Name: Date:

HANDS-ON ACTIVITY

Modeling Monohybrid and Dihybrid Crosses

The inheritance of any given set of alleles depends on chance. Therefore, the laws of probability can be used to predict the genotypes and phenotypes of offspring resulting from specific crosses. In this investigation, you will use colored plastic chips to relate the laws of probability to hybrid crosses.

MATERIALS

- bag, brown paper lunch size (4)
- chip, blue plastic (30)
- chip, red plastic (30)
- chip, white plastic (30)
- chip, yellow plastic (30)

PREDICT

How do actual results of monohybrid and dihybrid crosses compare with predicted results?

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PROCEDURE

Introduction

1. Work in pairs. One person should draw chips as directed, and the other should record the results.
2. Obtain two brown paper lunch bags, one labeled *male* and the other *female.* Each paper bag should contain 15 white chips and 15 blue chips.
   a. What is the probability that you will draw a blue chip from either paper bag? Explain.

      _____

      _____

   b. What is the probability that you will draw a white chip from either bag?

      _____

   c. What is the probability that you will draw one blue chip from each paper bag at the same time?

      _____

   d. What is the probability that you will draw one white chip from each paper bag at the same time?

      _____

   e. What is the probability that you will draw a blue chip and a white chip in any combination? Explain.

      _____

      _____
3. Mix the chips in each paper bag thoroughly. Without looking at the chips, pull out one chip from each bag and place them as a pair on the table. What combination of chips did you draw? What was the probability that you would draw that particular combination?
4. Return each chip to its paper bag.

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Part A: Monohybrid Cross

1. In this investigation, the paper bag labeled *male* represents a male animal, and the bag labeled *female* represents a female animal. What do the colored chips in the paper bags represent?

   _____

2. Suppose a blue chip (*B*) represents the allele for blue fur color and a white chip (*b*) represents the allele for white fur color. Assume that blue fur color is dominant. Write the genotypes of the parent animals for fur color below. (Remember that each bag contains both blue and white alleles.)

   Male's genotype: _____

   Female's genotype: _____

3. Complete the Punnett square in the Observations section to determine the possible combinations of alleles that could occur in offspring of a cross between these two animals.

4. List the possible allele combinations in the first column of Data Table 1.

5. Use your data from the Punnett square to determine what proportion of offspring are expected to have a given allele combination.

6. Use the proportions to calculate the number of offspring that are expected to have each allele combination. To do this, multiply the fraction expected for each allele combination by the total number of offspring. The total number of offspring, or trials, for your team will be 40. Write your predictions in the second column of Data Table 1.

7. Shake the bags to mix the chips thoroughly.

8. Without looking in the paper bags, pull out one chip from each paper bag. Use a hatchmark to record your results in the third column of Data Table 1.

9. Return each chip to the paper bag from which you drew it.

10. Repeat steps 6–9 to perform another 39 trials. Record your data. Remember to return the chips to their appropriate paper bags after each trial.

11. When you finish your team's 40 trials, count the hatchmarks for each combination and record that number in the fourth column of Data Table 1.

12. Obtain the totals of all the other teams and write the class data for each combination in the last column of Data Table 1. Also record the total class trials.

Part B: Dihybrid Cross

1. In this part of the investigation, you will determine the probability of obtaining a particular combination of alleles for two traits. Both parent animals in this series of crosses are heterozygous for the two traits. Recall that crossing two individuals that are heterozygous for two traits is called a dihybrid cross.

2. Obtain 2 brown paper lunch bags, each containing 15 red chips and 15 yellow chips. One bag should be labeled *male,* and the other should be labeled *female.*

3. You and a partner will perform 48 trials. However, in addition to the red and yellow chips, you will use the blue and white chips from Part A. Thus, in each of these trials, you will draw four chips rather than two.

4. Place the two paper bags labeled *male* next to each other. Together these bags represent a single male parent. Place the two paper bags labeled *female* next to each other. These bags represent a single female parent.

5. The red chips (*R*) represent the allele for long fur, and the yellow chips (*r*) represent the allele for short fur. Assume that long fur is dominant over short fur.

   What are the genotypes of the parent animals?

   _____

6. Complete the Punnett square for this cross in the Observations section.

   What phenotype ratios are expected for this cross?

   _____

7. List the possible phenotypes of offspring in Data Table 2.

8. Use the predicted phenotype ratios to calculate the number of offspring expected for each phenotype. Remember that the total number of offspring in this investigation is 48. Write your predictions in the second column of Data Table 2.

9. Shake the bags to mix the chips thoroughly.

10. Without looking, pull out one chip from each paper bag and place it on the table next to its paper bag. Determine which phenotype will result from this allele combination. Use a hatchmark to record your results in the third column of Data Table 2.

