Genetic recombination

- **Genetic recombination** is the exchange of genetic material between different organisms which leads to production of offspring with combinations of traits that differ from those found in either parent.
- Genetic recombination occurs in both prokaryotes and eukaryotes
- Genetic recombination creates diversity of genomes within the same species. This creates greater adaptability of the species to changing ecological conditions in the process of evolution.
- In sexually reproducing eukaryotes genetic recombination occurs by re-assortment of chromosomes, gene conversion and chromosomal crossover.

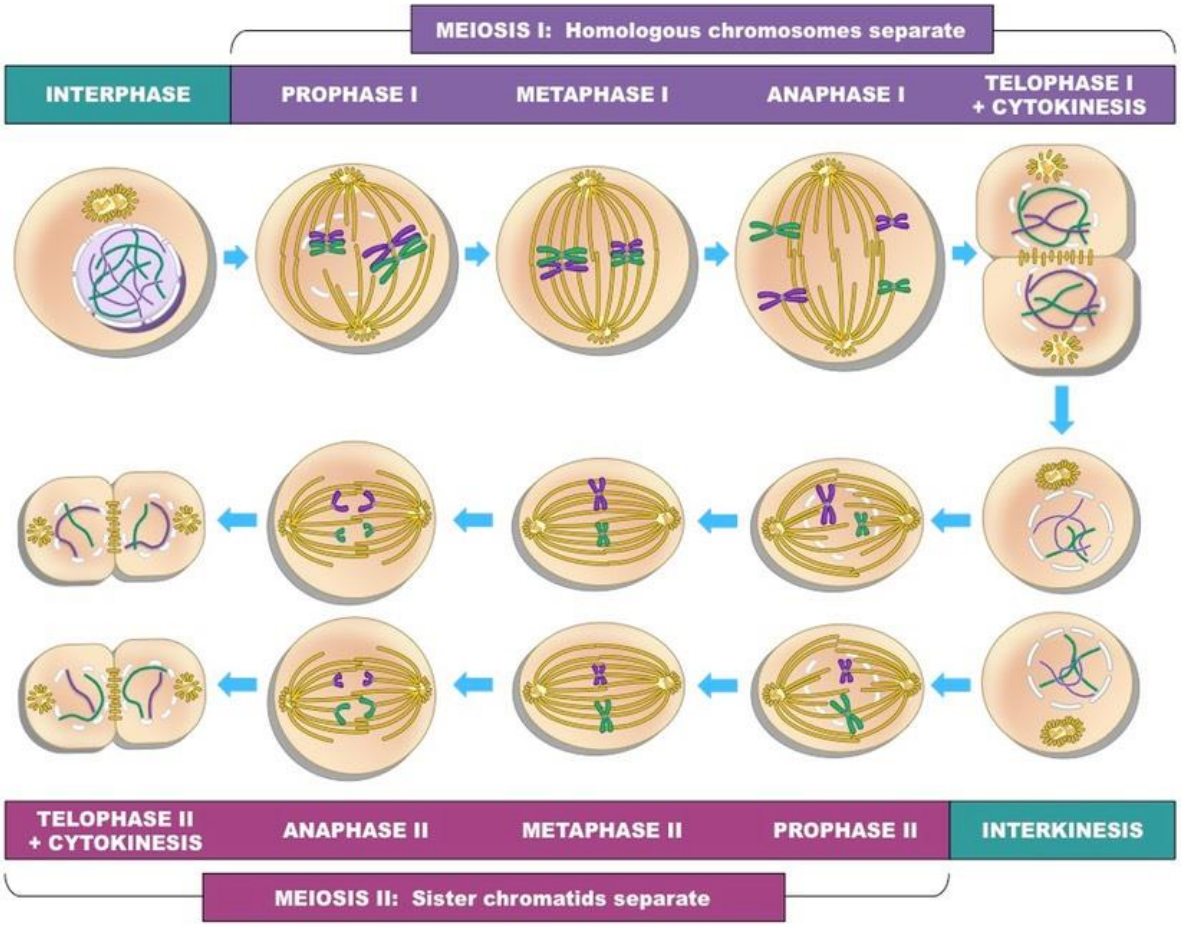
Ploidy

