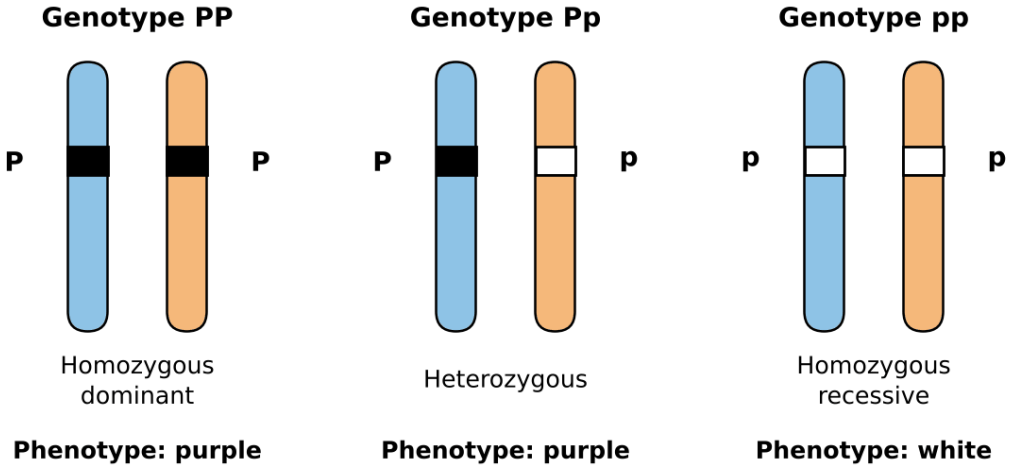
Essential Question

How do dominant and recessive alleles determine traits?

Genes, Alleles, and Traits

- A gene is a section of DNA that codes for a trait
- Alleles are different versions of the same gene
- You have two alleles for each gene, one from each parent
- Genotype is the alleles; phenotype is the observable trait



Each bar is one chromosome. The band is the same gene on both.

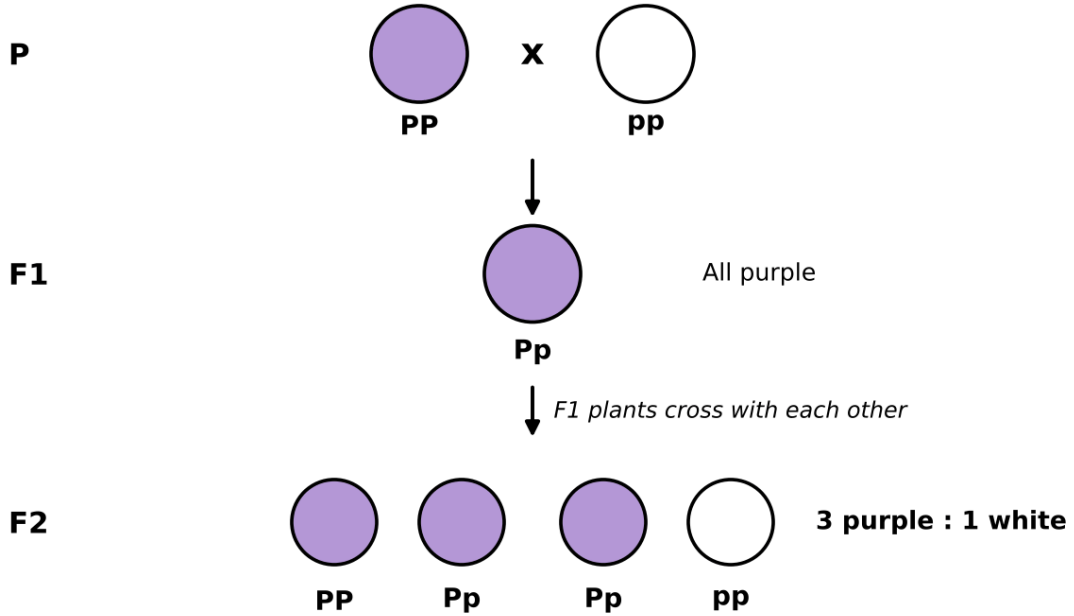
Dominant and Recessive Alleles

- A dominant allele shows when at least one copy is present
- A recessive allele shows only when two copies are present
- Dominant alleles get a capital letter and recessive alleles a lowercase letter
- Dominant does not mean most common or best

