*This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.*

Meiosis is the cell division that produces gametes (sex cells). It generates genetic variation essential for evolution.

- Meiosis produces FOUR genetically DIFFERENT haploid cells from one diploid parent cell.
- Haploid: containing only one set of chromosomes (23 in humans — one from each pair).
- During fertilisation, two haploid gametes fuse → diploid zygote (46 chromosomes).
- Meiosis involves TWO divisions: Meiosis I separates homologous chromosome pairs; Meiosis II separates sister chromatids.

★ **HT** Sources of variation in meiosis: crossing over (exchange of DNA between homologous chromosomes — creates new allele combinations) and independent assortment (random orientation of chromosome pairs).

★ **HT** Crossing over: homologous chromosomes pair up and exchange segments of DNA → new combinations of alleles in gametes.

★ **HT** With 23 pairs of chromosomes, there are 2^{23} (~8 million) possible chromosome combinations from independent assortment alone. Combined with crossing over: essentially infinite variation.

Key Terms

Meiosis	Cell division producing 4 genetically DIFFERENT haploid cells — for sexual reproduction
Haploid	Containing one set of chromosomes — 23 in human gametes
Diploid	Containing two sets of chromosomes — 46 in human body cells
Crossing over	Exchange of genetic material between homologous chromosomes during meiosis I — creates new allele combinations
Independent assortment	Random orientation of chromosome pairs during meiosis — each gamete gets a random mix of maternal and paternal chromosomes

■ **Exam Tip:** Meiosis vs mitosis: MITOSIS = 2 identical DIPLOID cells. MEIOSIS = 4 DIFFERENT HAPLOID cells. In an exam: if asked what type of cell division produces gametes, ALWAYS say meiosis.