- *Ploidy* is the number of complete *sets of chromosomes* in a cell.
- *Diploid* cells have two homologous copies of each chromosome, usually one from the mother and one from the father. All or nearly all mammals are diploid organisms.
- Humans are diploid. Human diploid chromosome set consist of 23 pairs of chromosomes, 46 chromosomes total.

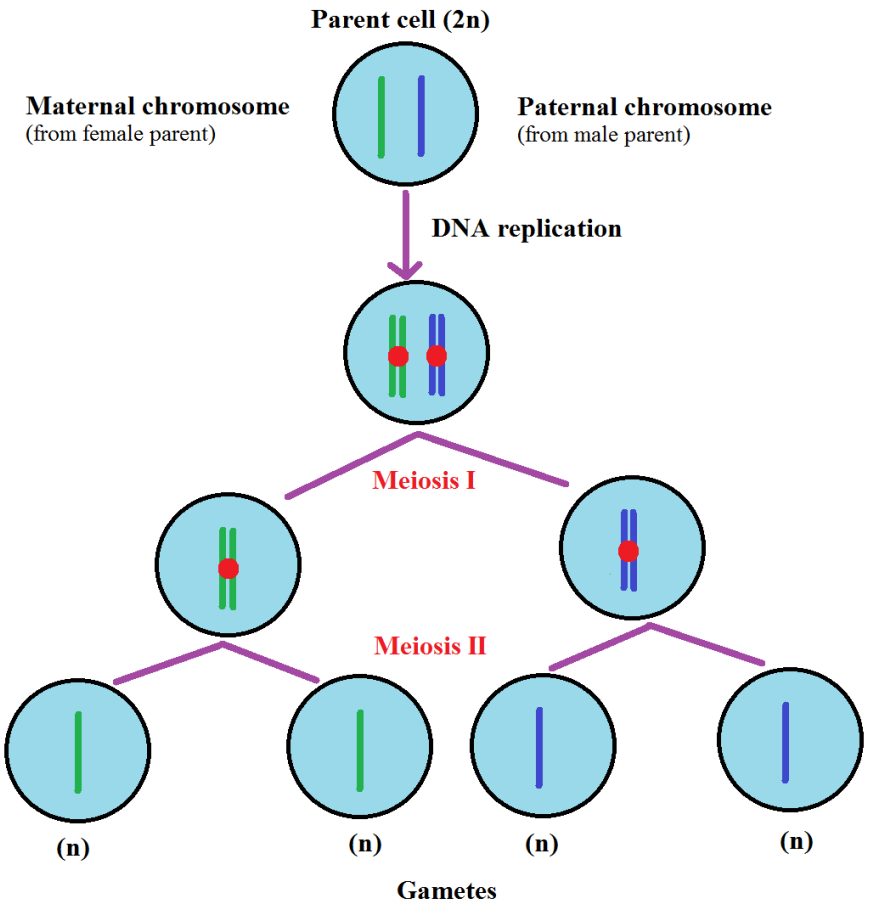
Meiosis

- Meiosis is a specialized type of cell division that reduces the chromosome number by half, creating four *haploid* cells, each genetically distinct from the parent cell that gave rise to them.
- Meiosis usually occur during germ cell formation.
- Meiosis consists of two cell divisions – meiosis I and meiosis II

