Exercise walk-through

Passage of information from parents to offspring ▪ 16.1

eXercise

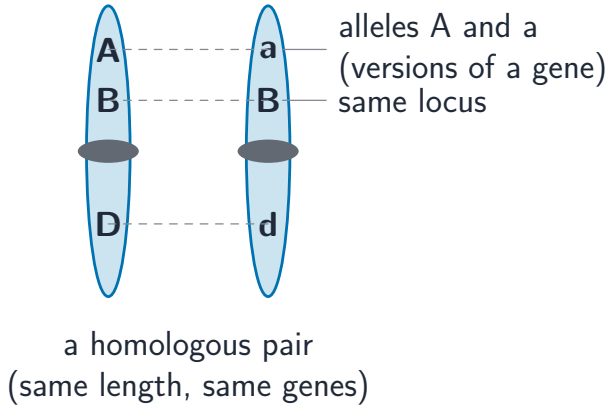
You must be able to

- explain haploid and diploid, homologous pairs, and the need for a reduction division
- describe the behaviour of chromosomes during meiosis and identify its stages
- explain how meiosis and fertilisation produce genetically different individuals

Method — Haploid, diploid and homologous pairs

A **diploid 二倍体** cell (2n) has two sets of chromosomes; a **haploid 单倍体** cell (n) has one. **Homologous chromosomes 同源染色体** are a pair of the same length carrying the same genes (alleles may differ).

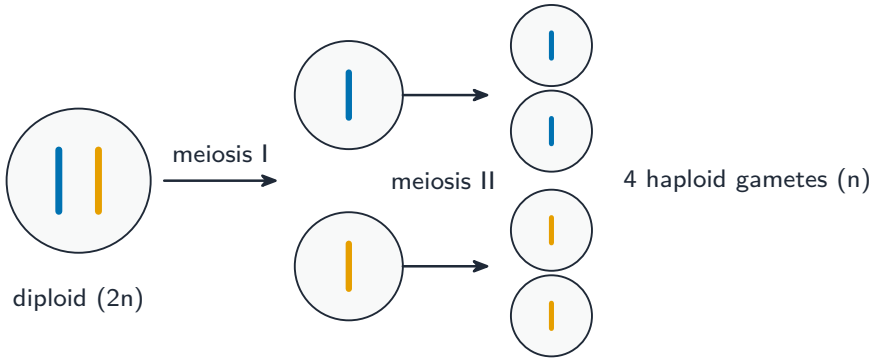
Method — Haploid, diploid and homologous pairs



A homologous pair: same length, same gene loci, but the alleles differ (A and a)

Method — Meiosis halves the chromosome number

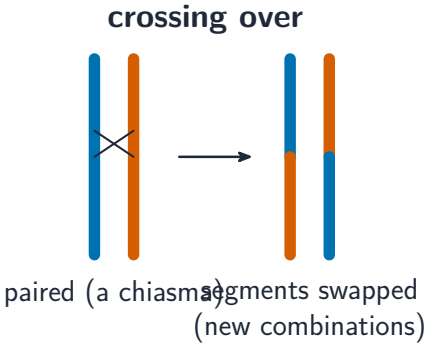
Gametes must be haploid, or the chromosome number would double each generation. Meiosis has two divisions (meiosis I and II).



A diploid cell divides by meiosis I into two, then meiosis II into four haploid gametes

Method — How meiosis makes variation

Then **random fertilisation** lets any gamete fuse with any other, so every new individual is genetically different.



Crossing over: paired chromosomes swap matching segments at a chiasma

Method — How meiosis makes variation

independent assortment

the pairs line up in a random order, so each gamete gets a random mix

Practice 2.1 ▪ 2 marks

State the difference between a haploid and a diploid cell.

Solution 2.1

Worked steps

haploid has one set of chromosomes (n); diploid has two sets (2n) B1 *each*.

Practice 2.2 ▪ 2 marks

Name the two processes during meiosis that make gametes genetically different.

Solution 2.2

Method: How meiosis makes variation

Worked steps

crossing over; independent assortment (random orientation) B1 *each*.

Exam-style 3.1 ▪ 1 mark

Why must gametes be produced by a reduction division?

A to make the gametes larger

B to keep the chromosome number constant from generation to generation

C to copy the DNA

D to produce identical cells

Solution 3.1

Method: Meiosis halves the chromosome number

A to make the gametes larger

B to keep the chromosome number constant from generation to generation ✓

C to copy the DNA

D to produce identical cells

Worked steps

B. Halving the number means fertilisation restores the diploid number, keeping it constant.

Exam-style 3.2 ▪ 1 mark

During which division of meiosis are homologous chromosomes separated?

A meiosis I

B meiosis II

C mitosis

D fertilisation

Solution 3.2

A meiosis I ✓

B meiosis II

C mitosis

D fertilisation

Worked steps

A. Homologous chromosomes are separated in meiosis I.

Exam-style 3.3 ▪ 4 marks

Explain how crossing over and independent assortment each increase genetic variation.

Solution 3.3

Method: How meiosis makes variation

Worked steps

crossing over: homologous chromosomes swap matching segments at chiasmata M1, making new combinations of alleles A1; independent assortment: the homologous pairs line up in a random order at the equator M1, so gametes receive different mixes of maternal and paternal chromosomes A1.

Exam-style 3.4 ▪ 2 marks

An organism has a haploid number of $n = 4$.
(a) Calculate the number of different chromosome combinations possible in its gametes from independent assortment alone (2^n).
(b) Explain why the actual number of genetically different gametes is even larger than this.

Solution 3.4

Method: How meiosis makes variation

Worked steps

(a) $2^4 = 16$ M1 A1.

(b) crossing over also creates new allele combinations, adding to the variety B1.