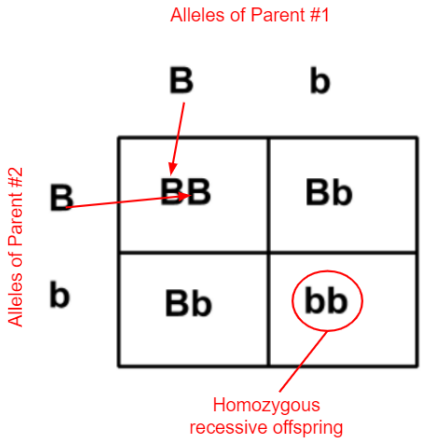
Heads or Tails?
Modeling The Principle of Dominance

INTRODUCTION: Gregor Mendel, the father of genetics, used pea plants to uncover how parents pass their traits to offspring. From his experiments, he discovered the principle of dominance. This principle states that a single gene consists of two variations, or alleles - a dominant and a recessive. When genes are inherited, the dominant allele will overpower the recessive allele in regard to the physical expression of a trait. Dominant alleles are expressed as uppercase letters, while recessive alleles are expressed as lowercase letters. For example, studies have shown that the brown (B) allele for the eye color gene is dominant over the blue (b) allele.

When fusion of the egg and sperm (fertilization) occurs, offspring end up with a combination of alleles from both parents, known as a genotype. By definition, genotypes are the genetic makeup of offspring. In the principle of dominance, three potential genotypes exist - homozygous dominant (two dominant alleles), homozygous recessive (two recessive alleles), and heterozygous (one dominant and one recessive allele). Using our eye color example, homozygous dominant is BB, homozygous recessive is bb, and heterozygous dominant is Bb.

Genotypes determine the physical expression of a gene, or phenotype. According to the principle of dominance, any genotype that has a dominant allele will show the dominant phenotype. Therefore, homozygous dominant will show the dominant trait, homozygous recessive will show the recessive trait, and heterozygous will show the dominant trait. Back to our eye color example, BB will show brown, bb will show blue, and Bb will show brown.

Mathematical models, known as Punnett Squares, are used to predict the probability of an offspring's genotypes and phenotypes. In a Punnett Square, the alleles of the two parents are crossed to show all possibilities of genotypes and phenotypes. For example, if we cross two heterozygous brown-eyed parents (Bb x Bb), we will get a 1 out of 4 (25%) chance of their offspring being homozygous recessive (bb), blue-eyed kids. The eye color Punnett Square along with its expected genotype and phenotype probabilities are provided.



Expected Genotypes:

BB = 1/4 = 25%
Bb = 2/4 = 50%
Bb = 1/4 = 25%

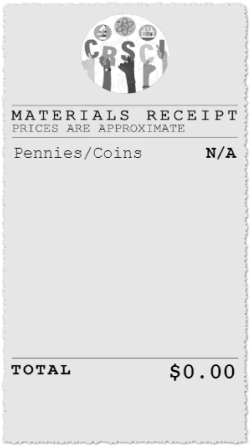
Expected Phenotypes:

brown eyes (BB or Bb) = 3/4 = 75%
blue eyes (bb) = 1/4 = 25%

PURPOSE: In this lab, you use two pennies to simulate the reproduction of two heterozygous, blue-eyed parents (Bb). Because each penny has a head and tail, head represents the dominant allele (B) and tail represents the recessive allele (b). You will flip the coin to see how accurate the expected genotype and phenotype probabilities are to the actual probabilities calculated from the lab.

PROCEDURE:

1. Toss both pennies simultaneously. Remember, each penny is one parent.
2. Determine the genotype produced from the flip (HINT: Two heads means homozygous dominant, BB.)
3. Tally that genotype under "# of Flips" in Table #1.
4. Repeat steps 1-3 nine more times.
5. Calculate the "Actual Probability (%)" for each genotype in Table #1. (HINT: Everything's out of 10.)
6. Calculate the "Actual Probability (%)" for each phenotype in Table #2. (HINT: Use your genotype %).



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DATA/OBSERVATIONS:

Table #1: Expected vs Actual Genotypes			
Genotype	**Expected Probability (%)**	**# of Flips**	**Actual Probability (%)**
BB (head, head)	1/4 = 25%		
Bb (head, tails)	2/4 = 50%		
bb (tails, tails)	1/4 = 25%		

Tabel #2: Expected vs Actual Phenotypes		
Phenotype	**Expected Probability (%)**	**Actual Probability (%)**
brown eyes (BB + Bb)	25% + 50% = 75%	
blue eyes (bb)	25%	

CONCLUSION:

1. Were your actual probabilities close to your expected? Describe why or why not. BE SPECIFIC.

2. Will your offspring end up with brown eyes or blue eyes? How do you know?

3. Assume one of your pennies was manufactured incorrectly and ended up with two tails. Complete the Punnett Square below showing a cross between the two-tailed penny and a normal head-and-tail penny.