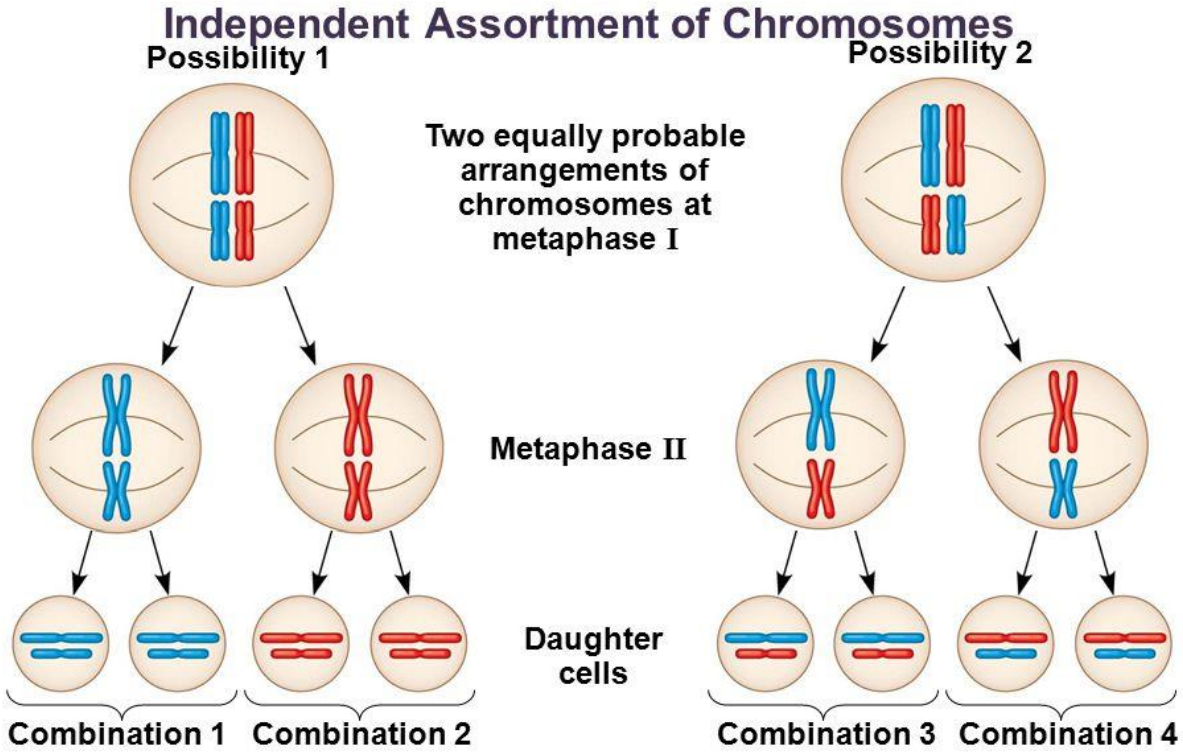
Meiosis


MEIOSIS I: Homologous chromosomes separate
INTERPHASE
PROPHASE I
METAPHASE I
ANAPHASE I
TELOPHASE I + CYTOKINESIS
TELOPHASE II + CYTOKINESIS
ANAPHASE II
METAPHASE II
PROPHASE II
INTERKINESIS
MEIOSIS II: Sister chromatids separate

