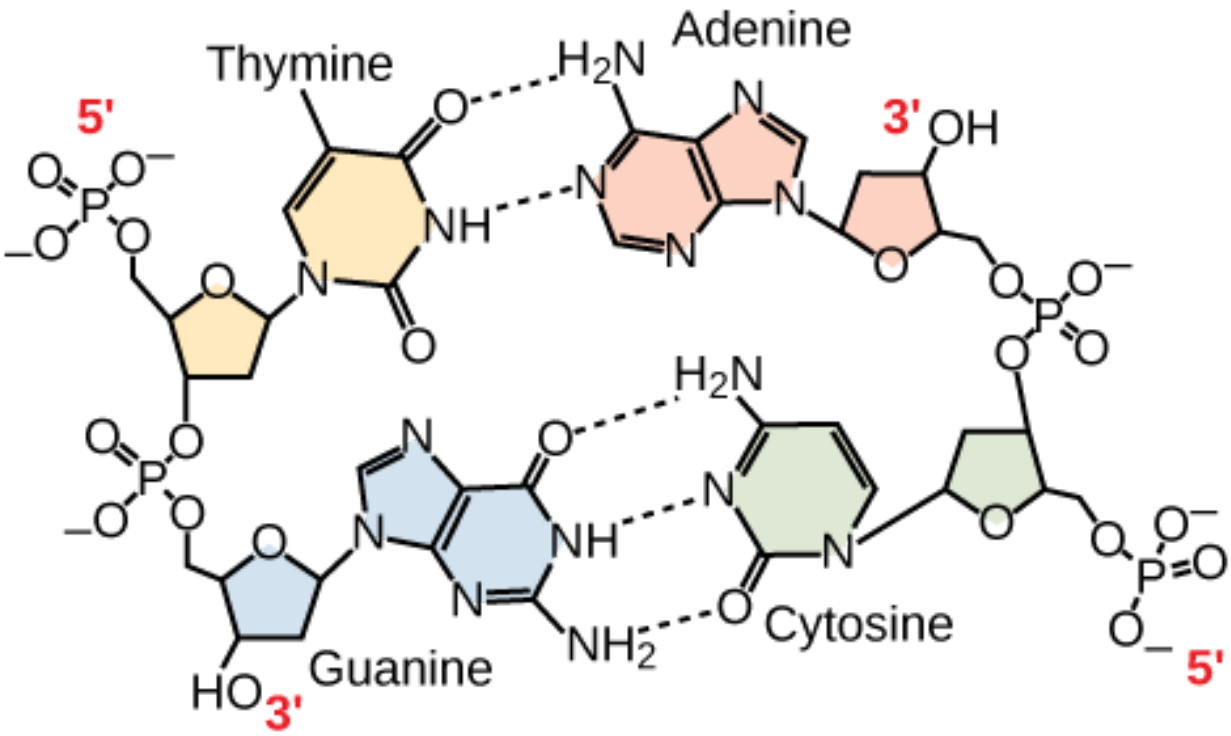
(page 37, figure 3)

Base pairing

DNA is made up for two polynucleotide strands

Strands are held together by complementary hydrogen bonding between bases (page 38)

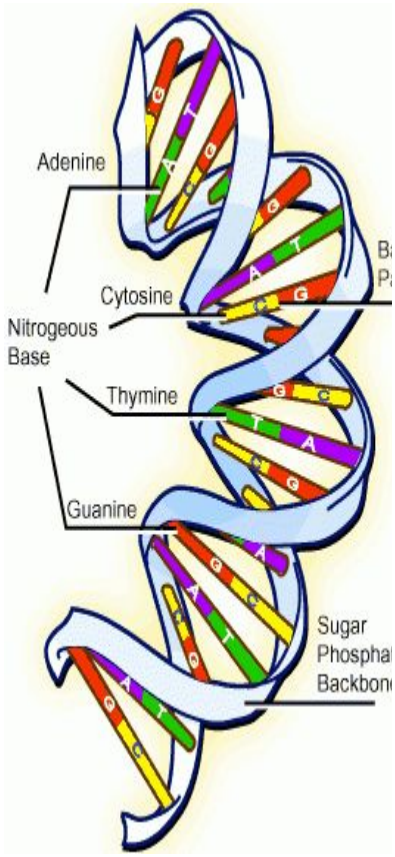
DNA bases: Adenine (A), Guanine (G), Cytosine (C) and Thymine (T)

