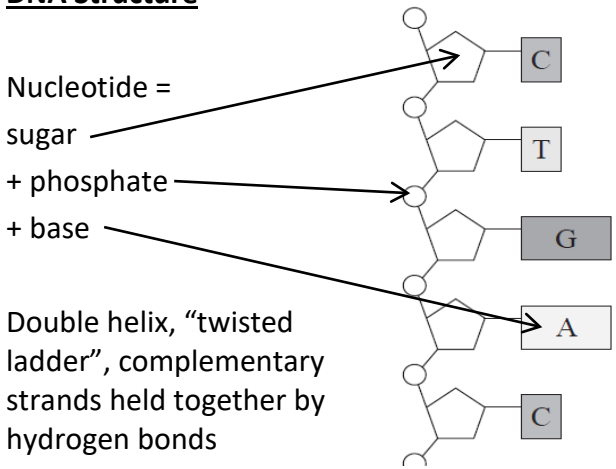
DNA Structure



How DNA "codes" for proteins

- **gene** is part of the DNA molecule / chromosome
- is a sequence of bases / nucleotides
- codes for a specific sequence of amino acids in a protein or codes for a characteristic

alleles – different forms of a gene - with slight difference in base sequence ⇒ different aa ⇒ different protein ⇒ different properties / characteristic e.g. blue / brown eyes

DNA Replication

- original DNA strands unzips, each side acts as template for new strand
- new nucleotides add on to the original bases (and are joined together by enzymes)
- order of bases in one strand determines the order of bases in the other strand
- bases of old and new strand are complementary to each other, **A=T** and **G≡C** ensures new strand is accurate / exact copy of old strand

Cell division

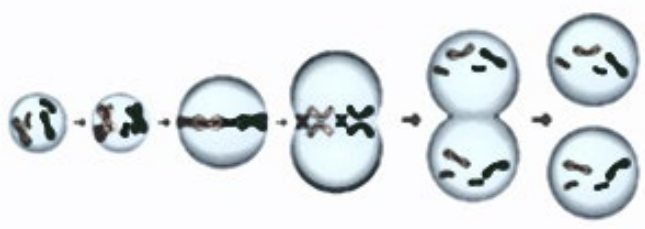
Before either type of cell division, the DNA must first be replicated or copied

Mitosis

- occurs in somatic cells e.g. toe, liver, skin
- production of new cells for growth & repair
- used in asexual reproduction (mostly plants)
- the two daughter cells genetically identical
- cells are diploid / have full genetic information

Cell divides - one copy of each chromosome carrying the same genes, goes into each new body cell. DNA must be accurately copied so daughter cells have same DNA as parent cell. Sequence of bases must stay the same because they code for an amino acid sequence in a protein. Changes in the code are a mutation - cell may no longer be able to carry out its function.

chromosomes replicate, becoming visible, nuclear membrane breaks down, line up singularly on equator, chromatids pulled to opposite poles by spindle, cytoplasm divides etc

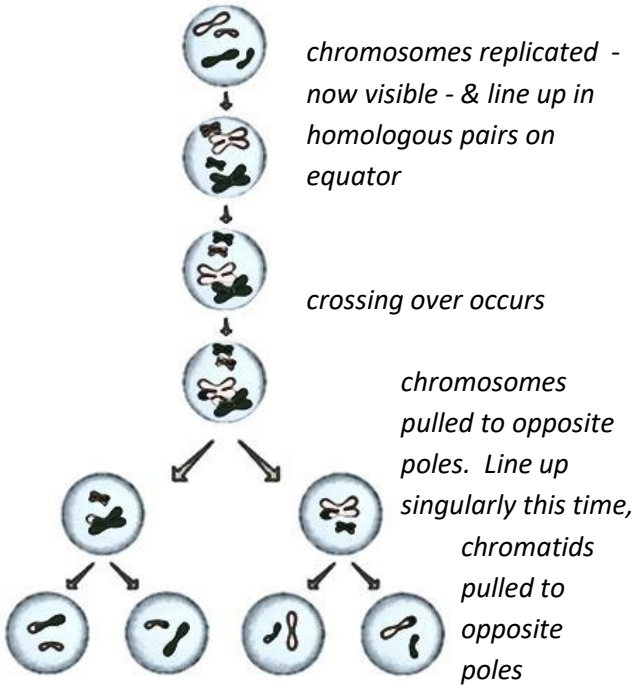


Meiosis

- occurs in cells in reproductive organs e.g. testis & ovary (animals), ovary & anther (plant)
- produces sex cells / gametes e.g. sperm, egg, pollen, ovule

