المراجعة الشاملة للدرس الأول genetics Mendelian وفق الهيكل الوزاري

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة علوم في الفصل الأول

1	أسئلة مراجعة الدرس الخامس inheritance of patterns Complex من الوحدة الأولى
2	شرح وملخص وحدة الوراثة المعقدة والوراثة البشرية
3	حل نموذج اختبار تجريبي وفق الهيكل الوزاري
4	نموذج اختبار تجريبي وفق الهيكل الوزاري
5	حل مراجعة الوحدة الأولى الوراثة البشرية والمعقدة منهج انسباير

1 Mendelian Genetics

Definitions

1. Genetics

The scientific study of heredity and how traits are passed from parents to offspring.

الوراثة هي العلم الذي يدرس كيف تنتقل الصفات من الآباء إلى الأبناء، أي يفسر لماذا نُشبه والدينا في بعض الصفات مثل لون العين أو الطول.

2. Heredity / Inheritance

The process by which traits are passed from parents to their children.

الوراثة تعني انتقال الصفات الوراثية من الآباء إلى الأبناء مثل لون الشعر أو شكل الأنف، وهي العملية اللي بتحصل عن طريق الجينات.

3. Trait

A specific inherited characteristic, such as eye color, height, or flower shape.

الصفة الوراثية هي ميزة أو خاصية ناتجة عن الجينات، مثل لون العيون، أو طول النبات، أو شكل الأزهار.

4. True-breeding (Pure breeding)

Plants that consistently produce offspring with only one form of a trait.

نباتات نقية تورّث نفس الصفة دائمًا، مثل نبات البازلاء الذي يعطي دائمًا بذورًا صفراء فقط أو خضراء فقط، بدون خلط.

5. Self-fertilization

Occurs when a male gamete within a flower combines with a female gamete in the same flower.

التلقيح الذاتي هو عندما يقوم النبات بتخصيب نفسه، أي أن حبوب اللقاح (المذكرة) تخصّب البويضات (المؤنثة) في نفس الزهرة.

6. Cross-pollination

The transfer of a male gamete from one plant's flower to the female organ of another plant's flower.

التلقيح الخلطي يعني نقل حبوب اللقاح من زهرة نبات إلى زهرة نبات آخر، وده اللي استخدمه مندل لتجربة الصفات المختلفة.

7. P Generation

The parent generation in Mendel's experiments.

الجيل الأبوي، وهو الجيل الأول اللي بدأ به مندل تجاربه (الآباء الأصليون).

8. F_1 Generation

The first filial generation — offspring from the P generation cross.

الجيل الأول الناتج من تزاوج الجيل الأبوي، وغالبًا بيظهر فيه الصفة السائدة فقط.

9. F_2 Generation

The second filial generation — offspring from self-fertilizing F_1 plants.

الجيل الثاني الناتج من تلقيح الجيل الأول بنفسه، وغالبًا بيُظهر نسبة 3:1 بين الصفة السائدة والمتنحية.

10. Allele

An alternative form of a single gene passed from generation to generation.

الأليل هو شكل مختلف من نفس الجين، يعني مثلاً الجين المسؤول عن لون البذور له أليل للون الأصفر وآخر للون الأخضر.

11. Dominant Allele

The allele that masks (hides) the effect of another allele when both are present.

الأليل السائد هو اللي بيظهر في الشكل الخارجي حتى لو وُجد مع أليل آخر متنحٍ.
مثلاً: الأصفر سائد على الأخضر يظهر اللون الأصفر فقط.

12. Recessive Allele

The allele whose trait is masked (hidden) when a dominant allele is present.

الأليل المتنحي هو اللي ما بيظهر إلا لو كان موجود لوحده بدون أليل سائد.
مثلاً: اللون الأخضر في البذور لا يظهر إلا لما يكون النبات "yy".

13. Homozygous

An organism with two of the same alleles for a trait (e.g., YY or yy).

كائن يحمل نسختين متماثلتين من نفس الجين، نفس نبات بذوره صفراء "YY" أو خضراء "yy".

14. Heterozygous

An organism with two different alleles for a trait (e.g., Yy).

