

## General Biology Lab (BIO 110L)

### PRELAB FOR LAB 6: APPLICATION OF MEIOSIS: GENETICS PROBLEMS

#### MONOHYBRID CROSSES & THE PUNNETT SQUARE Total points:100

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#### INTRODUCTION

A variety of offspring can be produced as a result of sexual reproduction. Every individual produced by sexual reproduction has two genes for each characteristic (trait). They receive one gene from each parent. However, there are alternate genes for the same characteristic (trait) known as **alleles**. For example there are alternate genes for eye color; the blue eye allele and the brown eye allele. Some alleles, called **dominant alleles** are able to express a characteristic and mask the presence of other **recessive alleles**. The only way to have a recessive trait expressed is to have **both** alleles be **recessive**. If an individual has two identical alleles for a characteristic (two blue eye alleles or two brown eye alleles) it is **homozygous**. If the two alleles are different from one another (one brown eye allele and one blue eye allele) the individual is **heterozygous**. Therefore an individual may have some recessive alleles that do not express themselves but are still part of their genetic catalog. All the genes that an individual has are its **genotype**. The genotypes are usually written in the form of letters. The observable characteristics displayed in the organism's structure, behavior, or physiology is known as the organism's **phenotype**.

Match the definitions on the left with the terms on the right. **Put the matching letters only.**(7x 6 = 42)

- |   |                 |
|---|-----------------|
| ___D___ 1. genotypes made of the same (identical) alleles                                   | A. alleles      |
| ___A___ 2. alternate forms of genes for a single trait                                      | B. dominant     |
| ___B___ 3. alleles that are able to express a characteristic and mask the alternate allele. | C. Phenotype    |
| ___E___ 4. alleles that are non-expressive as they are masked by dominant alleles           | D. homozygous   |
| ___F___ 5. genotypes made of two different alleles  | E. recessive    |
| ___G___ 6. All the genes that an individual has are its                                     | F. heterozygous |
| ___C___ 7. Observable characteristics displayed by the organism                             | G. genotype     |

Scientists use a box figure (**Punnett Square**) to make predictions about various genetics problems. The Punnett Square allows you to determine the probability of obtaining each of the genotypes and phenotypes possible in the offspring resulting from a particular cross. The Punnett Square only shows the chances of what might occur each time the event is undertaken.

#### Punnett Square Steps

**Step One: Determine the Genotype of the Parents**

**Step Two: Set up the Punnett Square**

**Step Three: Determine the Offspring %**

Step 1: Let the 2 Parents' genotype be Bb and Bb respectively where **B represents Brown eyes** and **b represent blue eyes**.

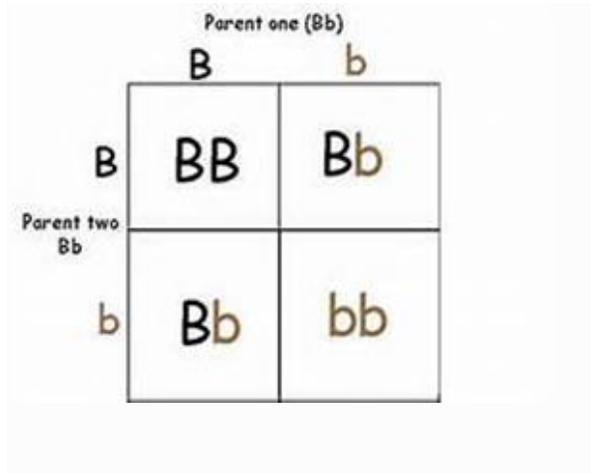
Step 2: Next, put the genotype of one parent across the top and that of the other parent down the left side. Note that only one letter goes for each box for the parents. It does not matter which parent is on the side or the top of the Punnett square.

Step 3: Next fill in the grids by doing the crosses. Write the uppercase letter first. Each small square within the big square is 25% There are 4 small squares so the total is 100%

8a. The parents are \_\_\_\_\_  $3 \times 3 = 9$   
 a) Homozygous **b) Heterozygous**

8b. \_\_\_\_\_ % of the offspring has homozygous blue eyes.  
 a) 0% **b) 25%** c) 50%

8c. The phenotype of 50% of the offspring are heterozygous \_\_\_\_\_ eyes.  
 a) Brown b) Blue



Below each of the following words are choices. Circle the choices that are examples of each of those words.