Genotype	Type	Phenotype (P = purple is dominant)
PP	Homozygous dominant	Purple
Pp	Heterozygous	Purple
pp	Homozygous recessive	White

Mendel's Pea Plant Crosses

- Mendel crossed true-breeding plants with different traits
- All F1 offspring showed only the dominant trait
- The recessive trait returned in about 1 of 4 F2 offspring
- The ratio of about 3 dominant : 1 recessive appeared for every trait he tested

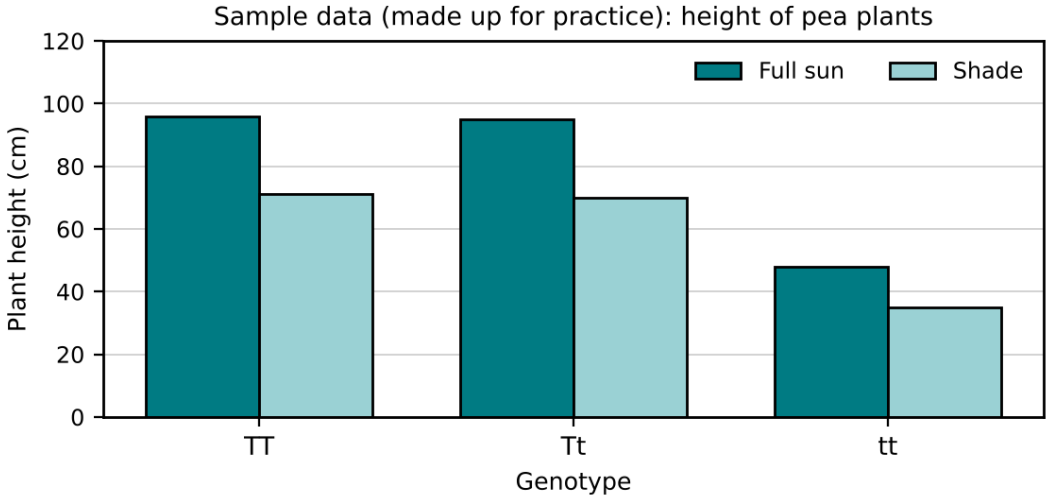


Mendel's Pea Plant Crosses (table)

Trait in the F2 generation	Dominant	Recessive	Ratio (dominant / recessive)
Flower color	705	224	3.15 : 1
Pod shape	882	299	2.95 : 1
Seed shape	5,474	1,850	2.96 : 1

Genes and the Environment

- Genes set the possible range for a trait
- The environment can change how much a trait is expressed
- The same genotype can give different phenotypes in different conditions
- Most traits depend on both



Example 1: Mendel's Ratio

In one cross, Mendel counted 705 F2 plants with purple flowers and 224 with white flowers. (a) Find the ratio of purple to white. (b) How many of each would exactly a 3 : 1 ratio predict? (c) Is the result consistent with a 3 : 1 ratio? Compare it with the seed shape data, 5,474 round seeds and 1,850 wrinkled seeds.

F2 plants	Dominant	Recessive
Flower color	705 purple	224 white
Seed shape	5,474 round	1,850 wrinkled

Solution: Mendel's Ratio

(a) Ratio: 705 / 224 = 3.15, so the ratio is 3.15 : 1.

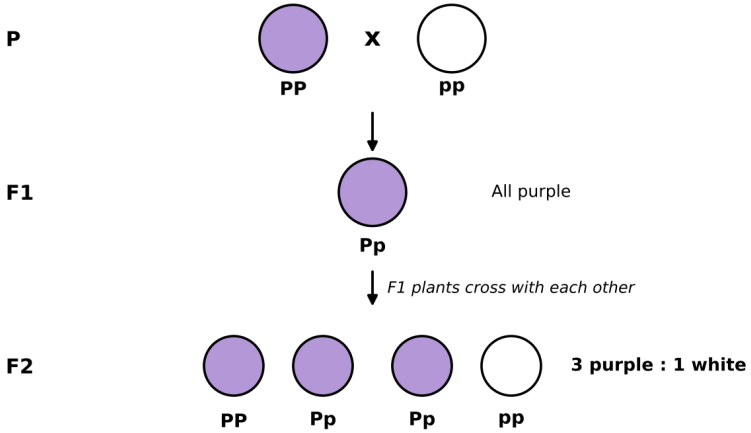
(b) Predicted counts: Total = 705 + 224 = 929 plants. A 3 : 1 ratio means 3/4 are purple and 1/4 are white. Purple: 3/4 x 929 = 696.75, about 697. White: 1/4 x 929 = 232.25, about 232.