Meiosis

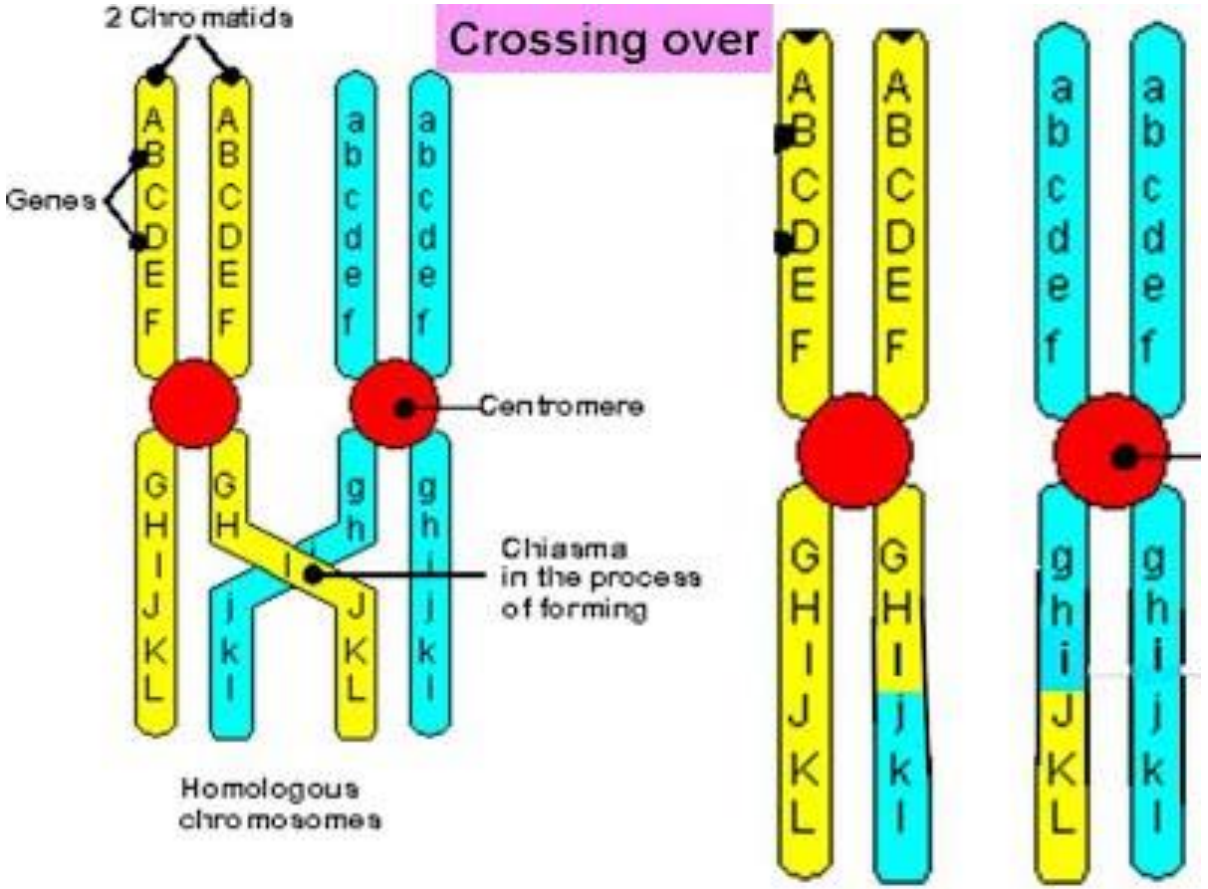

Parent cell (2n)
Maternal chromosome
(from female parent)
Paternal chromosome
(from male parent)
DNA replication
Meiosis I
Meiosis II
(n)
(n)
(n)
(n)
Gametes

