

Mendel's law of Segregation & Independent Assortment



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Mendel's law of segregation



Gregor Johann Mendel (1822 - 1884):

- He experimented with pea plants, by crossing various strains and observing the characteristics of their offspring.
- He thought that 'heritable factors' (genes) retained their individuality generation after generation.
- Principles of genetics were developed in the mid 19th century

Mendel's law of segregation



- Mendel deduced the underlying principles of genetics from his experiments:
 1. Law of Dominance
 2. Law of Segregation
 3. Law of Independent assortment

Mendel's law of segregation



Law of segregation:

- Mendel's Law of Segregation, states that allele pairs separate or segregate during gamete formation and randomly unite at fertilization.
- It states that allele pairs **segregate** equally into gametes during meiosis.

Mendel's law of segregation



Law of segregation(contd...)

- This means that a gamete will have only one allele of any given gene, and that the probability of a gamete having one allele or the other is equal (and therefore $\frac{1}{2}$, or 50%, for either allele).
- In other words ,a parent plant passes on only one gene of each pair to its offspring.
- A gamete will receive one allele or the other.

Mendel's law of segregation



Law of segregation(contd...):

- Mendel formulated the law of segregation as a result of performing monohybrid cross experiments on plants.
- The specific traits that he studied exhibited complete dominance.

For example

- the gene for seed colour in pea plants exists in two forms.
- There is one form or allele for yellow seed colour (Y) and another for green seed colour (y).

