

Heredity

AP Biology ■ Unit 5

AP Biology

	B	b
B	BB	Bb
b	Bb	bb

What we will cover

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

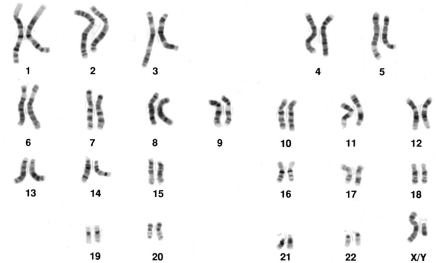
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Meiosis

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

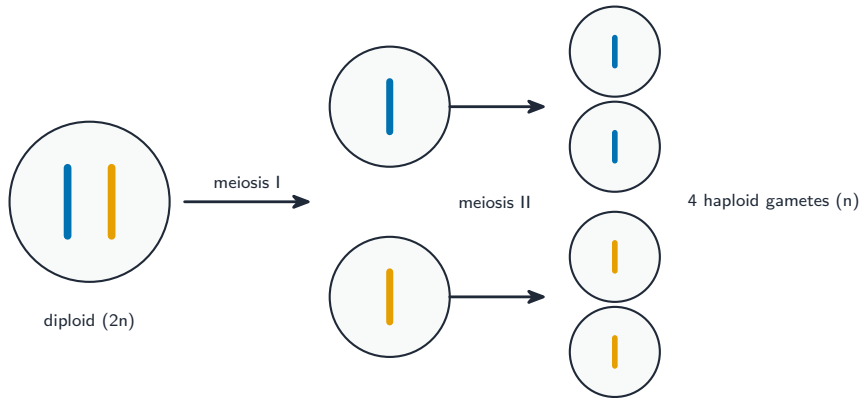
Two haploid gametes join at fertilization to restore the diploid number.



Normal Karyotype

Meiosis halves chromosome sets for gametes

Meiosis



Meiosis and genetic diversity

Three shuffles make every gamete unique:

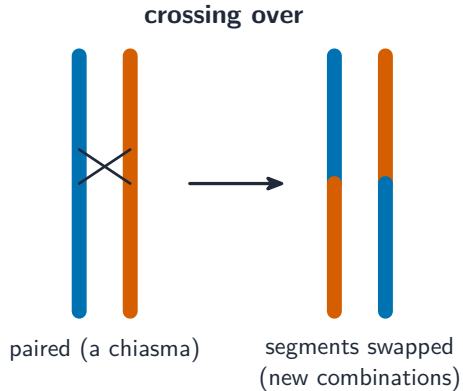
- **Crossing over** 交叉互换 – homologs swap pieces
- **Independent assortment** 自由组合 – pairs line up at random
- **Random fertilization** 随机受精 – any sperm, any egg

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*

Meiosis and genetic diversity



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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Mendelian genetics

parents: $Tt \times Tt$

	T	t	
T	TT	Tt	green = tall (has a T)
t	Tt	tt	orange = short (tt)

ratio 3 tall : 1 short

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 & **epistasis** 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	$X^B X^b$	$X^b Y$

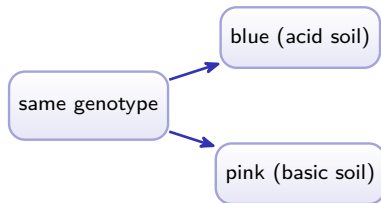
carrier daughter colour-blind son

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.

Unit 5 – key takeaways

1 Meiosis

diploid $\rightarrow$ 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