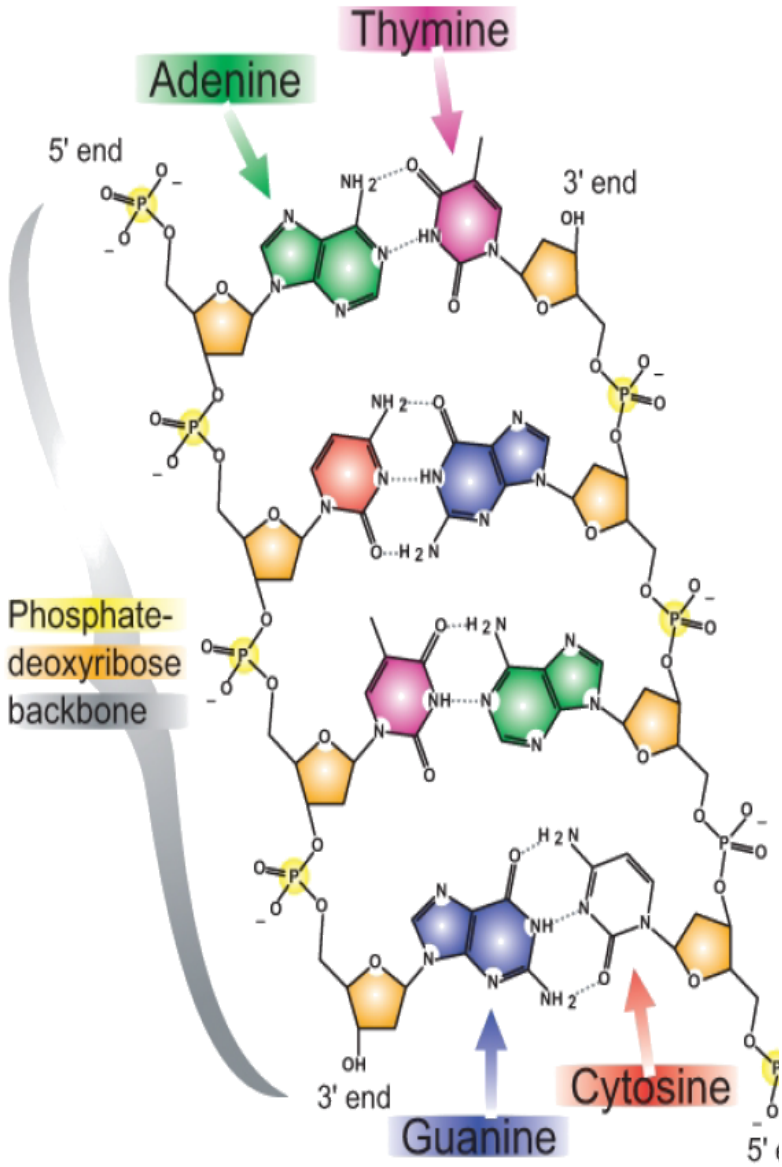


A pairs with T (2 hydrogen bonds)
G pairs with C (3 hydrogen bonds)