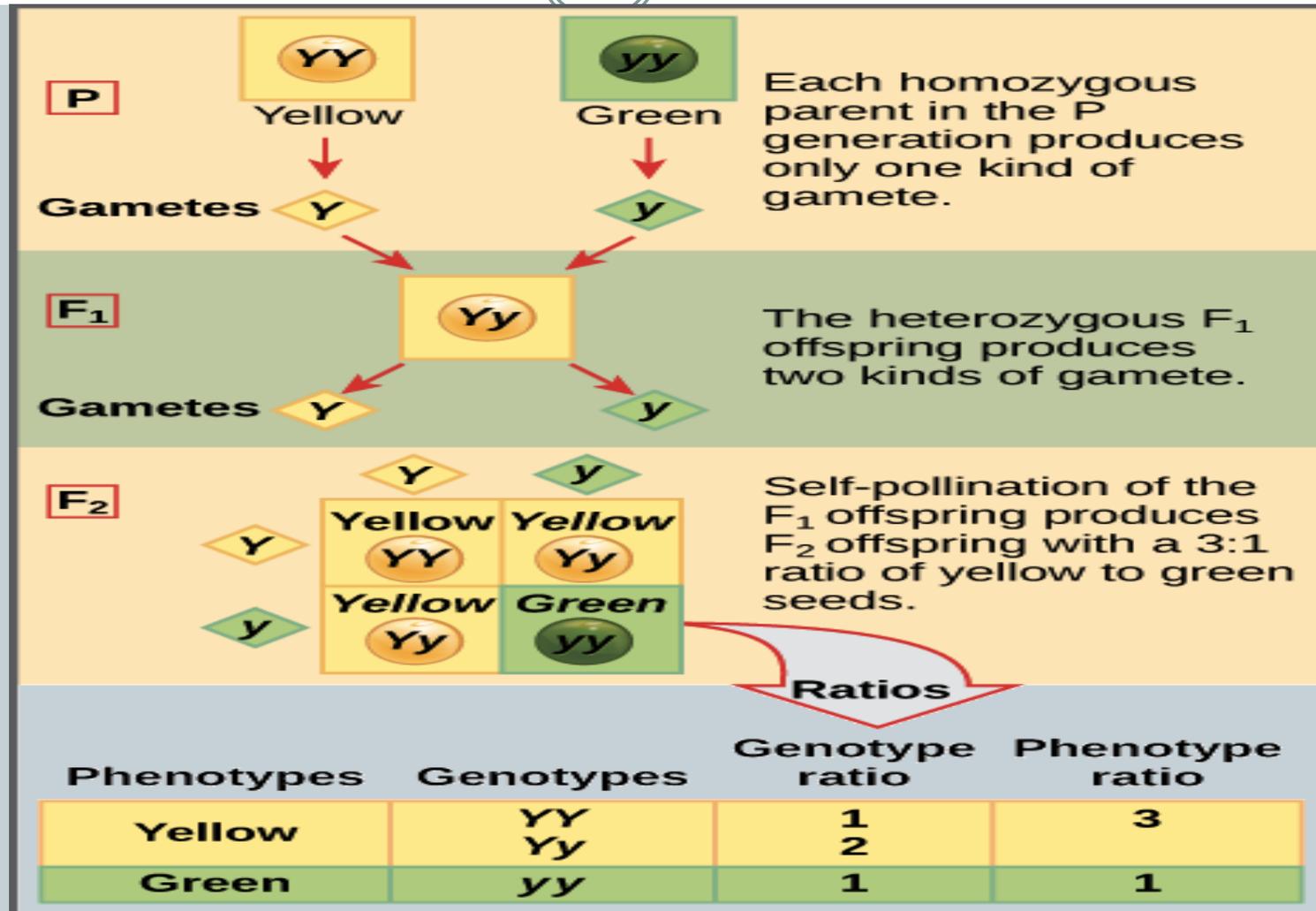
Mendel's law of segregation



For example(contd...):

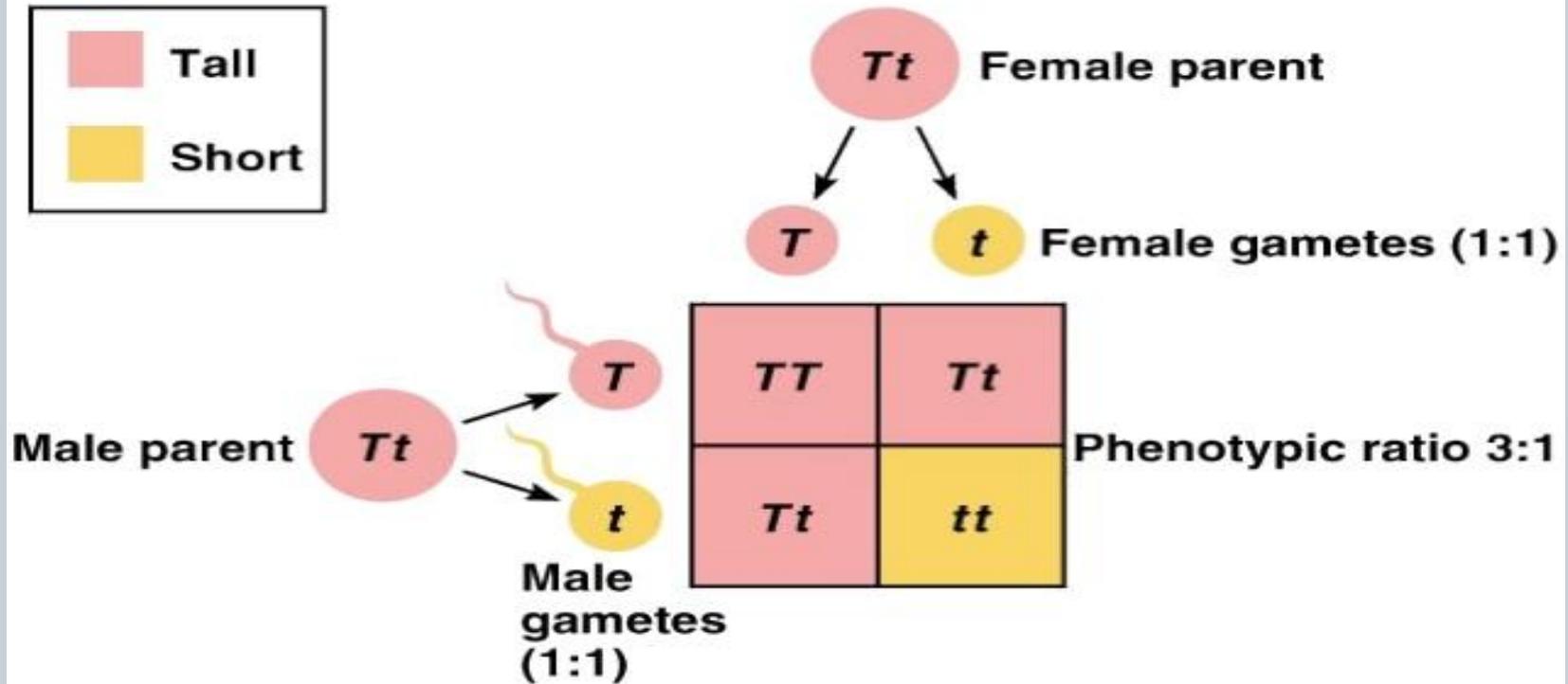
- In this example, the allele for yellow seed colour is dominant, and the allele for green seed colour is recessive.
- When the alleles of a pair are different (heterozygous), the dominant allele trait is expressed, and the recessive allele trait is masked.
- Seeds with the genotype of (YY) or (Yy) are yellow, while seeds that are (yy) are green.
- Yellow and green appear in the ratio of 3:1(in f₂ generation).

