

## 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

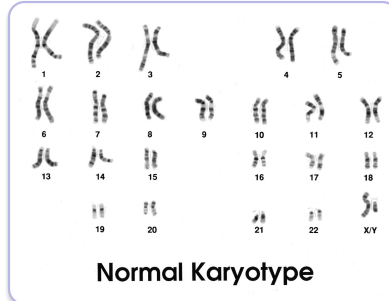
## Meiosis

## 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.



**Normal Karyotype**

*Meiosis halves chromosome sets for gametes*

# 2 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

## 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

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

# 4 Non-Mendelian

## Non-Mendelian patterns

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

**Incomplete dominance**

不完全显性: red+white → 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 & **epis-**

**tasis** 上位效应: a smooth range

## Non-Mendelian patterns

|         |       |           |         |
|---------|-------|-----------|---------|
| father: |       | $X^B$     | 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 × white → 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

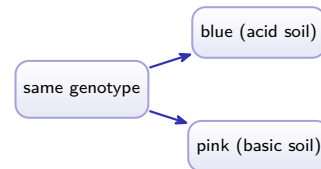
## Environment

## 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.

# 6

## 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  $\chi^2$

### 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