(c) Compare: The data (705 and 224) are close to the predicted 697 and 232. The seed shape ratio, 5,474 / 1,850 = 2.96 : 1, is also close to 3 : 1. Fertilization is random, so small differences from the prediction are expected.

Answer: (a) 3.15 : 1. (b) About 697 purple and 232 white. (c) Yes, the data are close to 3 : 1.

Example 2: Use the Cross Model

The diagram shows a cross of true-breeding purple (PP) and white (pp) pea plants. (a) What is the genotype of every F1 plant, and why are they all purple? (b) What fraction of the purple F2 plants are heterozygous? (c) Out of 1,000 F2 plants, about how many are expected to have white flowers?



Solution: Use the Cross Model

(a) F1 genotype: Each F1 plant gets P from the purple parent and p from the white parent, so all are Pp. They are purple because P is dominant.

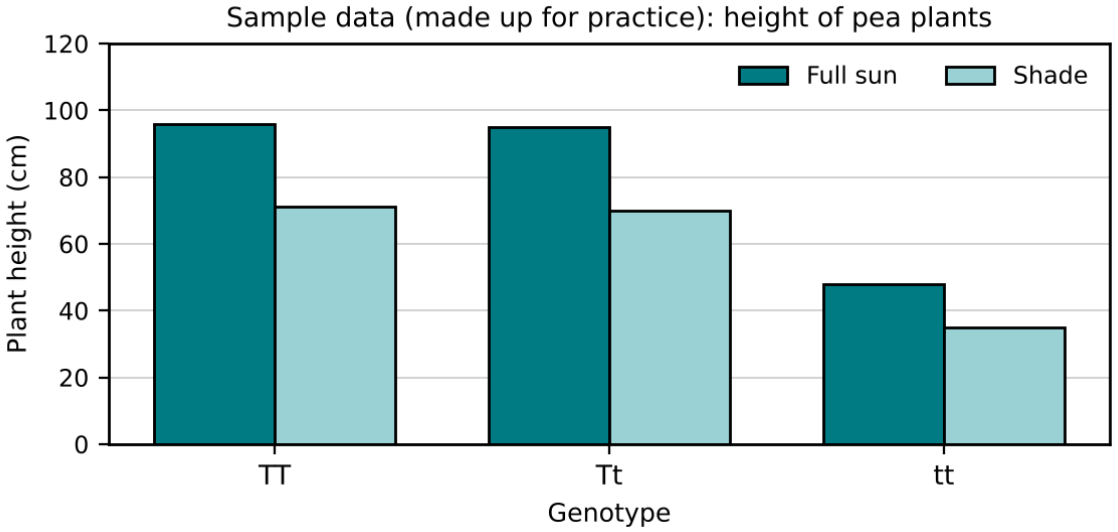
(b) Heterozygous purple plants: Of the F2 plants PP, Pp, Pp, and pp, three are purple. Two of those three are Pp, so the fraction is 2/3.

(c) White plants: Only pp is white, which is 1/4 of the F2. 1/4 x 1,000 = 250 plants.

Answer: (a) Pp, and P is dominant. (b) 2/3. (c) About 250 plants.

Example 3: Genes and Environment

The graph shows made-up practice data for pea plant height. Write a claim, evidence, reasoning statement about this question: does genotype alone decide how tall the plants grow?



Solution: Genes and Environment

Claim: No. Height depends on both genotype and environment.

Evidence: TT plants are 96 cm in full sun but 71 cm in shade, a drop of 25 cm. Also, TT plants are taller than tt plants in both settings (96 cm vs 48 cm in sun, 71 cm vs 35 cm in shade).

Reasoning: The same genotype gave two different heights, so something other than genotype changed the phenotype: the amount of light. But genotype still matters, since the tt plants stay shorter than TT plants under the same conditions.

Answer: Height depends on genotype and environment: TT drops 25 cm in shade, and TT is still taller than tt in both settings.

Mendelian Inheritance

Big Ideas

- A gene has different versions called alleles
- Genotype is the alleles; phenotype is the trait you see
- A dominant allele shows when one copy is present
- A recessive trait shows only with two copies
- Mendel's crosses gave about 3 dominant : 1 recessive in the F2
- Genes and environment both affect traits