Chromosome assortment

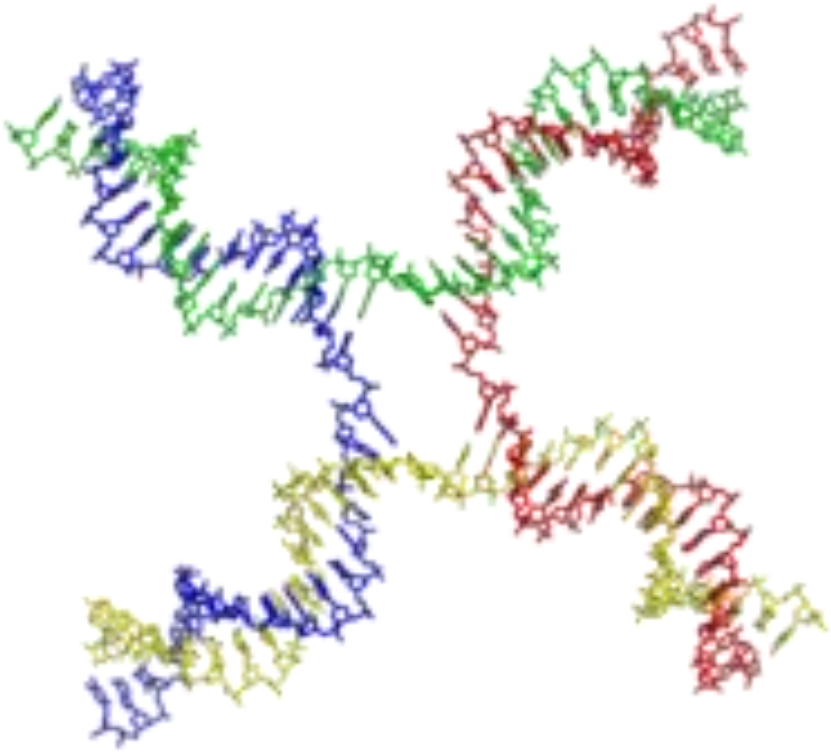


The number of combinations possible when chromosomes assort independently into gametes is 2^n, where *n* is the haploid number.