كائن يحمل أليلين مختلفين، واحد سائد وواحد متنحي، فيظهر تأثير السائد فقط (زي Yy بذور صفراء).

15. Genotype

The organism's allele pair (genetic makeup).

التركيب الجيني هو مجموعة الجينات أو الأليلات اللي يمتلكها الكائن، مثل: YY أو Yy أو yy.

16. Phenotype

Observable characteristic or outward expression of an allele pair.

الصفة الشكلية هي المظهر الخارجي الناتج عن الجينات، نفس اللون اللي بنشوفه فعلاً (بذور صفراء أو خضراء).

17. Law of Segregation

Each gamete receives only one allele for each trait during meiosis.

قانون الانعزال: أثناء تكوين الأمشاج (الخلايا الجنسية)، كل خلية بتاخد أليل واحد من كل زوج من الأليلات، عشان لما يتحدوا يرجعوا زوج جديد.

18. Law of Independent Assortment

Genes for different traits are distributed to gametes independently of one another.

قانون التوزيع المستقل: الجينات المختلفة بتنتقل بشكل مستقل، يعني لون البذرة لا يتأثر بشكلها، كل صفة بتتوزع لوحدها أثناء الانقسام.

19. Punnett Square

A diagram used to predict the possible offspring genotypes from a cross.

مربع بانت هو جدول بنستخدمه علشان نعرف احتمالات التراكيب الجينية والنسب المتوقعة للصفات في الأبناء.

20. Monohybrid Cross

A cross between two individuals differing in only one trait.

تزاوج أحادي، يعني تجربة فيها صفة واحدة فقط مثل لون البذرة (صفراء × خضراء).

21. Dihybrid Cross

A cross between individuals differing in two traits.

تزاوج ثنائي، يعني دراسة صفتين في نفس الوقت مثل لون وشكل البذرة (صفراء ومستديرة × خضراء ومجعدة).

22. Probability

The likelihood that a specific event will occur.

الاحتمال هو مقياس لمدى إمكانية حدوث حدث معين، زي احتمال ظهور وجه العملة عند رميها (½).

23. Hybrid

An organism produced by crossing parents with different traits (heterozygous).

الهجين هو كائن ناتج من تزاوج نوعين مختلفين في صفة معينة، بيكون حامل للصفة السائدة والمتنحية معًا (زي Yy).

Hint

Pure = Homozygous = True-breeding

Heterozygous = Hybrid

Main Scientists

1. Gregor Mendel

Who was he:
- An Austrian monk and plant breeder.

What he studied:
- Studied inheritance using garden pea plants.

What he discovered:
- Found that traits pass from parents to offspring — this is called heredity (**method of inheritance**)

Why he used pea plants:
- Because they are true-breeding (produce the same trait every time).

When:
- Published his work in 1866.

Title / Importance:
- Known as the Father of Genetics.

Dr. Reginald Punnett

Who was he:
- A British geneticist.

What he did:
- Developed the Punnett Square.

Purpose of his work:
- Used to predict offspring from a cross between two known genotypes.

Importance:
- Helped show possible genotype combinations and ratios easily.

Reproduction

1. Type of Reproduction

Pea plants usually reproduce by self-fertilization, which is common in many flowering plants.

2. Self-fertilization (التلقيح الذاتي)

Definition:

When a male gamete within a flower combines with a female gamete in the same flower.

Example in peas:

One flower acts as both the male and female — it fertilizes itself naturally.

Result:

Produces true-breeding plants (offspring identical to the parent).

3. Cross-pollination (التلقيح الخلطي)

Definition:

Transfer of male gametes (pollen) from the flower of one pea plant to the female organ of another pea plant.

Mendel's steps:

1. Transferred male gametes from the flower of a true-breeding green-seed plant.
2. Placed them onto the female organ of a true-breeding yellow-seed plant.

To prevent self-fertilization:
- Mendel removed the male organs from the flower of the yellow-seed plant.

Result:

Produced hybrid (heterozygous) offspring with mixed traits.

