

Heredity

AP Biology • Unit 5

AP Biology

	B	b
B	BB	Bb
b	Bb	bb

Heredity

What we will cover

- 1 Meiosis
- 2 Meiosis and genetic diversity
- 3 Mendelian genetics
- 4 Non-Mendelian patterns
- 5 Environment and phenotype

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1 Meiosis

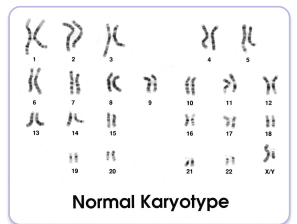
Heredity

Meiosis

Meiosis 减数分裂 turns one **diploid** 二倍体 cell into four **haploid** 单倍体 **gametes** 配子 – halving the chromosome number.

- **meiosis I** separates **homologous** 同源染色体 pairs (halving)
- **meiosis II** separates the copies

Two haploid gametes join at fertilization to restore the diploid number.



Meiosis halves chromosome sets for gametes

2 Diversity

Heredity

Diversity

Meiosis and genetic diversity

Three shuffles make every gamete unique:

- **Crossing over** 交叉互换 – homologs swap pieces
- **Independent assortment** 自由组合 – pairs line up at random
- **Random fertilization** 随机受精 – any sperm, any egg

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



Variation among offspring is not noise – it is insurance

3 Mendelian

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└ Mendelian

Mendelian genetics

The **law of segregation** 分离: alleles separate, so each gamete carries one. A **Punnett square** 庞纳特方格 predicts the cross.

- **genotype** 基因型 (Bb) vs **phenotype** 表型 (trait)
- **dominant** 显性 (capital) hides **recessive** 隐性

$Bb \times Bb \rightarrow$ phenotype ratio **3:1**. Test the fit with $\chi^2 = \sum \frac{(O - E)^2}{E}$.

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4 Non-Mendelian

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└ Non-Mendelian

Non-Mendelian patterns

Many traits break Mendel's simple dominant/recessive rule:

Incomplete dominance
不完全显性: red+white $\rightarrow$ pink

Codominance 共显性: AB blood (both show)

Multiple alleles 复等位基因: I^A, I^B, i

Sex-linked 伴性遗传: colour blindness

Polygenic 多基因遗传 & **epistasis** 上位效应: a smooth range

Heredity
└ Non-Mendelian

Non-Mendelian patterns

		X^B	Y
mother	X^B	$X^B X^B$	$X^B Y$
	X^b	$X^B X^b$	$X^b Y$

carrier daughter colour-blind son

- **Incomplete dominance** 不完全显性: heterozygotes are a blend (red $\times$ white $\rightarrow$ pink).
- **Codominance** 共显性: both alleles show fully (AB blood type).
- **Multiple alleles**, **polygenic** 多基因 traits (many genes, like height), **pleiotropy** (one gene, many effects), and...

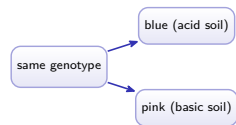
5 Environment

Environment and phenotype

Genes are not the whole story – the **environment** 环境 shapes the phenotype too.

- temperature (dark fur on cool paws)
- nutrition, light

Phenotypic plasticity 表型可塑性: one genotype, a **range** of phenotypes
– nature sets the options, the environment chooses.



Hydrangea: the soil decides the colour.

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Recap

Unit 5 – key takeaways

1 Meiosis

diploid → four haploid gametes;
halves chromosomes

2 Diversity

crossing over, independent assortment,
random fertilization

3 Mendel

$Bb \times Bb \Rightarrow 3:1$; test fit with χ^2

4 Beyond Mendel

incomplete dominance, codominance,
plasticity

Check yourself

- 1 How many cells, and what ploidy, does meiosis produce?
- 2 What phenotype ratio comes from $Bb \times Bb$?
- 3 Red + white flowers give pink – which inheritance pattern?
- 4 Two identical clones differ in colour – what is this called?

BB	Bb
Bb	bb

Answers 1. four haploid cells 2. 3:1 3. incomplete dominance 4. phenotypic plasticity