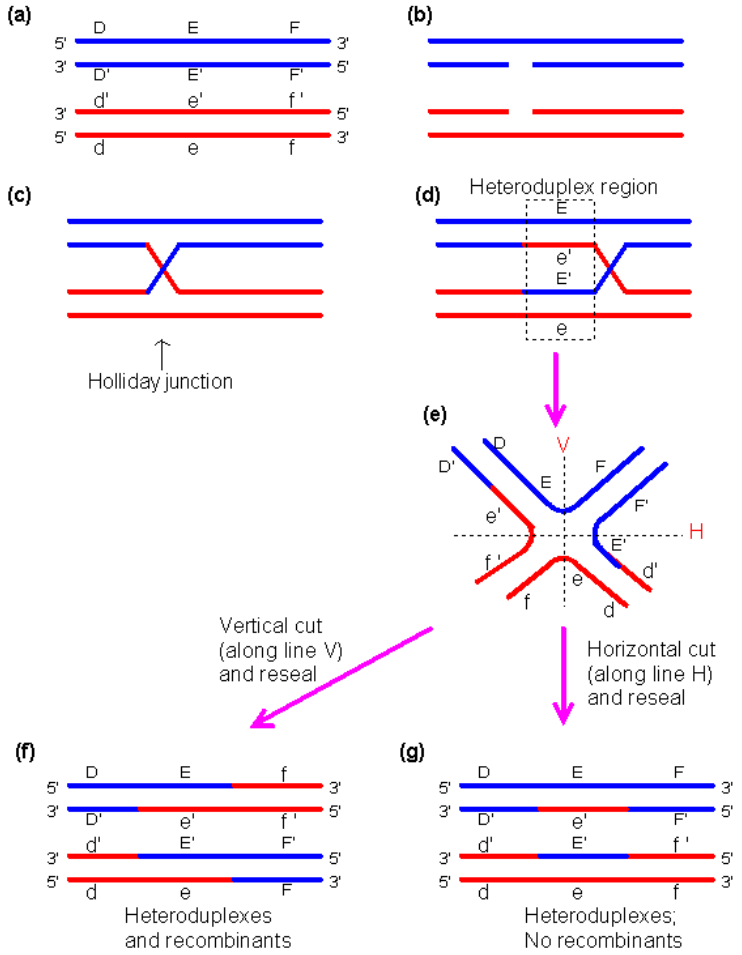
Chromosomal crossover



Mechanism of crossing over – Holiday Junction formation

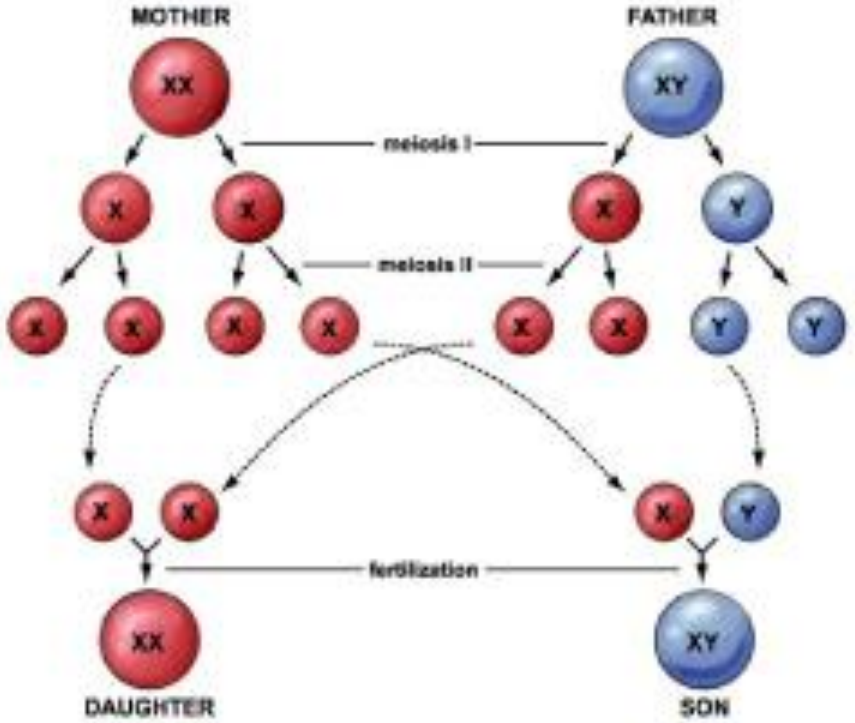


2 ways of Holiday junction resolution



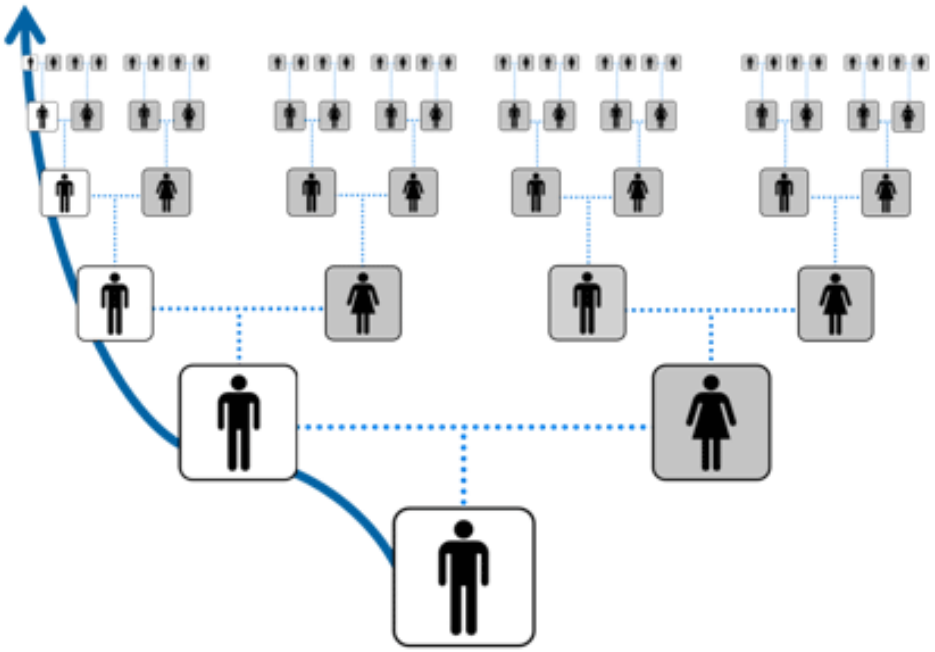
- Holiday junction could be resolved in two ways:
- Recombinant resolutions leads to *crossovers* or crossing overs.
- Since the majority of genomes' sequences are identical, the products of non-recombinant resolutions are usually not detected.
- When heteroduplex region contains a genetic marker, for example an SNP, non-recombinant resolution leads to *gene conversion*.