DNA double helix

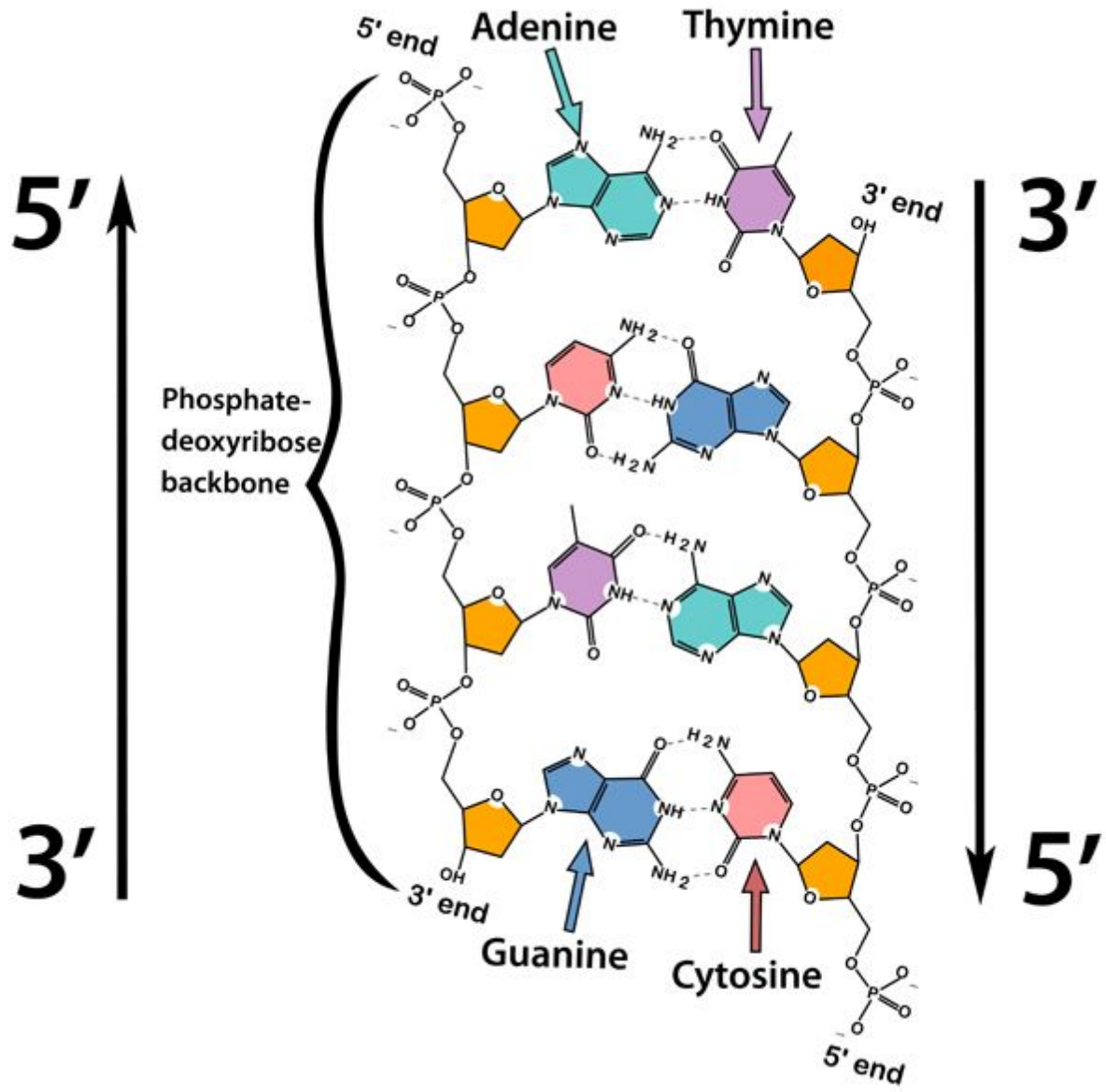
The polynucleotide strands twist around each other in a helix formation (pg 38)





10 base pairs are required for one complete turn of the helix

DNA strands are anti-parallel (pg 41)



Anti-parallel arrangement ensures that bases are on the inside and phosphates on the outside

Stability of DNA (pg 37)