Meiosis continued/

- cells divide twice
- chromosome number halved (haploid) / half the genetic information - need half chromo. no. to enable fertilisation to form zygote & so each new cell has correct no. of chromosomes.
- produces 4 daughter cells, genetically different



How meiosis causes variation

- Homologous pairs line up during meiosis and exchange material during crossing over
- One of each pair of homologous chromosomes goes to a different daughter cell (segregation)

Meiosis produces gametes. DNA of two gametes is combined during fertilisation - means offspring produced are different from both parents.

Sexual and asexual reproduction

Sexual (plants & animals)

meiosis and variation

- involves gametes produced by meiosis
- produces variation
- advantage of variation - provide offspring with greater chance of survival in successive generations in a changing environment
- "slow" as offspring have to grow and become sexually mature before breeding can occur

Asexual (plants and cloned animals)

mitosis and a lack of variation

- advantage - faster
- produces genetically identical plants / animals
- produces / grows plants very quickly / plants fruit sooner than from a plant grown from a seed - benefits the grower - always get desired phenotype of plant & produce more plants to make a bigger profit or more plants in a shorter time
- disadvantages – e.g. plants all genetically identical, so susceptible to same diseases. Less variation – may be less suited to future changes in environment.

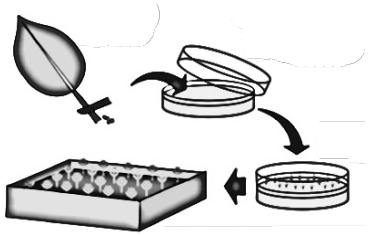
KEY WORDS - *for this part of the standard*
allele, asexual, characteristic, chromosome, clone, complementary, diploid, fertilisation, gamete, gene, haploid, karyotype, meiosis, mitosis, replication, selective breeding
semi-conservative, sexual, trait, variation, zygote

Asexual reproduction in plants

vegetative propagation & cloning in plants

Asexual reproduction techniques include taking stem cuttings, splitting bulbs or tubers and tissue culture.

E.g. tissue culture: A single plant is divided into small clusters of cells and placed on tissue culture. The single plant can produce many identical plants. Sometimes the original plant has been genetically engineered for a required gene.



Selective breeding – plants / animals

Breed together individuals that have desirable phenotypes / characteristics e.g. cows with more meat or better milk yields, or a e.g. potato with resistance to disease & potato with a firm texture.

Slow process – occurs of numerous generations. At each stage individuals are selected with the desired characteristics.

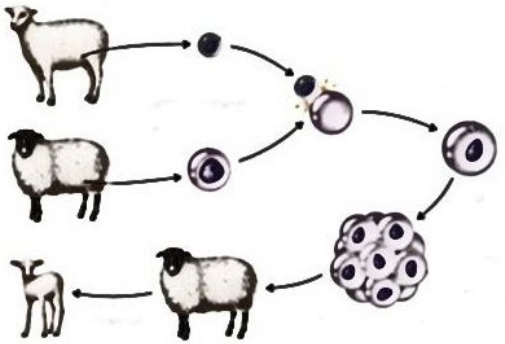
Cross pollinate potato plants. Seeds grown / geminated. Potatoes grown from these seeds that show both desired characteristics can then be reproduced asexually to (quickly) produce a crop.

Both selective breeding & cloning processes (see opposite) reduce genetic diversity of a breed by eliminating certain genes / combinations of genes.

Cloning - Animals

enucleating - microinjection - surrogate mothers (SCNT)

- nucleus transplanted into an enucleated cell - electrical current is passed through it so that the cell starts dividing - embryo transplanted into a surrogate mother
- expensive, low success rate, some problems (eg premature aging), ethics surrounding humans!!



Artificial twinning

Egg from a desirable cow is fertilised by the sperm from a desirable bull. Fertilised egg is allowed to divide several times. The undifferentiated ball of cells is then broken up. Each cell is then grown and transplanted into surrogate cows. Advantage: best characteristics of animals can be selected and new animals produced faster than traditional methods. NOTE: Calves are clones of each other but not of the parents.