

Exercise walk-through

5.2

Meiosis and Genetic Diversity

AP Biology

Meiosis and genetic diversity

Three shuffles make every gamete unique:

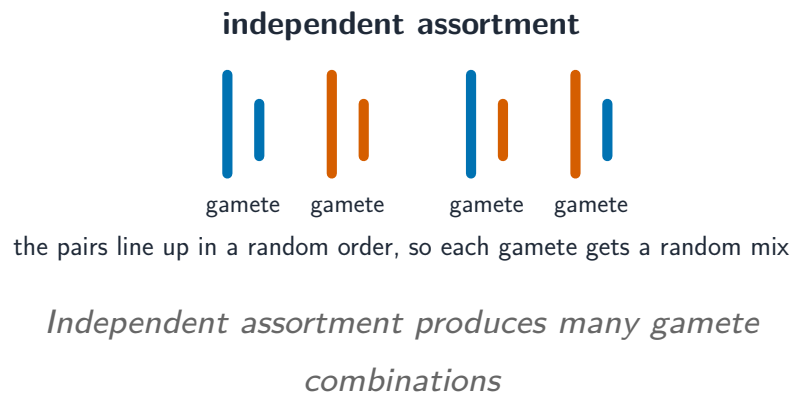
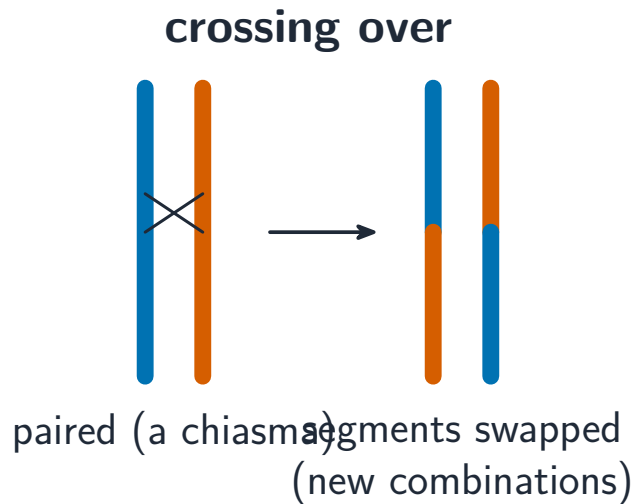
- **Crossing over** – homologs swap pieces
- **Independent assortment** – pairs line up at random
- **Random fertilization** – any sperm, any egg

Independent assortment alone gives 2^{23} human gamete types – **genetic diversity** is insurance.



Variation among offspring is not noise – it is insurance

Crossing over swaps segments between homologous



Crossing over swaps segments between homologous chromosomes

Where meiosis gets its variation

crossing over

homologous chromosomes swap segments in prophase I – new combinations *within* a chromosome

independent assortment

each homologous pair lines up independently at metaphase I – 2^{23} combinations in humans

random fertilisation

any sperm with any egg, multiplying the possibilities again

together

these create **enormous variation** – the raw material evolution acts on

homozygous / heterozygous

two identical alleles, or two different ones, at a locus

Mutation *creates* new alleles; meiosis *recombines* the existing ones. Both are needed, and they are not the same source.

Exercises 2.1-2.3

2.1 Name the process where homologous chromosomes swap segments. [1]

2.2 What does independent assortment describe? [1]

2.3 For an organism with 3 chromosome pairs, how many gamete combinations arise from independent assortment? [2]

Exercises 2.1-2.3

2.1 Name the process where homologous chromosomes swap segments. [1]

2.1

- Crossing over

2.2 What does independent assortment describe? [1]

2.2

- Homologous pairs line up randomly, so chromosomes sort into gametes in many combinations

2.3 For an organism with 3 chromosome pairs, how many gamete combinations arise from independent assortment? [2]

2.3

- $2^3 = 8$ combinations

Exercise 3.1

3.1 Crossing over increases variation by

[1]

☐

A copying DNA exactly

B exchanging segments between homologous chromosomes

C removing chromosomes

D joining two gametes

Exercise 3.1

3.1 Crossing over increases variation by

[1]

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A copying DNA exactly

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3.1 B

- exchanging segments between homologous chromosomes

Exercise 3.2 (a)

3.2 A student lists sources of genetic variation.

(a) Name three sources from meiosis and reproduction.

[3]

Exercise 3.2 (a)

3.2 A student lists sources of genetic variation.

(a) Name three sources from meiosis and reproduction.

[3]

(a)

- Crossing over, independent assortment, random fertilization

Exercise 3.2 (b)

3.2 A student lists sources of genetic variation.

(b) Explain how independent assortment creates variation.

[2]

Exercise 3.2 (b)

3.2 A student lists sources of genetic variation.

(b) Explain how independent assortment creates variation.

[2]

(b)

- Each homologous pair aligns independently, so the maternal and paternal chromosomes are mixed into gametes in many different combinations

Exercise 3.3

3.3 Explain why sexual reproduction produces more genetic variation than asexual reproduction. [2]

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3.3

- Sexual reproduction combines crossing over, independent assortment, and random fertilization to mix alleles from two parents, whereas asexual reproduction copies one parent's genome, giving little variation