Feature	Self-Fertilization	Cross-Pollination
Definition	Fertilization occurs within the same flower.	Fertilization between two different plants.
Number of Plants Needed	One plant only	Two plants
Male Gamete Source	From the same flower	From a different flower/plant
Resulting Type	True-breeding (pure)	Hybrid (heterozygous)
Variation in Offspring	No variation — all offspring identical	Variation — mixing of traits
Used by Mendel to...	Maintain pure lines (control traits)	Study inheritance between traits

Mendel's Experiment

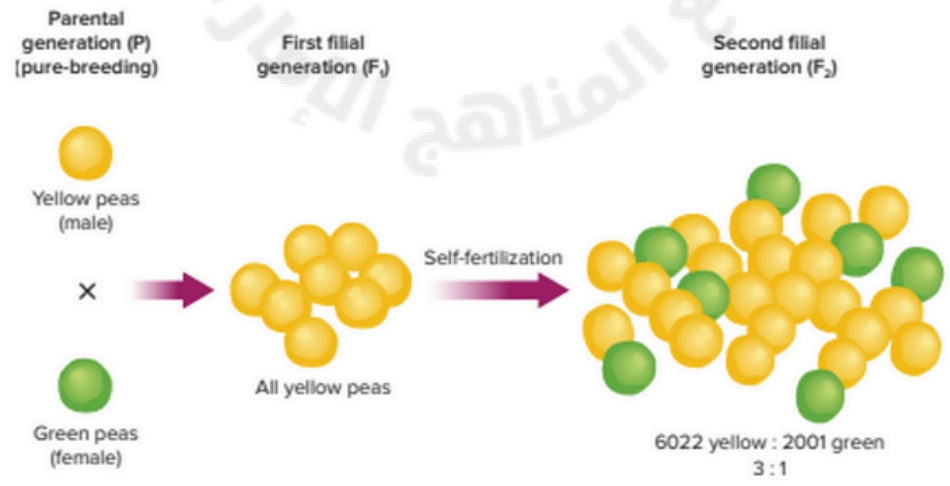


Figure 2

1. The Organism Used

- Mendel used the garden pea plant .
- It's a flowering plant that can reproduce by self-fertilization or cross-pollination.
- Pea plants are true-breeding (homozygous), producing the same traits every generation.

2. The Traits Studied

- **Mendel studied seven traits in the pea plant, such as:**
  - Seed color (yellow / green)
  - Flower color (purple / white)
  - Seed shape (round / wrinkled)
  - Pod shape (inflated / constricted)
  - Pod color (green / yellow)
  - Stem length (tall / short)
  - Flower position (terminal / axial)

3. Type of Plants Used

- **He selected two true-breeding (homozygous) plants:**
  - One with yellow seeds (YY)
  - One with green seeds (yy)

4. Cross-Pollination

- Mendel cross-pollinated the yellow-seed plant with the green-seed plant .
- To prevent self-fertilization, he removed the male organs from the yellow-seed flower.
- The result of this cross is the Parent (P) generation.

5. F_1 Generation

- All offspring in the F_1 generation had yellow seeds .
- The green trait disappeared — Mendel questioned whether it was lost or hidden (masked).

6. F_2 Generation

- Mendel then allowed the F_1 plants to self-fertilize.
- The next generation (F_2) showed:
  - 6022 yellow seeds
  - 2001 green seeds
- Giving a 3 : 1 ratio (yellow : green).

7. Mendel's Conclusion

- The green trait was not lost, but hidden in F_1 and reappeared in F_2.
- Each trait is controlled by two alleles — one from each parent.

Mendel's Laws

Mendel developed two main laws:

1. Law of Segregation
2. Law of Independent Assortment

These two laws explain how traits are passed from one generation to another.

