Period _____ Name _____

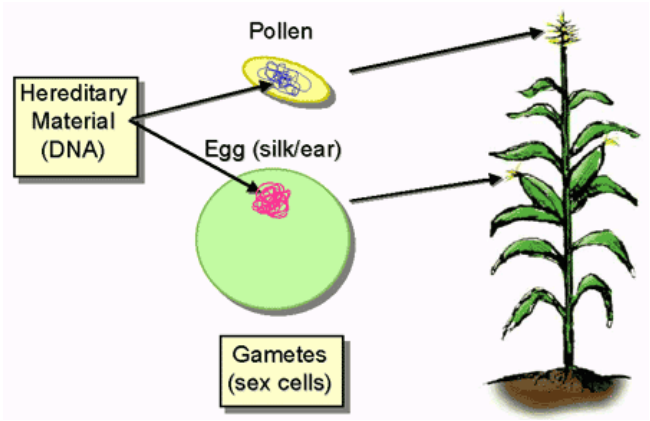
Biology Dihybrid Corn Genetics Lab Worksheet TT11B (EGYR + 30)

Introduction

In this exercise, you will examine an ear of corn and determine the type of cross and genes responsible for the coloration and texture of the corn kernels. There are several traits in the corn seed type the traits include:

Kernel Color (Purple or Yellow) **Kernel texture (Smooth or Shrunken)**

Corn is also known as maize and its scientific name is *Zea mays.* Transgenic (genetically modified) maize made up 85% of the maize planted in the United States in 2009. Corn has 10 chromosome pairs (20 individual chromosomes). Each kernel (seed) on an ear results from a ***separate*** fertilization event and thus represents one (1) offspring. Thus, if you plant a seed (kernel) in the ground, you could theoretically grow a new corn plant. Furthermore, the seeds on the ear are the F2 generation from a cross that began with two parental varieties of corn with contrasting phenotypes.



Monohybrid Cross

1. Use the letter **P**, write the genotype of the two different types of true-breeding parents.

2. If you were to cross these two parents, what would be the genotype of all F1 offspring?_____

3. Use a Punnett Square to diagram the F1 cross (cross the offspring from parent cross)..

4.If the P gene coded for seed color and purple was dominant, write the Genotype and Phenotype ratios:

---

5. Use the corn from the bin marked **A.** Count the number of purple and yellow kernels **in three of the rows** on your group's ear of corn and record the number in the data table. (count 3 rows even though the table says 5)

6. Use the corn from the bin marked **B.** Count the number of smooth and shrunken seeds on three rows and record on the chart. (count 3 rows even though the table says 5)

Period _____ Name _____

	Number of Kernels	Kernal Percentage (divide count by total)	3. What are the probable phenotypes of the parents with regard to coloration?
Kernal Coloration			
Purple			
Yellow			
Total (for 5 rows)			4. What are the probable phenotypes of the parents with regard to texture?
Kernal Texture			
Smooth			
Shrunken			
Total (for 5 rows)			

7. The corn from **Bin A** is the F2 generation. Use the letter **P** to represent the gene for seed color.

What color is the dominant phenotype? _____ Write the genotype of these seeds._____
What color is the recessive phenotype? _____ Write the genotype of these seeds._____
What was the genotype and phenotype of each parental corn in the P-generation cross?

What was the genotype and phenotype of the individuals used in F1 cross? _____

Diagram the F1 cross using a Punnett Square:

Write the genotype and phenotype ratios of the F2 offspring:

Are the F2 offspring from **bin A** in the expected 3:1 phenotypic ratio? ____ Explain why there might be differences.

8. The corn from Bin B is the F2 generation. Use the letter **S** to represent the gene for seed texture.

What texture is the dominant phenotype? _____ Write the genotype of these seeds._____
What texture is the recessive phenotype? _____ Write the genotype of these seeds._____
What was the genotype and phenotype of each parental corn in the P-generation cross?

What was the genotype and phenotype of the individuals used in F1 cross? _____

Diagram the F1 cross using a Punnett Square:

Write the genotype and phenotype ratios of the F2 offspring:

Are the F2 offspring from **bin B** in the expected 3:1 phenotypic ratio? ____ Explain why there might be differences.

Dihybrid Cross

9. We will now consider a dihybrid cross, which is a combination of the two monohybrids. You will use the corn from **bin C**. Your ear of corn may be a result of a cross between plants that were both heterozygous (PpSs x PpSs). To develop a prediction (hypothesis) create a punnett square or use a mathematical system to

Period _____ Name _____

determine the phenotype ratio that ***you would expect*** in the F2 generation if the cross was in fact from crossing two double-heterozygous F1 individuals. Record the proportion of phenotypes you would expect to get from this cross in the spaces indicated, then calculate the percent for each proportion (fraction) **SHOW YOUR WORK**:

Expect: Purple & smooth ____ Purple & shrunken ____ Yellow & smooth ____ Yellow & shrunken ____

as a percent: ____ ____ ____ ____

10. Now using the ***ACTUAL*** corn from bin C, count the number of each of the seed types indicated below in three rows on the ear of corn:

	Number Counted	Percentage: Number counted / total x 100
Purple & smooth		
Purple & shrunken		
Yellow & smooth		
Yellow & shrunken		
TOTAL		

11. Did the F2 generation show a 9:3:3:1 phenotypic ratio? ____ Explain why there might be differences.

12. In science we use statistics to really see if there is in fact a difference. Very rarely, will the F2 be show ***exactly*** the expected phenotypic ratio. To determine if the slight differences from your observed data are due to chance alone (meaning that they it's close enough to the 9:3:3:1) or if the data are in fact not in the 9:3:3:1 and are significantly different, you need to use a **chi square test**. The table below will help you make the calculations.