Human sex chromosomes

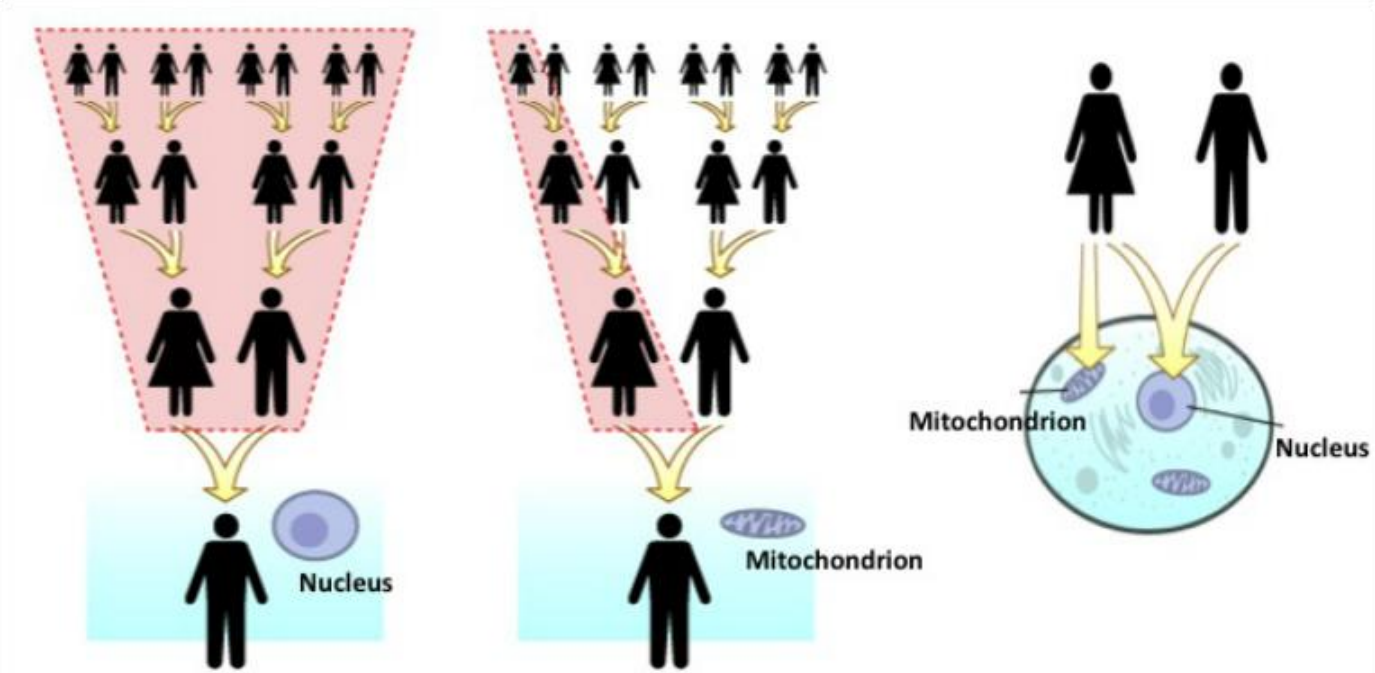


Y chromosome

Y chromosome is inherited by boys only from a single lineage - paternal



Mitochondrial DNA



Nuclear DNA is inherited from all ancestors (left panel); Mitochondrial DNA is inherited from a single lineage, maternal (center panel); mitochondria are passed from mother to child only, whereas the genes in the nuclei of your cells come from both parents (right panel). From the University of California Museum of Paleontology's Understanding Evolution (http://evolution.berkeley.edu).