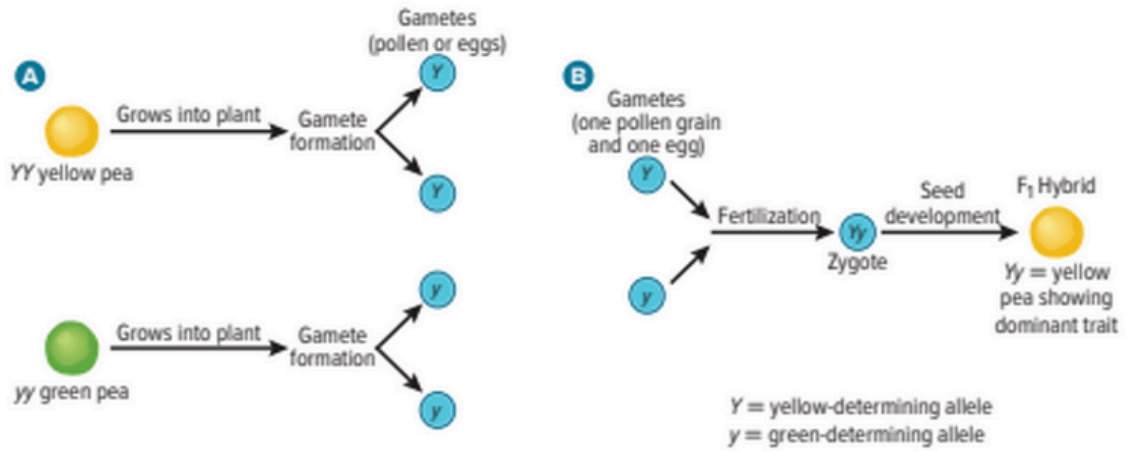


Figure 3

1. Law of Segregation

Experiment:

- Mendel used homozygous yellow (YY) and green (yy) pea plants.

During meiosis:

- Each parent gives one allele:
  - Yellow plant → Y
  - Green plant → y

During fertilization:

- Gametes unite → Y + y = Yy

Result (F_1):

- All plants = Yy (hybrid)
- All seeds = yellow (yellow is dominant).

Conclusion:

- The two alleles separate during gamete formation,
- then reunite during fertilization.

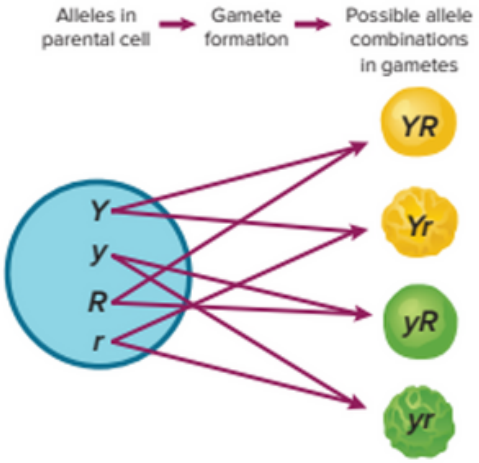


Figure 4 (Law of Independent Assortment)

1. **Observation**
- Mendel studied two traits together:
  - Seed color: Yellow (Y) or Green (y)
  - Seed shape: Round (R) or Wrinkled (r)
- **He noticed that:**
  - Smooth, round peas appear more often than wrinkled ones.
  - Round (R) is dominant, wrinkled (r) is recessive.

2. Parental (P) Generation
- Crossed:
  - Yellow round (YYRR) × Green wrinkled (yyrr)
- Resulting F_1 plants all had the same phenotype → Round yellow peas
- Genotype: YyRr

3. F_1 Self-Fertilization (Dihybrid Cross)
- Mendel allowed YyRr plants to self-fertilize.
- Each parent could form four types of gametes:
- YR, Yr, yR, yr

4. Random Assortment
- During meiosis, genes on separate chromosomes assort independently.
- This means any Y or y can pair with any R or r : random combinations.

5. Result (Law Statement)

Genes for different traits separate independently during gamete formation.
This is called the Law of Independent Assortment.

Hint

Both Law of Segregation and Law of Independent Assortment occur during meiosis.

So, meiosis is the key process behind both laws — it's where alleles separate and recombine to create genetic variation.

