

AP Biology/ Corn Genetics Lab Activity Name _____

Part I: Doing Chi-square calculations

An important question to answer in any genetic experiment is how can we decide if our data fits any of the Mendelian ratios we have discussed. A statistical test that can test out ratios is the Chi-Square or Goodness of Fit test.

Chi-Square Formula

$$\chi^2 = \sum \frac{(\text{Observed Value} - \text{Expected Value})^2}{(\text{Expected Value})}$$

Degrees of freedom (df) = n-1 where n is the number of classes

A Chi-Square Table

Degrees of Freedom	.99	.95	.80	.50	.20	.05	.01
1	0.000157	.00393	.0642	0.455	1.642	3.841	6.635
2	0.020	1.03	0.446	1.386	3.219	5.991	9.210
3	0.115	0.352	1.005	2.366	4.642	7.815	11.345
4	0.297	0.711	1.649	3.357	5.989	9.488	13.277

Calculate the chance that the deviation from the values in the following crosses are due to random chance alone.

1.) The genotypic ratio of a cross between a hybrid tall pea plants shows the following results

- 34 pure tall pea plants
- 35 hybrid tall pea plants
- 31 pure short pea plants

Calculate the chance that the deviation from the expected values in this cross are due to random chance alone.

- 2.) A large American family has 7 boys and 5 girls. Calculate the chance that the deviation from expected values in this cross are due to random chance alone.
- 3.) If there is a deviation from expected values in a genetic cross that is not due to random chance, what process is a likely culprit for this deviation from expected results. Hint: The answer may be related to the process of meiosis.

Part II: Analysis of Corn Crosses

A cross between individuals that involves one pair of contrasting traits is called a **monohybrid cross**. First we will use **Punnett square** diagrams to predict the results of various monohybrid crosses. We will then examine ears of corn Purple results from the dominant allele (**P**), and yellow from the recessive allele (**p**). We will be making observations and assumptions for both the **genotype** or genetic make-up, and the **phenotype** or external appearance.



MATERIALS:

Appropriate ears of corn such as: heterozygous X heterozygous 3:1, and a monohybrid test cross 1:1.

PROCEDURE:

1. Obtain an ear of corn that is the result of **Heterozygous X Heterozygous**. Count and record the kinds of kernels indicated by your instructor and record the numbers. Also record the total number of kernels.
2. Determine the percentage of each kernel type represented by your calculations.

3. Complete a Chi-square computation to analyze the probability your results are reasonable.

Part III. Dihybrid Cross:

A dihybrid cross is a cross between individuals that involves two pairs of contrasting traits. Predicting the results of a dihybrid cross is more complicated than predicting the results of a monohybrid cross. All possible combinations of the four alleles from each parent must be considered. We will examine a dihybrid cross involving both color and texture. Purple (**P**), is dominant to yellow (**p**), and smooth texture (**S**) is dominant to wrinkled (**s**). Both parent plants are **heterozygous** for both traits.



MATERIALS:

Appropriate ear of corn; heterozygous X heterozygous 9:3:3:1, purple/yellow, starchy/sweet.

PROCEDURE:

Theoretical: First let us use a **Punnett square** to examine the theoretical outcome of the **Heterozygous X Heterozygous** dihybrid cross.

1. Fill in the Punnett square. Each box represents a genotype possibility for an offspring. Place the alleles donated by each parent in the corresponding box. One offspring has been done for you as an example. Now list the possible phenotypes in the spaces below the Punnett square. **REMEMBER:** a phenotype is how the offspring will look. If an individual's genotype is heterozygous, the dominant trait will be expressed in the phenotype. There are **four** possible phenotypes for the offspring of this cross, and both traits are in each phenotype. One has been done for you as an example.

Now show the ratio of the phenotypes. For this, it is simply the number of possible individuals with each phenotype.

Heterozygous X Heterozygous

		Heterozygous parent (PpSs)			
		PS	P _s	pS	ps
Heterozygous parent (PpSs)	PS			PpSS	
	P _s				
	pS				
	p _s				

Phenotype: Purple Smooth _____ _____ _____

Ratio: _____ : _____ : _____ : _____

Actual cross: Now we will make a count of an actual cross and compare the calculations of it's phenotype ratios to the theoretical.

2. Obtain an ear of corn that is the result of a cross that was **Heterozygous X Heterozygous** for both traits. Copy the four phenotypes in the appropriate blanks, then count and record the number of kernels for each phenotype.

Now calculate the ratio for the cross. The phenotype with the least number of individuals you will call **1**. Place the **1** in the space below the appropriate phenotype. Now divide the other count numbers by the number of individuals from the phenotype you called 1, and round your answers to the nearest whole number. Put the answers under the appropriate phenotypes.

Phenotype				
Actual Number				
Observed Ratio				
Expected Ratio				

Compare your results with the theoretical answers you obtained for the cross. Did you obtain a ratio in your experiment that was close to the theoretical? Use the chi square computation to justify your answer.

[Additional Problems]

1. Purple (**P**), is dominant to yellow (**p**), and smooth texture (**S**) is dominant to wrinkled (**s**). Both parent plants are **heterozygous** for both traits.



A cross of two dihybrid corn plants produced the following results.

- 256 smooth, purple kernels
- 62 wrinkled purple kernels
- 67 smooth, yellow kernels
- 15 wrinkled, yellow kernels

a.) Show the theoretical results of this cross including your punnett square, genotypic and phenotypic ratios, and all work.

b.) Complete the Chi-square analysis of this cross ... showing all work ... and justification of whether or not these results are probable.

2. (a.) What are transposons?

(b.) All of our "purple" corn kernels were not purple, but had varying colors from purple. Explain this phenomenon.