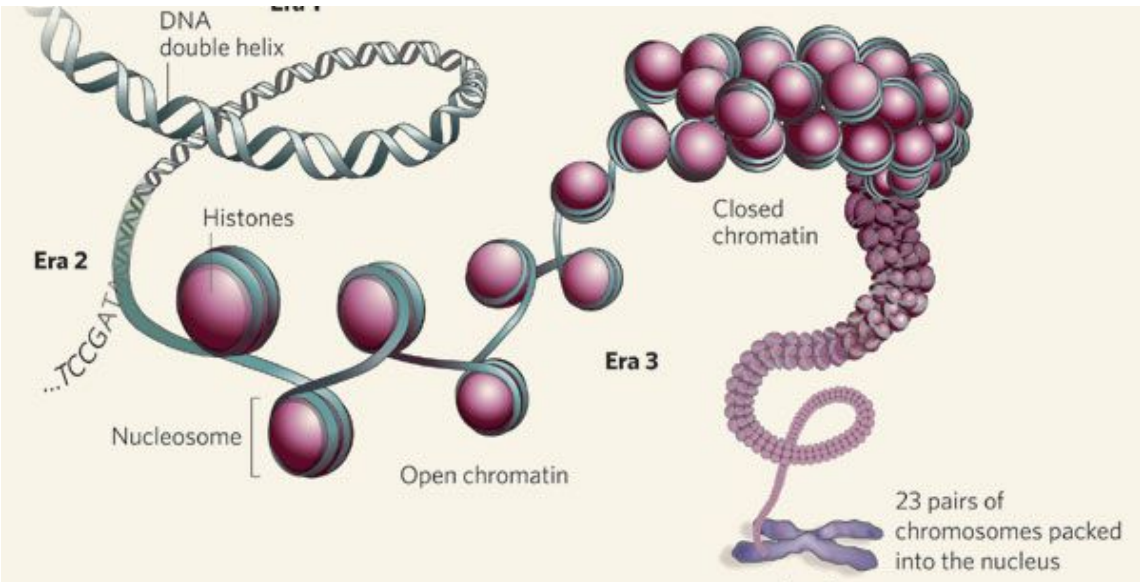
- The bases are on the inside and the charged phosphate groups are on the outside - this protects the helix against chemical damage

- G-C base pairings are held together by three hydrogen bonds - the higher the proportion of G-C, the higher the temp at which the hydrogen bonds separate

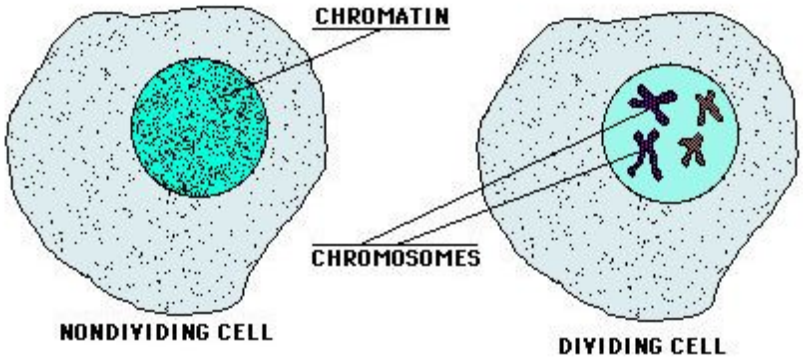
Function of DNA (page 38/39)

- Stable, can be passed on daughter cells
- Two long strands - can carry amounts of information
- Easy to zip/unzip during replication and transcription - each hydrogen bond is weak
- Complementary base pairing ensures bases are copied accurately during replication

How to fit 3 m of DNA fits into a nucleus (pg 205) - DNA spooled around positively charged proteins called histones



Chromosome vs Chromatin (pg 207)



Chromatin in found in the cell during the "resting" or "growing" phase - called interphase

The DNA is loosely coiled around histones - allows the DNA to be unzipped easily for transcription

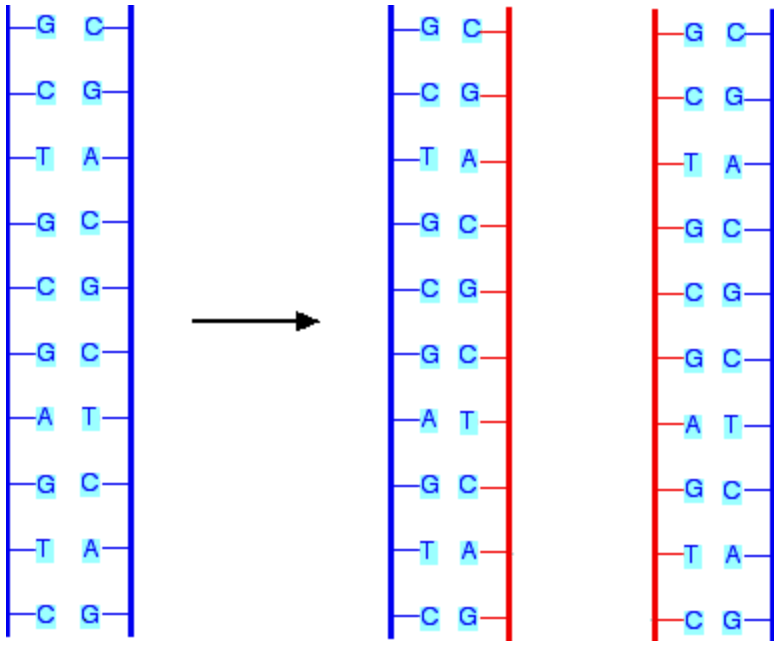
Chromosome is found in the cell just before it starts cell division - mitosis or meiosis

