TOPIC 10.1: MEIOSIS

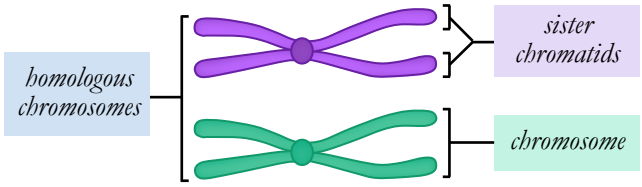
Homologous Pairs

The chromosomes of sexually reproducing organisms are **homologous** (i.e. they exist in pairs)

- There is a paternal copy and a maternal copy (sex chromosomes may not be homologous)

Chromosomes will replicate during interphase to form genetically identical sister chromatids

- These chromatids are separated during meiotic division to become autonomous chromosomes

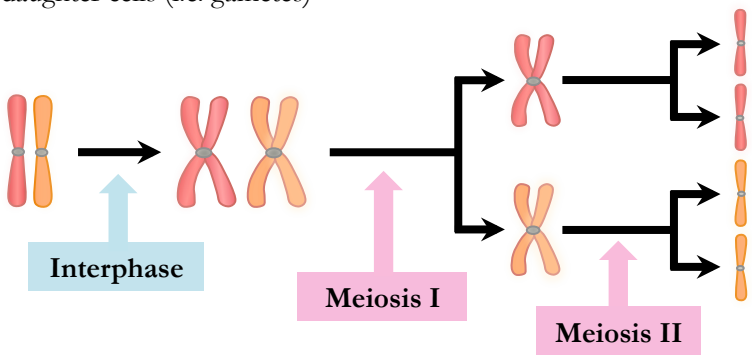


Meiotic Divisions

Meiosis produces haploid gametes via two nuclear divisions:

- Homologous pairs are separated during meiosis I
- Sister chromatids are separated during meiosis II

The final outcome of meiosis is four genetically distinct haploid daughter cells (i.e. gametes)



Random Assortment

During Metaphase I, homologous pairs of chromosomes line up in a random orientation along the equator

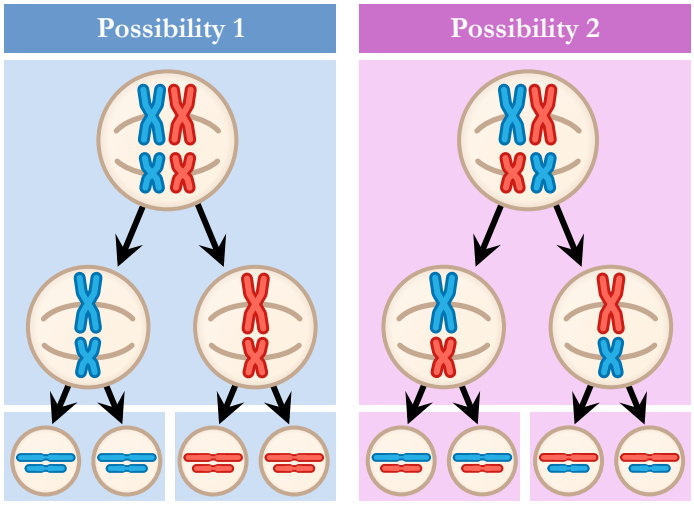
This means there is an equal chance of a gamete containing either the maternal or paternal copy of a given chromosome

The orientation of each homologous pair is independent to the orientation of any other homologous pair

The number of potential chromosome combinations can be determined by the formula: $\mathbf{2^n}$ *(where n = haploid number)*

As humans have a haploid number of 23, they can produce 2^{23} gamete combinations via random assortment

- $2^{23} > 8$ million different combinations



Four gamete combinations are possible (2^n)

Crossing Over

During Prophase I, homologous pairs of chromosomes form points of connection between non-sister chromatids

The connection points form via a process known as synapsis and the resulting complex is called a bivalent (or tetrad)

While in synapsis, non-sister chromatids may break and recombine with their homologous partner (crossing over)

- Crossing over may result in the exchange of alleles

The non-sister chromatids remain physically connected at points of exchange (chiasmata) until separated by anaphase

Recombinants

The non-sister chromatids that have had genetic material exchanged are called recombinants

- Recombination may result in novel allele combinations