	Expected Number	Observed Number	[Observed - Expected]^2 ÷ expected
Purple & smooth	Total x 9/16 =		
Purple & shrunken	Total x 3/16 =		
Yellow & smooth	Total x 3/16 =		
Yellow & shrunken	Total x 1/16 =		
		CHI SQUARE VALUE ========> (add the numbers from the rows above)	

13. Now determine if your chi square value is a good fit with your data. Your degrees of freedom (df) is the number of possible phenotypes minus 1. In your case, 4 - 1 = 3. Find the number in that row that is closest to your chi square value. **Circle that number.**

	Good Fit Between Ear & Data						Poor Fit	
df	.90	.70	.60	.50	.20	.10	.05	.01

14. This is where the Chi-Square test comes in. By performing this test we will not only be able to decide about supporting or rejecting our hypothesis, we will be able to do so with a certain confidence that we have made the right decision. The chi square test does not prove that a hypothesis is correct, rather it evaluates to what extent the data and the hypothesis have a good fit.

Explain what you think it means to have a "good fit" or a "poor fit" in this case.

15. Does you chi square analysis of real corn data support the hypothesis that the parental generation was PpSs x PpSs? Justify your answer with an explanation.

16. Is it possible to have other phenotypic ratios in a 2-factor cross?

Consider the cross, between the two parent plants: Ppss x PPSs. What is the phenotype for each parent:

Ppss: _____ PPSs: _____

What is the probability that the offspring of this cross will be Purple and Shrunken?

Diagram the cross using a Punnett Square or some other mathematical system **- show your work.**

Write the phenotypic ratio that you would expect for this cross:

Do all 2-factor crosses result in a 9:3:3:1 ratio? Justify your answer using evidence from this question:

Period _____ Name _____

Genetics Practice Problems (30 pts) - **Write neatly and be sure you answer each question completely by labeling your answers.**

1. (10 pts) The chestnut coat color of horses is due to a recessive gene, while the dominant allele results in black. The pacing gait is due to a recessive gene, whereas the dominant allele results in the trotting gait. Show the types of offspring that could result from a cross of a black trotter (male), heterozygous for both genes, with achestnut pacer (female).

a. Possible genotypes for Black coat: _____ Chestnut coat: _____
b. Possible genotypes for Trotting gait: _____ Pacing gait: _____
c. Write the Male genotype: _____ male possible gametes: _____
d. Write the Female genotype: _____female possible gametes: _____
e. Diagram the 2-factor cross (show your work)

f. Genotypic Ratio:_____ Phenotypic Ratio:_____
h. What percentage of the offspring will exhibit both dominant traits? _____
i. What percentage of the offspring will be chestnut trotters? _____
j. What are the chances of having a chestnut horse that paces? __ in __

2. (5 pts) In turkeys a dominant gene R produces the familiar bronze color; its recessive allele r results in red. Another dominant gene H results in normal feathers; its recessive allele h produces feathers without webbing, so that they resemble tufts of hair. Two bronze turkeys with normal feathers were mated, and their offspring consisted of 8 bronze with normal feathers, three bronze with hairy feathers, two red with normal feathers, and one red with hairy feathers. **What were the genotypes of the parents? Use a Punnett Square or other mathematical system to show your work!**

3. (5 pts) In sheep white is due to a dominant gene (W), black to its recessive allele (w). A white ewe mated to a white ram produces a black lamb.

If they produce another offspring, could it be white?

If so, what are the chances of it being white?

List the genotypes of all animals mentioned in this problem:

Period _____ Name _____

3.(5 pts) In Labradors, black coat color (B) is dominant over chocolate coat color (b). *However, a second gene determines whether or not pigment will be deposited at all*. If a lab receives 2 recessive alleles for this trait (which is symbolized by E or e), it will be yellow. **Use this information to solve the following problem: A black Labrador of genotype Bb Ee is crossed with a yellow Labrador of genotype Bb ee. What are the expected phenotypes of their offspring and in what proportion?**

4. (5 pts) A dog breeder has two chocolate labs that he mates every year. Offspring produced from the matings are recorded: 34 are chocolate and 12 are yellow. What are the genotypes of the 2 chocolate colored parents? **Show the cross to prove it.**

Period _____ Name _____

Genetics Practice Problems - Extra Credit Problems (5 points each)

1. Use your answer to the question about the dog breeder who breeds the chocolate labs from the LAB questions. Use the Chi-square test to confirm that the observed ratio is in fact a good fit to the expected ratio. **SHOW ALL YOUR WORK. - be neat!**

2. Problem: A large ear of corn has a total of 433 grains, including 271 Purple & Smooth, 73 Purple & Shrunken, 63 Yellow & Smooth, and 26 Yellow & Shrunken.

Your Tentative Hypothesis: This ear of corn was produced by a dihybrid cross, (PpSs x PpSs) involving two pairs of heterozygous genes resulting in a theoretical (expected) ratio of 9:3:3:1.
Objective: Test your hypothesis using **chi square** and **probability** values. **SHOW ALL YOUR WORK.**

3. Problem: In a certain reptile, eyes can be either black or yellow. Two black eyed lizards are crossed, and the result is 72 black eyed lizards, and 28 yellow-eyed lizards.

Your Tentative Hypothesis: The black eyed parents were Bb x Bb.
Objective: Test your hypothesis using chi square analysis. In this set, because only two values (traits) are examined, the degrees of freedom (*df*) is 1. **SHOW ALL WORK!**