Dihybrid Cross Simulation

Mendel later wondered if traits always travelled together or if they were inherited separately. To answer the question he considered parents which were heterozygous for two traits- a **dihybrid cross**. In one cross he studied the inheritance of seed color and seed shape. The allele for yellow seeds (Y) is dominant to the allele for green seeds (y). The allele for round seeds (R) is dominant to the allele for wrinkled seeds (r).

Mendel crossed true-breeding plants that had yellow, round seeds (YYRR) with true-breeding plants that had green, wrinkled seeds (yyrr). If the two traits are transmitted from parents to offspring as a package, the F_1 spring would produce yellow, round seeds. The F_2 offspring would produce two phenotypes (yellow + round; green + wrinkled) in a 3:1 ratio, just like a monohybrid cross. If, however, the alleles separated independently of one another, we should observe different combinations. The four different kind of sperm and four different kinds of eggs should give 16 different combinations in the offspring.

In this activity we'll simulate a dihybrid cross so you can learn about the possible outcomes.

First, let's use two coins to model the behaviour of alleles in a monohybrid cross.

Use two pennies. One penny represents a pair of alleles in one parent, while the other penny represents the pair of alleles of the same gene in the other parent. Let heads (H) represent the dominant allele yellow (Y) and let tails (T) represent the recessive allele green (y).

1. **Identify** the parents as heterozygous or homozygous. **Justify** your response.

Toss the coins together and record the resulting genotype in Table 1. Remember that each coin represents a parent, so each parent can give only one allele of the pair. Repeat the toss another nine times, recording a mark in the "Tally" column of Table 1. Once you're finished, pool the data with the class. Divide every probability in each column by the smallest probability in that column.

Table 1 Monohybrid cross results

	Phenotype	Tally	Expected Probability	Observed Probability (Individual)	Observed Probability (Class)
PP (HH)					
Pp (HT)					
Pp (TT)					

2. **Describe** the difference between the expected probability and your individual probability AND the expected probability and the class probability. **Explain** the differences.

3. **Describe** how you would modify the procedure to model a dihybrid cross.

Use two pennies to represent the alleles for seed color as before and use two coins of a different denomination to represent the alleles for seed shape, with heads representing the allele for round seeds (R) and tails representing the allele for wrinkled seeds (r).

4. **State** the number of alleles donated by each parent for seed color and for seed shape. **Describe** how this is indicated in this model.

5. **Identify** the possible gametes the parents can produce.

Toss all 4 coins and determine the phenotype represented by the outcome. Record the results by putting a mark in the appropriate row of the "Tally" column of Table 2. Toss all four coins nineteen more times, and record the results in Table 2. Pool your data with the class. Transfer your results to Table 3 and then complete the table. Reduce the ratio to lowest possible terms by dividing each term by the smallest term.

Table 2 Monohybrid cross results

	Penny phenotype	Other coin phenotype	Tally	# Offspring Observed (Individual)	# Offspring Observed (Class)
1st & 2nd Dominant					
1st Dominant & 2nd Recessive					
1st Recessive & 2nd Dominant					
1st & 2nd Recessive					

Table 3: Individual and class data for number of offspring and phenotypic ratios

		yellow, round seeds	yellow, wrinkled seeds	green, round seeds	green, wrinkled seeds
Individual	# offspring				
	Ratio				
Class	# offspring				
	Ratio				

6. Use the class results to **make a claim** about the expected results from a dihybrid cross.

7. **Make a claim** regarding the inheritance of the alleles for seed color and for seed shape. **Justify** your claim.