Monohybrid Cross

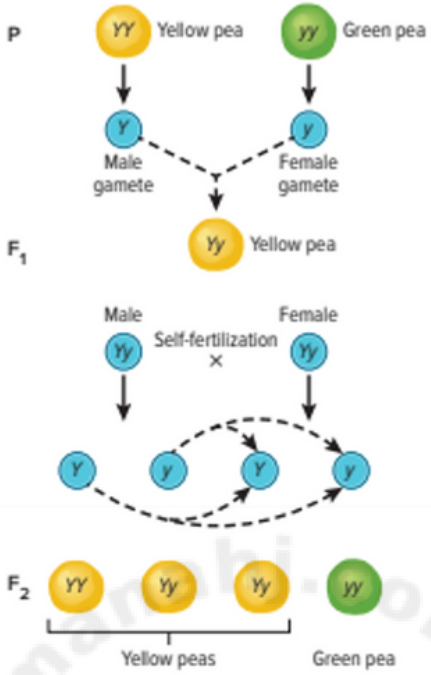


Figure 5

Definition

- A monohybrid cross involves hybrids for a single trait (like seed color).
- Example: Yy × Yy (yellow heterozygous peas).

Gamete Formation

- The Yy plant produces two types of gametes:
  - One with Y allele
  - One with y allele
- **These combine randomly during fertilization forming four genotypes:**
- **YY, Yy, Yy, yy**

Note:

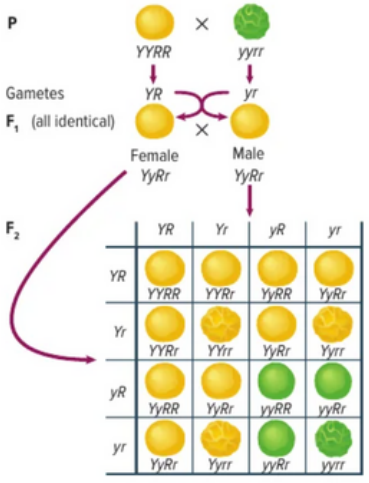
The dominant allele (Y) is always written first, whether it comes from male or female.

Results

Genotypic ratio: 1 : 2 : 1

Phenotypic ratio: 3 : 1 (Yellow : Green)

Dihybrid Cross



Type	Genotype	Phenotype	Number	Phenotypic ratio
Parental	Y_R_	yellow round	315/556	9:16
Recombinant	yyR_	green round	108/556	3:16
Recombinant	Y_rr	yellow wrinkled	101/556	3:16
Parental	yyrr	green wrinkled	32/556	1:16

Definition

- A dihybrid cross studies two traits at the same time.
- **In pea plants:**
  - Round (R) is dominant over wrinkled (r).
  - Yellow (Y) is dominant over green (y).

1. Parental (P) Generation

- **Crossed:**
  - Homozygous yellow round (YYRR)
  - Homozygous green wrinkled (yyrr)
- **Result → F_1 generation = YyRr**
  - All F_1 plants are yellow and round (dominant traits).
  - These are called dihybrids because they are heterozygous for both traits.

2. F_1 Self-Fertilization

- Each YyRr plant produces 4 gamete types → YR, Yr, yR, yr
- Cross forms a 4 × 4 Punnett square = 16 combinations
- Genotypes = 9 different types
- Genotypic ratio = complex (1 : 2 : 2 : 4 : 1 : 2 : 1 : 2 : 1)

Phenotype	Example Genotype	Ratio
Yellow round	YYRR, YYRr, YyRR, YyRr	9
Yellow wrinkled	YYrr, Yyrr	3
Green round	yyRR, yyRr	3
Green wrinkled	yyrr	1

Phenotypic ratio : 9 : 3 : 3 : 1

Hint

- **Monohybrid Cross → involves one gene, so it follows only the Law of Segregation.**

(Each pair of alleles separates during meiosis).

- **Dihybrid Cross → involves two genes, so it follows both laws:**

1. Segregation (each allele pair separates)
2. Independent Assortment (different gene pairs separate independently).

Both happen during meiosis,

Probability in Genetics

Figure 9

- **Inheritance = Probability → Mendel compared gene inheritance to flipping a coin.**
  - Chance of heads = ½
  - Chance of two heads = ¼ → like two traits together.
- **Predicted vs Actual:**
  - Real results may vary, but with more trials, they approach the expected ratio (1:1).
- **Mendel's results:**
  - Not exactly 9:3:3:1, but became closer as offspring number increased.
- **Conclusion:**

The larger the sample, the closer results match Punnett predictions.

Genetic inheritance follows probability — the more crosses, the clearer the expected ratios appear.