9. Dominant allele (10 pts)

D e k **L N** n **R S**

10. Recessive allele (10pts)

M **n d** F **g r k** P

11. Homozygous dominant (6pts)

**AA** Gg **KK** mm uu Rr **TT**

12. Homozygous recessive (6 pts)

**ee** Ff HH Oo **rr** Uu **tt**

13. Genotypes in which dominant gene must show (6 pts)

**AA** **Dd** **EE** ff **Jj RR Ss**

14. Genotypes in which recessive gene must show (6 pts)

**aa** Gg **ff** KK **rr** Oo Tt

15. What do the letters on the outside of the Punnett square stand for? \_\_\_\_\_ (5 pts)

a) offsprings' genotype    b) genotype of parents

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**MONOHYBRID CROSSES & THE PUNNETT SQUARE**    Total points:100

**Lab Report**

1. Examine the following Punnett squares and circle/ highlight those that are correct. (10 pts)

	B	B
b	BB	BB
b	bb	bb

A

	B	B
b	BB	Bb
b	Bb	bb

B

	B	B
b	Bb	Bb
b	Bb	Bb

C

2. If **B** represents Brown Eyes and **b** represents Blue Eyes what would be the **genotypes** of the following? (3x4=12 pts)

- A. Homozygous Brown Eyes: BB                      B. Homozygous Blue Eyes: bb  
 C. Heterozygous Brown Eyes: Bb

3. For each of the genotype determine the **phenotype** (2x4= 8 pts)

- 1) Purple flowers are dominant to white flowers Pp purple  
 2) Round seeds are dominant to wrinkled seeds rr wrinkled

4. What are the **genotypes** of the parents? The letter used for each genotype is given in the box below. (2x4= 8)

R is round,    r<sub>1</sub> is wrinkled

- A. A homozygous round seeded plant is crossed with a heterozygous round seeded plant. RR X Rr  
 B. A homozygous round seeded plant is crossed with a homozygous wrinkled seeded plant RR X rr

5. What are the **phenotypes** of the parents? The letter used for each genotype is given in the box below. (4x2 =8)

P is purple; p<sub>1</sub> is white; T is tall; t<sub>1</sub> is short;

- A. A TT plant is crossed with a t<sub>1</sub>t<sub>1</sub> plant. tall X short  
 B. A p<sub>1</sub>p<sub>1</sub> flowered plant is crossed with a p<sub>1</sub>p<sub>1</sub> flowered plant. white X white  
 C. A Tt<sub>1</sub> plant is crossed with a Tt<sub>1</sub> plant. tall X tall

**SECTION 2: INVESTIGATION OF A MONOHYBRID CROSS USING THE PUNNETT SQUARE AND THEN USE BEADS TO SIMULATE THE CROSS**

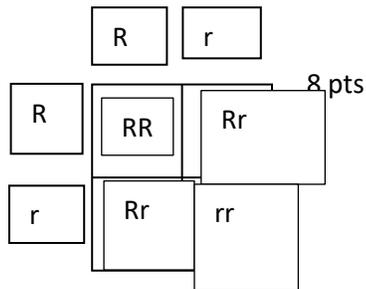
**Objective:** In this lab you will make predictions of possible genotypes and phenotypes using a Punnett Square, and then use beads to simulate the cross. Next compare the actual results (results from the simulated cross) with the predicted results (results from the Punnett Square).

**Materials:** red beads, white beads, 2 paper cups (one labeled male and the other labeled female), 2 bowls (one

labeled male and the other labeled female). The 2 paper cups filled with 10 red (R) beads and 10 white (r) beads. **This represents 2 heterozygous parents (Rr x Rr).**

1. Fill in the Punnett Square below using the parents given above:

Male parent genotype  Rr  x Female parent genotype  Rr  (2pts)



Genotypes:

25  % homozygous red (RR)     50  % heterozygous Red (Rr) (2

25  % homozygous white (rr) (2 pts)

Phenotypes:  75  % red (2 pts)     25  % white (2 pts)

**SECTION: 3**

**INVESTIGATION OF A MONOHYBRID CROSS USING THE PUNNETT SQUARE**

The data chart below has been completed for you with 10 possible genotypes of offspring between **2 heterozygous parents (Rr X Rr)**

Let **R = Red hair** and **r = white hair**. Complete the phenotype column with the correct trait. (Red or White)  
Then, answer the questions below.

**Data Table 6.1 (10 pts)**

Trial	Offspring's Genotype	Offspring's Phenotype
1	RR	red
2	Rr	red
3	RR	red
4	Rr	red
5	rr	white
6	Rr	red
7	Rr	red
8	rr	white
9	Rr	red
10	RR	red

Analysis and Conclusions

3. What is the dominant trait? \_\_\_\_\_ red \_\_\_\_\_ (2 pts)
4. What is the recessive trait? \_\_\_\_\_ white \_\_\_\_\_ (2 pts)
5. What are the genotypes of the parents? Male \_\_\_\_\_ Rr \_\_\_\_\_ Female \_\_\_\_\_ Rr \_\_\_\_\_ (2 pts)
6. What are the phenotypes of the parents? \_\_\_\_\_ red \_\_\_\_\_ & \_\_\_\_\_ red \_\_\_\_\_ (2 pts)

**ANSWER QUESTION # 7 & 8 FROM DATA TABLE 6.1**

7. **Genotypes** (12 pts) Number of offspring with homozygous red (RR) genotype: 3; percentage: 30%

Number of offspring with heterozygous red (Rr) genotype: 5; percentage: 50 %

Number of offspring with homozygous white (rr) genotype: 2; percentage: 20%

8. **Phenotypes** (8 pts) Number of red 8 ; percentage: 80 %

Number of white 2 ; percentage: 20%