The Chi-Square Test

An important question to answer in any genetic experiment is how we can 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 test. The Chi-square analyzes if your observed value is *significantly different* from the expected value.

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 phenotypes

H_0 = null hypothesis: The expected phenotypic ratio is 9:3:3:1 ratio.

Observed Values	Expected Values
315 Round, Yellow Seed	(9/16)(556) = 312.75 Round, Yellow Seed
108 Round, Green Seed	(3/16)(556) = 104.25 Round, Green Seed
101 Wrinkled, Yellow Seed	(3/16)(556) = 104.25 Wrinkled, Yellow
32 Wrinkled, Green	(1/16)(556) = 34.75 Wrinkled, Green
556 Total Seeds	556.00 Total Seeds

$$\chi^2 = \frac{(315 - 312.75)^2}{312.75} + \frac{(108 - 104.25)^2}{104.25} + \frac{(101 - 104.25)^2}{104.25} + \frac{(32 - 34.75)^2}{34.75}$$

Chi-square value = 0.47

Number of phenotypes (n) = 4 df = n-1 + 4-1 = 3

Enter the Chi-Square table at df = 3 and we see the probability of our chi-square value is greater than 0.90. By statistical convention, we use the 0.05 probability level as our critical value. If the calculated chi-square value is less than the 0 .05 value, we accept the hypothesis. If the value is greater than the critical value, we reject the hypothesis. Threrefore, because the calculated chi-square value is less than the critical value, we accept the hypothesis that the data fits a 9:3:3:1 ratio.