11.2 Applying Mendel's Principles

Lesson Objectives

Explain how geneticists use the principles of probability to make Punnett squares.

Explain the principle of independent assortment.

Explain how Mendel's principles apply to all organisms.

Lesson Summary

Probability and Punnett Squares Probability is the likelihood that a particular event will occur. Probability predicts the recombination of alleles:

- ▶ Of an allele pair, the probability of each allele in a gamete is ½, or 50 percent.
- When F, hybrid individuals are crossed, the probability of
 - two recessive alleles is 1/4.
 - two dominant alleles is 1/4.
 - one dominant allele and one recessive allele is ½ (¼ + ¼).
- ▶ Organisms that have two identical alleles for a gene are homozygous for that trait. If they have different alleles for the same gene, they are heterozygous for that trait.
- Physical traits are an organism's phenotype. Its genotype is its genetic makeup.
- A Punnett square is a mathematical tool that helps predict combinations in genetic crosses.

Independent Assortment The principle of independent assortment states that genes for different traits segregate independently during the formation of gametes. In two-factor crosses, the phenotypes of the F2 offspring occur in a 9:3:3:1 ratio: 9 with with both traits dominant, 3 with the first trait dominant and the second trait recessive, 3 with the first trait recessive and the second trait dominant, and 1 with both traits recessive.

A Summary of Mendel's Principles

- Genes are passed on from parents and determine traits.
- ▶ Where two or more alleles for a gene exist, some may be dominant and others recessive.
- ▶ In sexually reproducing organisms, offspring receive a copy of each gene from each parent. The alleles segregate when forming gametes.
- ▶ Alleles for different genes usually segregate independently.

Probability and Punnett Squares

1. What is probability?	
2. In a parent pea plant with the allele pair Gg , wh contain the G allele?	at is the probability that one gamete will

3. Complete the graphic organizer to define the characteristics of homozygous and heterozygous genotimes.

	Homozygous	Heterozygous	
Genotype			
Phenotype			

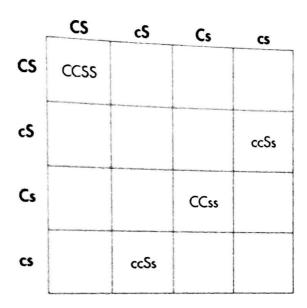
4. The dominant allele for smooth pod shape in peas is S. The recessive allele for constricted pod shape is s. In the Punnett square, show the result of crossing two heterozygous parents (Ss). Write the genotype and the phenotype of each type of offspring in the space provided.

	\$	S
S	Genotype:	Genotype:
5	Genotype:	Genotype:

For Questions 5–9, refer to the Punnett square above.

- 5. What is the probability of a heterozygous offspring? Explain your answer.
- 6. What is the probability of a homozygous offspring? Explain.
- 7. What is the probability of a homozygous recessive offspring?
- 8. What is the probability of a smooth phenotype?
- 9. What is the probability of a homozygous recessive individual (ss) producing a gamete with

11. Using the principle of independent assortment, complete the Punnett square to show the results of an F_1 cross between two individuals heterozygous for both pod color (C = green and c = yellow) and pod shape (S = smooth and s + constricted). The gametes and some of the genotypes of the F₂ offspring are given.



For Questions 12-15, refer to the Punnett square above.

- 12. Which genotype belongs to an offspring that is homozygous recessive for both traits? What is the probability of that genotype?
- 13. What is the phenotype of an individual heterozygous for both traits?
- 14. What is the probability of an F₂ offspring having the green pod color and smooth pod shape? Explain. (Note: Remember that more than one genotype can produce this phenotype.)

15. The Punnett square predicts a 9:3:3:1 ratio for phenotypes. Explain what that ratio means.

Summary of Mendel's Principles

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