Different versions of a single gene are called alleles, and one can be dominant over the other(s).

**GENETICS PROBLEMS**

1. **GENETICS PROBLEMS**

   Describe “genotype” and “phenotype” in your own words. A genotype is the genetic makeup of an individual; a phenotype is the physical quality/appearance of an individual. How are the two terms related? The phenotype of an individual is determined by its genotype.

2. **GENETICS PROBLEMS**

   Draw a Punnett square depicting the cross of the F1 generation of Mendel’s pea plant experiments.

   - **P**
     - **P**
     - **p**

   - **F1**
     - **PP**
     - **Pp**

   - **F2**
     - **3 : 1 Ratio**

   - **Pp**
     - **P**
     - **p**
     - **pp**
In Rabbits, the allele B for black hair is dominant over the allele b for brown hair. Calculate the probability of homozygous dominant offspring resulting from a cross between two heterozygous parents.

The probability of having homozygous dominant offspring is \( \frac{1}{4} \) or 25%.

In horses, the allele C for a chestnut coat is dominant to the allele c for a gray coat. Calculate the probability of heterozygous offspring resulting from a cross between a heterozygous parent and a homozygous recessive parent.

The probability of having heterozygous offspring is \( \frac{1}{2} \) or 50%.

In horses, the allele C for a chestnut coat is dominant to the allele c for a gray coat. A heterozygous stallion and a heterozygous mare have produced three chestnut foals. What is the chance that their next foal will also be chestnut?

The probability of having another chestnut foal is \( \frac{3}{4} \) or 75%.

In eggplant, the allele P for purple eggplants are dominant over the allele p for white eggplants. Calculate the probability of heterozygous offspring resulting from a cross between a homozygous dominant parent and a homozygous recessive parent.

The probability of having heterozygous offspring is 100%.
In pea plants, the allele T for tall pea plants is dominant to the allele t for short plants.

Calculate the probability of homozygous dominant offspring from a cross between a heterozygous parent and a homozygous recessive parent.

The probability of having homozygous dominant offspring is 0%.

If a brown-eyed woman’s father has blue eyes, and her mother has brown eyes, she is most likely heterozygous [homozygous | heterozygous] for the eye color trait.

In dragons, yellow eyes are dominant to green eyes. Two yellow-eyed dragons mate, and produce three eggs. Of the three hatchlings, one has green eyes.

What are the genotypes of the parent dragons?

The parent dragons must be heterozygous.

In Hawaiian Happy Face Spiders, the patterned allele is dominant to the plain allele.

A plain spider is crossed with a patterned spider. The patterned spider is heterozygous.

Which genotypes are produced among the offspring and in what ratio? Which phenotypes are produced and in what ratio?

The genotypic ratio of the offspring is 2:2 heterozygous to homozygous recessive; The phenotypic ratio of the offspring is 2:2 patterned to plain or 50/50.
Two patterned heterozygous spiders are crossed. 600 offspring are produced. How many of them are plain?

150 of the offspring would be predicted to be plain.

Mendel’s Law of Segregation

Which of Mendel’s Laws states that the members of each pair of alleles separate when gametes are formed?

Mendel’s Law of Segregation

Which Mendel’s Law states that two or more pairs of alleles segregate independently of one another during gamete formation, creating at least four different outcomes?

Mendel’s Law of Independent Assortment

Which of Mendel’s laws does this illustration represent?

Mendel’s Law of Segregation
16. **GENETICS PROBLEMS**

Which of Mendel's laws does this illustration represent?

**Mendel's Law of Independent Assortment**

17. **GENETICS PROBLEMS**

The diagram shows the positions of the genes for flower color and stem length in a pea plant. The chromosomes represented below will replicate before meiosis.

For these two genes, what is the maximum number of different allele combinations that can be formed normally in gametes produced from this cell?

**Answer:** four

Pt, PT, pt, pT

18. **GENETICS PROBLEMS**

In Alaskan malamutes, the dwarf allele is recessive (d), while the normal allele is dominant (D). Show a test cross in which all of the offspring are phenotypically dominant.

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19. **GENETICS PROBLEMS**

Which type of cross is demonstrated in this Punnett square?

**A dihybrid cross.**
In guinea pigs, the allele S for short hair is dominant over the allele s for long hair. Also, the allele B for black hair is dominant over the allele b for brown hair. Which ratio of offspring are expected to be short haired and brown from a cross of two guinea pigs that are both heterozygous for each trait?

