Laboratory Exercise 11 - Mendelian Genetics (Monohybrid Cross, Dihybrid Cross and χ^2 Analysis)

I. Monohybrid Cross: Count the yellow and purple kernels for 3 ears of corn from the "3:1" collection. These are the result of a **monohybrid cross** (two heterozygous parents) and we expect a ratio of 3 dominant phenotypes to 1 recessive phenotype.

	Purple Counted	Yellow Counted
Ear 1		
Ear 2		
Ear 3		
Total		
	Overall Total (Add both Totals from above)	

II. Test Cross: Count the yellow and purple kernels for 3 ears of corn from the "1:1" collection. These are the result of a **test cross** (two heterozygous parents) and we expect a ratio of 1 dominant phenotype to 1 recessive phenotype.

	Purple Counted	Yellow Counted
Ear 1		
Ear 2		
Ear 3		
Total		
	Overall Total (Add both Totals from above)	

III. Dihybrid Cross: Count the kernels for 3 ears of corn from the "9:3:3:1" collection. These are the result of a **dihybrid cross** (two heterozygous parents for two traits) and we expect a ratio of 9 dominant/dominant: 3 dominant/recessive: 3 recessive/dominant: 1 recessive/recessive.

	Purple / Smooth	Purple / Rough	Yellow / Smooth	Yellow / Rough
Ear 1				
Ear 2				
Ear 3				
Total				
			Overall Total (Add all Totals from above)	

Refer to http://waynesword.palomar.edu/lmexer4.htm for a nice discussion of chi-square analysis of a dihybrid cross.

Table 1. Probability Values from (http://waynesword.palomar.edu/lmexer4.htm)

Good Fit Between Ear & Data							Poor Fit	
df	**.90**	**.70**	**.60**	**.50**	**.20**	**.10**	**.05**	**.01**
1	**.02**	**.15**	**.31**	**.46**	**1.64**	**2.71**	**3.85**	**6.64**
2	**.21**	**.71**	**1.05**	**1.39**	**3.22**	**4.60**	**5.99**	**9.21**
3	**.58**	**1.42**	**1.85**	**2.37**	**4.64**	**6.25**	**7.82**	**11.34**
4	**1.06**	**2.20**	**2.78**	**3.36**	**5.99**	**7.78**	**9.49**	**13.28**

Chi-Squared Analysis

I. Monhybrid Cross (expected 3:1 phenotypic ratio)

Phenotype	Observed # (O)	Expected Results (E)	Difference (d) =(E – O)	Difference Squared (d^2)	Standardized Squared Deviation (d^2/E)
Purple					
Yellow					
					$\chi 2=$

$\chi 2=$ sum (**d^2/E**)

II. Test Cross (expected 1:1 phenotypic ratio)

Phenotype	Observed # (O)	Expected Results (E)	Difference (d) =(E – O)	Difference Squared (d^2)	Standardized Squared Deviation (d^2/E)
Purple					
Yellow					
					$\chi 2=$

$\chi 2=$ sum (**d^2/E**)

III. Dihybrid Cross (expected 9:3:3:1 phenotypic ratio)

Phenotype	Observed # (O)	Expected Results (E)	Difference (d)=(E – O)	Difference Squared (d^2)	Standardized Squared Deviation (d^2/E)
Purple / Smooth					
Purple / Rough					
Yellow / Smooth					
Yellow / Rough					
					$\chi 2=$

$\chi 2=$ sum (**d^2/E**)

How to Calculate Expected Values

I. Monohybrid Cross (3:1)

1. Use the Overall Total number of kernels counted.

2. Take that total and multiply it by 3/4 (0.75). This will give you the expected value for the purple kernels.

3. Take the total from #1 and multiply it by ¼ (0.25). This will give you the expected value for the yellow kernels.

II. Test Cross (1:1)

1. Use the Overall Total number of kernels counted.

2. Take that total and multiply it by ½ (0.5). This will give you the expected value for the purple kernels.

3. Take the total from #1 and multiply it by ½ (0.5). This will give you the expected value for the yellow kernels.

III. Dihybrid Cross (9:3:3:1)

1. Use the Overall Total number of kernels counted.

2. Take that total and multiply it by 9/16 (0.5625). This will give you the expected value for the purple/smooth kernels.

3. Take the total from #1 and multiply it by 3/16 (0.1875). This will give you the expected value for the purple/rough kernels.

4. Take the total from #1 and multiply it by 3/16 (0.1875). This will give you the expected value for the yellow/smooth kernels. This should be the same number as you calculated for # 3 above.

5. Take the total from #1 and multiply it by 1/16 (0.0625). This will give you the expected value for the yellow/rough kernels.