Monohybrid Crosses and The Punnett Square Lesson Plan

Students will simulate a monohybrid cross between two heterozygous parents and utilize the experimental data to develop a Punnett Square for the prediction of the offspring. Students will learn and apply knowledge of key terms of inheritance during this exercise.

Primary Learning Outcomes

- Students will learn about monohybrid crosses
- Students will learn the terminology used in Mendelain genetics
- Students will be able to complete Punnett Squares for monohybrid crosses
- Students will be able to predict phenotypic and genotypic ratios for monohybrid crosses based on the Punnett Square

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Assessed Georgia Performance Standards

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SB2. Students will analyze how biological traits are passed on to successive generations.

Background

Monohybrid crosses are the first step to understand Mendelain genetics. Mendel's laws of inheritance should be discussed prior to this exercise.

Materials for a class of 30 sutdents

30 brown paper bags (15 labeled "Female" and 15 labeled "Male")
Bag of white beans
Bag of red beans
(*Note*: The beans should be close to the same size)

Procedures

Step 1: Duration: 30 minutes (Teacher prep before class)
The instructor should prepare materials by labeling ½ of the bags *"Female"* and the other ½ *"Male"*. Next place 15 red and 15 white beans in each bag.

Step 2: Duration: 15 minutes
Introduce genetics and key terms (phenotype, genotype, trait, dominant, recessive, homozygous, heterozygous, etc.). Provide students with a brief description of Mendel's Laws of Independent Assortment and Segregation. Provide instructions for completing activity.

Step 3: Duration: 20-30 minutes
Students will complete the pre-lab definitions, conduct the activity, and answer post-lab questions as indicated on the student lab handout at the end of this document (2 pages).

Total Duration
Teacher preparation: 30 minutes
Class Time: 35-45 minutes

Assessment
Students will be assessed based on their completion of the activity. Since this activity does not take the whole class time, a worksheet on monohybrid crosses may be useful after this activity to further assess student comprehension.

Name _____

Monohybrid Crosses and the Punnett Square

Introduction

Scientists use a grid-like tool (Punnett Square) to make predictions about various genetic problems. The Punnett Square shows only the probability of what might occur and not the actual results. Probability is the chance of something occurring. If one wants to flip a coin 100 times, since there are 2 sides to the coin, he would expect 50 heads and 50 tails. If he flips the coin 100 times, he may actually get 60 heads and 40 tails. Prediction is one thing, and actually getting the predicted results is another. The Punnett Square only shows the chances of what might occur each time the event is undertaken.

Objective

In this investigation, you will use a Punnett Square to predict the possible genotypes and phenotypes and their ratios from a monohybrid cross.

Pre-lab questions

Define the following terms:

1. Punnett square - _____
2. genotype - _____
3. phenotype - _____
4. homozygous - _____
5. heterozygous - _____
6. trait - _____
7. dominant - _____
8. recessive - _____

Materials

- red beans
- white beans
- 2 small paper bags (one labeled male and the other labeled female)

Procedure

1. Each group of 2 students will pick up 2 paper bags filled with 15 red (R) beans and 15 white (r) beans. This represents 2 heterozygous parents (Rr x Rr).
2. One student in the group will be in charge of the male bag and the other student will be in charge of the female bag.
3. At the same time, each student will reach into their bag and pull out one of the beans. The only possibilities that can be made from this selection are: RR (homozygous red), Rr (heterozygous red), or rr (homozygous white). Mark the resulting genotype and phenotype in the data table.
4. Return the beans back into the bag and conduct the same process 14 more times (15 total trials).

Name _____

Data Table

Trial	Offspring's Genotype	Offspring's Phenotype
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Analysis and Conclusions

1. What is the dominant trait? _____
2. How do you know it is dominant? _____

   _____
3. Which one is the recessive trait? _____
4. What are the genotypes of the parents? _____
5. What are the phenotypes of the parents? _____
6. Fill in the Punnett Square below using the parents given in the procedure:

Male _____ X Female _____

7. What is the genotypic ratio? _____
8. What is the phenotypic ratio? _____