3/16 of the offspring.

You may require a dihybrid Punnett square but students should be familiar with the 9:3:3:1 ratio for heterozygous crosses.

Describe the difference in phenotypes between organisms that exhibit incomplete dominance for a trait vs. organisms that exhibit codominance for a trait.

In organisms that exhibit incomplete dominance, the traits blend together like mixing paint. In organisms that exhibit codominance, the traits are both present; neither is masked by the other.

In organisms that exhibit incomplete dominance, the traits blend together like mixing paint. In organisms that exhibit codominance, the traits are both present; neither is masked by the other.

Hair texture typically is incompletely dominant, and can be curly (C), straight (S) or wavy (SC).

Construct a Punnett square crossing a curly-haired parent with a wavy-haired parent. Determine all phenotypic ratios of the potential offspring.

50% of the offspring will show the hybrid trait (wavy); 50% of the offspring will have curly hair.

Which pattern of inheritance is depicted in the Punnett square?

Incomplete dominance.
24. **GENETICS PROBLEMS**

The rhododendron pictured here exhibits which of inheritance pattern for the flower petal color?

- **Codominance.**

25. **GENETICS PROBLEMS**

A cross between a black cat and a tan cat produces a tabby pattern (black and tan fur together).

List all the possible phenotypes and in what ratios from a cross between a tabby cat and a black cat.

- Codominance.

26. **GENETICS PROBLEMS**

- Plant 1: homozygous for the chevron allele.
- Plant 2: homozygous for the oval allele.

The chevron and oval alleles are **codominant**.

If plant 1 and plant 2 are crossed, the codominance of the alleles will **most likely** result in which of the following leaf patterns on the offspring plants?

- A
- B
- C
- D

27. **GENETICS PROBLEMS**

In humans, there are 3 alleles for blood types: A, B and O. A and B are codominant, resulting in a third blood type, AB. The O blood type is recessive.

If a man who is heterozygous for type B blood marries a woman who has type AB blood, which blood type would their child most likely be?

- The child would most likely be type B (with a 50% chance).
28 GENETICS PROBLEMS

In pigeons, three alleles of a single gene govern their feather color.
BB = blue feathers
BA = ash red feathers
bb = chocolate feathers (recessive).

Which complex pattern of heredity is this an example of? Multiple alleles.

29 GENETICS PROBLEMS

In pigeons, three alleles of a single gene govern their feather color.
B² = blue feathers (dominant)
B¹ = ash red feathers
b = chocolate feathers (recessive)

Construct a Punnett square crossing a pure ash-red pigeon to a blue pigeon who also carries the recessive allele. Which percentage of the offspring could be expected to be ash-red?

50% of the offspring could be expected to be ash-red.

30 GENETICS PROBLEMS

In cats, the genotype B is black, Bb is calico, and b is orange. The gene is located on the X chromosome, making it a sex-linked trait. If a calico female mates with a black male, what offspring would be expected?

Which pattern of inheritance does the diagram illustrate? X linked inheritance.

31 GENETICS PROBLEMS

In cats, the genotype B is black, Bb is calico, and b is orange. The gene is located on the X chromosome, making it a sex-linked trait. If a calico female mates with a black male, what offspring would be expected?

The offspring that would be expected are black and calico females, and black and orange males.
In cats, the genotype B is black, Bb is calico, and b is orange. The gene is located on the X chromosome, making it a sex-linked trait. Refer to card #31.
Explain why there could never be any male calico cats.

There can never be a calico male cat because two alleles are required. Since the alleles are X-linked, two X chromosomes are needed.

Hemophilia is an sex linked disorder in which blood clotting proteins are severely reduced; causing excessive bleeding from minor injuries.
Given that it the allele for hemophilia is present on the X chromosome, explain how you know the genotype of the father of a hemophiliac woman.

Since women inherit the X chromosome from their father (as opposed to the Y), and men only have one X chromosome. Therefore, if the woman is hemophilic her father must also be hemophilic given that it is a recessive disorder.

The disorder is recessive. I-1 has the disorder, and I-2 does not; all of their children are carriers/heterozygous, but they do not have the disorder/trait.

The disorder is dominant. One possible explanation is persons II-4 and II-5. The both have the trait but their son (person III-5) does not. If this were a recessive trait, all their children would have it.
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GENETICS PROBLEMS