

16.1 Passage of information from parents to offspring

Name: _____ Class: _____ Date: _____

Total: 13 marks

KEY WORDS gamete 配子 • meiosis 减数分裂 • haploid 单倍体 • crossing over 交叉互换 • homologous chromosomes 同源染色体

Objective

Build the skills to answer exam questions on the **passage of information from parents to offspring** — **meiosis** 减数分裂, and how **crossing over** 交叉互换, **independent assortment** 自由组合 and fertilisation create variation.

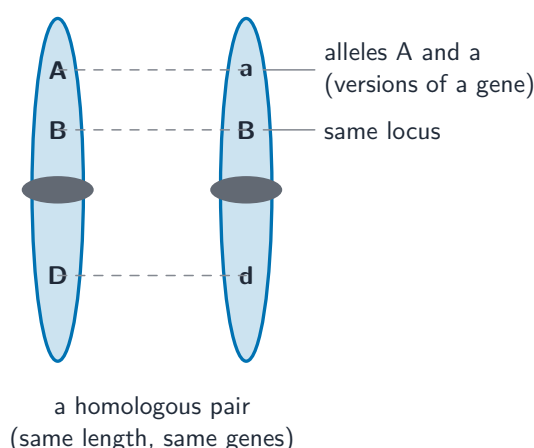
You must be able to:

- 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

1 Worked examples

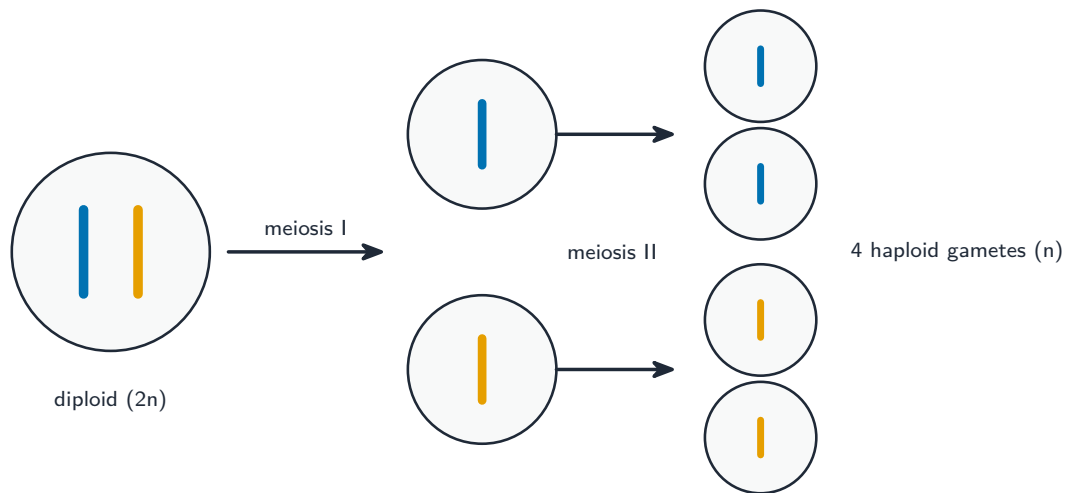
■ Haploid, diploid and homologous pairs

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).



A homologous pair carries the same genes at the same loci; the alleles may differ

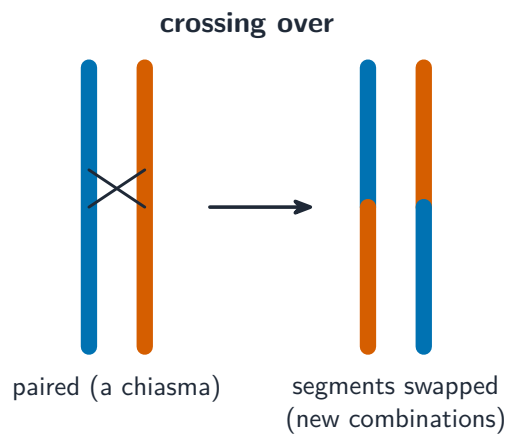
■ Meiosis halves the chromosome number



Meiosis I separates the homologous pair; meiosis II separates the chromatids → four haploid gametes

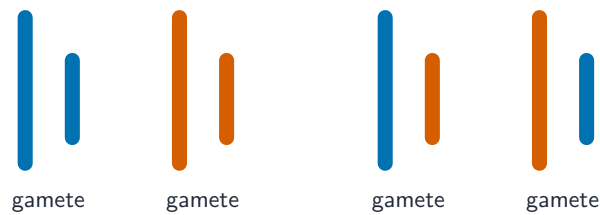
Gametes must be haploid, or the chromosome number would double each generation. Meiosis has two divisions (meiosis I and II).

■ How meiosis makes variation



Crossing over swaps matching segments, making new allele combinations

independent assortment



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

Independent assortment: pairs line up randomly, so gametes get many different mixes

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

2 Practice

2.1 State the difference between a haploid and a diploid cell.

[2]

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

[2]

3 Exam-style questions

3.1 Why must gametes be produced by a reduction division?

[1]

- 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

3.2 During which division of meiosis are homologous chromosomes separated?

[1]

- A meiosis I
- B meiosis II
- C mitosis

- D fertilisation

3.3 Explain how crossing over and independent assortment each increase genetic variation. [4]

3.4 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). [2]

(b) Explain why the actual number of genetically different gametes is even larger than this. [1]

Solutions

2.1 haploid has one set of chromosomes (n); diploid has two sets ($2n$).

2.2 crossing over; independent assortment (random orientation).

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

3.2 A. Homologous chromosomes are separated in meiosis I.

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

3.4 (a) $2^4 = 16$.

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