The DNA is supercoiled (packed tightly) around histones - not possible to unzip DNA, but easy to seprate into two daughter cells

DNA Replication

DNA is replicated semi-conservatively

Each new DNA is made up of one strand from the original DNA and one newly replicated strand



Catalysed by the enzyme: DNA Polymerase

Steps in DNA replication

1. DNA helicase breaks the H-bonds between the base-pairs
2. The two strands separate, and the base-pairs are exposed
3. Each strand acts as a template - free nucleotides found in the nucleus attach to the exposed bases
4. DNA Polymerase joins the sugar-phosphate backbone between the two strands, via a condensation reaction (phosphodiester bond), forming a new polynucleotide strand

Note: DNA Polymerase can only attach nucleotides in the 5' -> 3' direction, therefore two DNA Polymerase molecules are required to replicate DNA, one on each strand.

DNA Polymerase needs a 'primer' (a short RNA sequence) to start attaching new bases

Evidence for semi-conservative replication (Meselson-Stahl experiment) will be covered in the 1.15 class

Homework: Unravelling the role of DNA (pg 39-40)

Genes and Alleles (pg 419)

Bacteria have a single, circular strand of DNA

Humans have 23 pairs of linear DNA

Each pair is called a ‘homologous chromosome’

Homologous chromosomes carry the same genes (apart from X and Y)

We inherit one homologous gene from the mother, and the other from the father

Alleles - variants of the gene

E.g. Eye colour gene can have several variants - blue, black, green, etc

G/g = same gene, different variant (e.g. different eye colour)

If the two alleles are the same = homozygous

GG, gg

If the two alleles are different = heterozygous

Gg

The gene is the capital letter is called the ‘dominant’ allele

It will always mask the other allele, called ‘recessive’ allele

E.g. In eye colour, the allele for black eyes, B is dominant to the allele for blue eyes, b

If an individual has - BB = black eye colour
Bb = black eye colour
bb = blue eye colour

The characteristics encoded in recessive alleles are only expressed if the gene is homozygous - e.g. bb, gg

Genotype = all the alleles (of all genes) in a organism

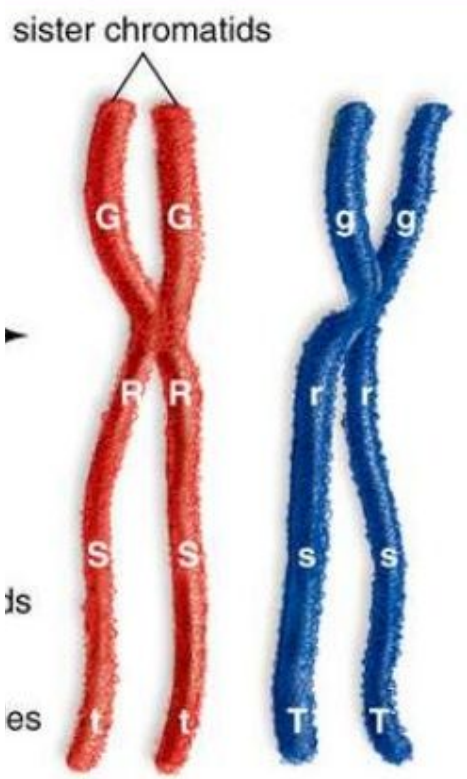
Phenotype = the expressed characteristics

Example:

Bb = genotype
Black eye colour = phenotype

A study of inheritance can be used to understand the link between genotype and phenotype (chapter 17, page 418)

During replication, each homologous chromosome is copied - the two copies are joined together via a point called the centromere (pg 77)



Each half of the replicated pair is called a 'sister chromatid'

One copy of each pair goes into the daughter cell during normal cell division (mitosis)