Name _____ Date _____

CHAPTER 25

ENRICHMENT ACTIVITY

Genetics Problem Solving

Crosses Involving One Trait

For the crosses in this activity, we will use some of the traits Mendel observed in garden peas. The expressions of the dominant and recessive alleles for the gene controlling one of these traits are described in the chart below along with the letter symbols that represent each allele.

Trait	*Dominant allele*	*Recessive allele*
seed coat color	brown (B)	white (b)

Remember, the genotype of each plant must have two letters, one representing each allele of the gene for the particular trait. For example, if a seed is round, it could have two possible genotypes—RR or Rr. RR is homozygous, since the two alleles are identical, and its phenotype is round. Rr is heterozygous, since the two alleles are different. Its phenotype is also round because the allele for round seeds (R) is dominant over the allele for wrinkled seeds (r).

In the examples that follow we will predict the phenotypes of the offspring that result from selected crosses. Keep in mind that the predictions are based on probability theory. Actual results may vary from predicted results.

SAMPLE PROBLEM 1

Predict the results of a cross between a pea plant that is homozygous for brown seeds and a plant that has white seeds.

Step 1 Determine the genotypes of the parents.

Since the plant with brown seeds is homozygous for the trait, its genotype must be BB. However, the problem does not tell us if the plant with white seeds is homozygous or heterozygous. But we know that white seed coat is a recessive trait, and that recessive traits are expressed only if they are homozygous. Therefore the genotype of this plant must be bb. The cross, therefore, is BB × bb.

Step 2 Determine the gamete genotypes produced by each parent.

The two alleles of any gene segregate during meiosis and, consequently, end up in separate gametes. Thus the brown seed parent (BB) will produce gametes all of which have the genotype B. The white seed parent (bb) will produce gametes that are all of the genotype b.

Step 3 Set up a Punnett square using the gamete genotypes.

The Punnett square is a diagram that aids in calculating all the possible offspring genotypes that could result from a particular cross. Along the top of a Punnett square every possible gamete genotype from one of the parents is listed. Along the left side of the square, every possible gamete genotype from the other parent is listed. For this sample cross the Punnett square should look like this:

	B	
b		

Step 4 Combine the gamete genotypes from one parent with those from the other parent to show all possible offspring genotypes.

To predict the offspring genotypes, combine the gamete genotypes of one parent with the gamete genotypes of the other parent. In this case the result is:

	B
b	**Bb**

Step 5 State the genotype ratio and the phenotype ratio.

As you can see, the only possible offspring genotype in this cross is Bb. The genotype ratio is all Bb. The phenotype is brown, since brown (B) is dominant over white (b). The phenotype ratio is all brown.

Summary: genotype ratio all Bb phenotype ratio all brown

SAMPLE PROBLEM 2

Predict the results of a cross between a heterozygous brown seed plant and a white seed plant.

Step 1 Determine the genotypes of the parents.

heterozygous brown parent Bb white parent bb Bb x bb

Step 2 Determine the gamete genotypes produced by each parent.

Bb → B, b bb → b

Step 3 Set up a Punnet square using the gamete genotypes.

	B	b
b		

Step 4 Combine the gamete genotypes of one parent with those of the other parent to show all possible offspring genotypes.

	B	b
b	**Bb**	**bb**

Step 5 State the genotype ratio and the phenotype ratio.

genotype ratio 1 Bb:1 bb = ½ Bb, ½ bb

phenotype ratio 1 brown:1 white = ½ brown, ½ white

EXERCISES

For the crosses shown in exercises 1–8 (a) draw a Punnett square in the space provided and write (b) the genotype ratio and (c) the phenotype ratio on the indicated lines. Refer to the table below and on page 25–7 for a description of traits.

Trait	*Dominant*	*Recessive*
seed coat shape	round (R)	wrinkled (r)
pod color	green (G)	yellow (g)
height of plant	tall (T)	short (t)

1. Rr × RR

a.

b. genotype ratio _____

c. phenotype ratio _____

2. Gg × GG
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

3. Tt × Tt
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

4. Rr × Rr
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

5. Cross 2 heterozygous green plants.
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

6. Cross a homozygous green plant with a heterozygous green plant.
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

7. Cross a homozygous tall plant with a short plant.
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

8. Cross a white seed plant with a heterozygous brown seed plant.
   a.
   b. genotype ratio _____
   c. phenotype ratio _____

9. In squash, the allele for white fruits (W) is dominant over the allele for yellow (w). If a white-fruited plant is crossed with a yellow-fruited plant and all the offspring are ~~yellow~~ white, what are the possible genotypes of the parents and the offspring?
   a. parents _____
   b. offspring _____