11. Return each chip to the paper bag from which you drew it.

12. Repeat steps 9–11 to perform another 47 trials. Record your data. Remember to return the chips to their appropriate paper bags after each trial.

13. When you finish your team's 48 trials, count the hatchmarks for each phenotype and record that number in the fourth column of Data Table 2.

14. Obtain the totals of all the other teams and write the class data for each phenotype in the last column of Data Table 2. Also record the total class trials.

15. Calculate the ratio of phenotypes for your actual results and the class totals and record them in the space provided.

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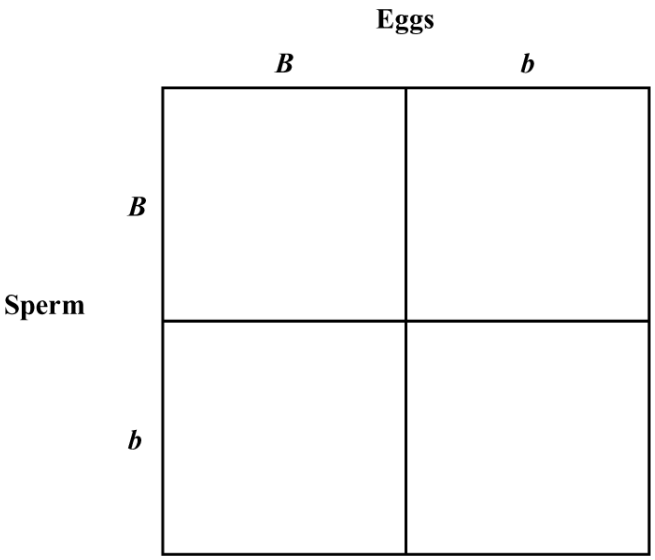
16. Before leaving the laboratory, return all materials as directed by your teacher.

Name: **Date:**

OBSERVATIONS

Punnett square for monohybrid cross

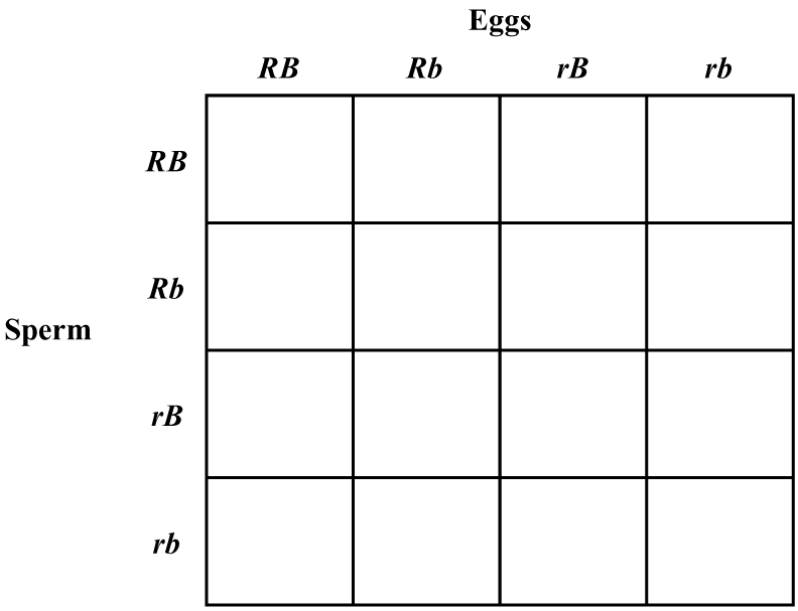


DATA TABLE 1: ALLELE COMBINATIONS, MONOHYBRID CROSS

POSSIBLE ALLELE COMBINATIONS	PREDICTED NUMBER	ACTUAL RESULTS	TALLY OF RESULTS	CLASS TOTALS
Total class trials:_____				

Name: **Date:**

Punnett square for dihybrid cross



DATA TABLE 2: ALLELE COMBINATIONS, DIHYBRID CROSS

POSSIBLE PHENOTYPES	PREDICTED NUMBER	ACTUAL RESULTS	TALLY OF RESULTS	CLASS TOTALS
Total class trials:_____				

Name: **Date:**

ANALYZE

1. Why was it important to return each chip to its bag before another trial?

_____

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2. How did your actual results compare with your predicted results in Part A?

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3. How did the class totals compare with your predicted results in Part A?

_____

_____

_____

4. Why did you keep the red and yellow chips separate from the blue and white chips in Part B?

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5. How did the predicted phenotype ratios compare with your actual phenotype ratios in the dihybrid cross?

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6. How did the predicted phenotype ratios compare with the ratios calculated from the actual class totals in the dihybrid cross?

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7. What conclusions can you draw about actual results versus results predicted based on probability?

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