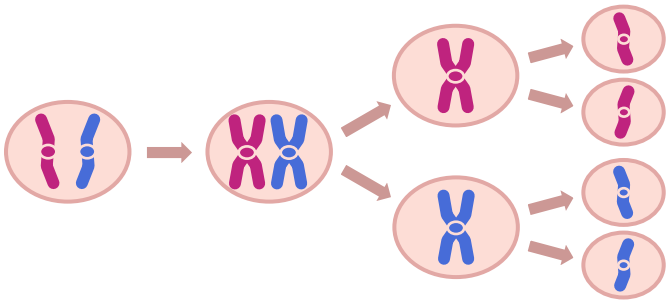
TOPIC 3.3: MEIOSIS

Meiosis

Meiosis is the reduction division of a diploid cell to produce four haploid cells (gametes) that are genetically distinct

It involves two divisions:

- Meiosis I separates homologous chromosomes
- Meiosis II separates sister chromatids



Interphase | Meiosis I | Meiosis II

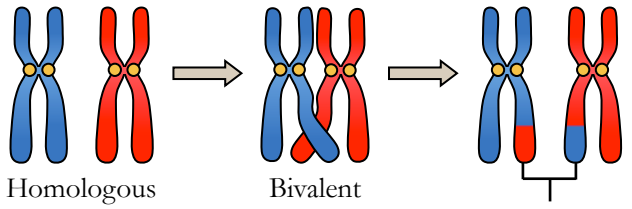
Mitosis versus Meiosis

Hint: Disco Pug	Mitosis	Meiosis
***D**ivisions*	One	Two
***I**ndependent Assortment*	No	Yes *(Metaphase I)*
***S**ynapsis*	No	Yes *(bivalents / tetrads)*
***C**rossing Over*	No	Yes *(Prophase I)*
***O**utcome*	Two cells	Four cells
***P**loidy*	Diploid → Diploid	Diploid → Haploid
***U**se*	Body cells	Sex cells (gametes)
***G**enetics*	Identical (clones)	Genetic variation

Genetic Variation

Crossing Over

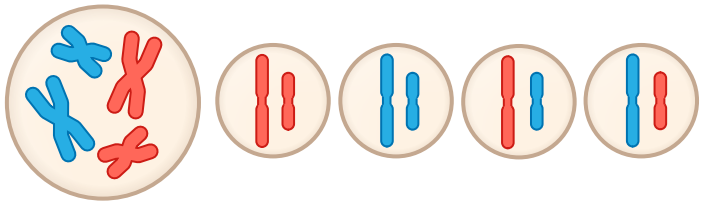
- Crossing over occurs via synapsis in Prophase I
- Homologous chromosomes form bivalents (or tetrads)
- Chiasmata represent the points where genetic information has been exchanged between the homologous pair
- The non-sister chromatids that have exchanged DNA are called recombinants



Homologous chromosomes | Bivalent (+ chiasma) | Recombinants

Random Assortment

- The homologous pairs orient randomly in Metaphase I
- This means there is an equal chance of a resulting gamete containing either the maternal or paternal chromosome
- As humans have a haploid number of 23, consequently there are 2^{23} potential gamete combinations (>8 million)

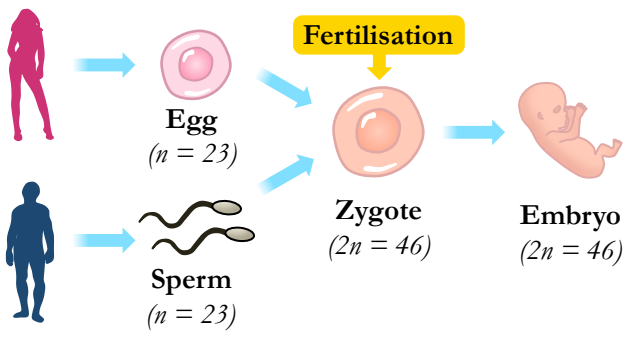


Parent Cell | Potential Gamete Combinations

Sexual Life Cycle

The halving of chromosome number by meiosis allows for a sexual life cycle with the fusion of gametes

- This acts as a further source of genetic variation



Non-Disjunction

Non-disjunction refers to chromosomes failing to separate, resulting in gametes with extra or missing chromosomes

The failure to separate may involve the homologous pairs in Anaphase I or the sister chromatids in Anaphase II

If a gamete with an extra chromosome fuses with a normal gamete, the resulting zygote will have three copies

- E.g. Trisomy 21 (Down Syndrome)

Studies show parental age influences chances of non-disjunction

- Older parents are at a higher risk of non-disjunction events