Mendel's law of segregation



Mendel's law of segregation

Applying the Law of Segregation



Law of independent assortment



Mendel's law of independent assortment:

- The Law of Independent Assortment states that during a dihybrid cross (crossing of two pairs of traits), an assortment of each pair of traits is independent of the other.
- In other words, during gamete formation, one pair of trait segregates from another pair of traits independently.
- This gives each pair of characters a chance of expression.
- The allele a gamete receives for one gene does not influence the allele received for another gene.

Law of independent assortment



Example-

- Dihybrid cross, between round-yellow seed and wrinkled green seed .
- He obtained only round yellow seeds in the F_1 generation. Later, self-pollination of F_1 progeny gave four different combinations of seeds in the F_2 generation.
- He obtained round-yellow, wrinkled-yellow, round green and wrinkled green seeds in the phenotypic ratio 9:3:3:1.

Law of independent assortment



Example(contd...)

- This dihybrid crosses between the parental genotype RRY_Y (round yellow seeds) and rry_y (green wrinkled seeds) explains the law.
- Here the chances of formation of gametes with the gene R and the gene r are 50:50.
- Also, the chances of formation of gametes with the gene Y and the gene y are 50:50.
- Thus, each gamete should have either R or r and Y or y.

Law of independent assortment



Example(contd...)

- Because each parent is homozygous, the law of segregation indicates that the gametes for the green & wrinkled plant all are yr,
- while the gametes for the yellow & round plant are all YR.
- Therefore, the F_1 generation of offspring all are YyRr.

Law of independent assortment



Example(contd...)

- For the F₂ generation, the law of segregation requires that each gamete receive either an R allele or an r allele along with either a Y allele or a y allele.
- The law of independent assortment states that a gamete into which an r allele sorted would be equally likely to contain either a Y allele or a y allele.
- There are four equally likely gametes are formed when the YyRr heterozygote is self-crossed as follows: YR, Yr, yR, yr

Law of independent assortment



Example(contd...)

- Thus the Law of Independent Assortment states that the segregation of R and r is independent of the segregation of Y and y.
- This results in four types of gametes RY, Ry, rY, and ry.
- These combinations of alleles are different from their parental combination (RR, YY, rr and yy).
- This shows that genes do not influence each other with regard to the sorting of alleles into gametes:

Law of independent assortment



Example(contd...)

- . Arranging these gametes along the top and left of a 4×4 Punnett square gives us 16 equally likely genotypic combinations.
- From these genotypes, we infer a phenotypic ratio of 9:3:3:1

Such as-

- 9 round & yellow
- 3 round & green
- 3 wrinkled & yellow
- 1 wrinkled & green.

Law of independent assortment

Dihybrid Cross



P Generation



F₁ Generation

Phenotype: 

gametes from heterozygous parent
YR yR Yr yr

gametes from heterozygous parent

YR
yR
Yr
yr

YYRR	YyRR	YYRr	YyRr
YyRR	yyRR	YyRr	yyRr
YYRr	YyRr	YYrr	Yyrr
YyRr	yyRr	Yyrr	yyrr

F₂ Generation

Phenotype:

9 :  3 :  3 :  1 : 

Law of independent assortment



Main points:

- Mendel's law of independent assortment states that genes do not influence each other with regard to the sorting of alleles into gametes; every possible combination of alleles for every gene is equally likely to occur.
- **independent assortment:** separate genes for separate traits are passed independently of one another from parents to offspring

Thank You

