Chi-Square Test

1. A fundamental problem in genetics is demining whether the _____ fits the results expected from theory. How can you tell if an _____ of offspring counts is legitimately the result of a giving _____.

    - For example, you do a cross and see 290 purple flowers and 110 white flowers in the offspring.
    - This is pretty close to a 3/4 : 1/4 ratio, but how do you formally define "pretty close"? What about 250:150?

The Chi-Square test is a "_____" test. It answers the question of how well do _____.

To begin a Chi-Square you must start with a_____

For our example the null hypotheses is that the offspring will appear in a ratio of $\frac{3}{4}$ dominant to $\frac{1}{4}$ recessive

HOW TO CALCULATE CHI-SQUARE

- Determine the number of each _____ that have been observed and how many would be _____ given basic genetic theory
-
- Calculate the Chi-Square using this formula

$$X^2 = \sum \frac{(obs - \exp)^2}{\exp}$$

- "X" is chi, Σ is sigma the means to sum the following terms for all phenotypes. "obs" is the number of individuals of the given phenotype observed, "exp" is the number of that phenotype expected from the null hypotheses

Example

- ☐ As an example, you count F2 offspring, and get 290 purple and 110 white flowers.
  - ☐ This is a total of _____ offspring.
  - ☐ We expect a _____ ratio. We need to calculate the expected numbers (you MUST use the numbers of offspring, NOT the proportion!!!); this is done by multiplying the total offspring by the expected proportions.

    _____purple and _____ white.
  - ☐ Thus, for purple, obs = _____ and exp = _____.
  - ☐ For white, obs = _____ and exp = _____
- ☐ Now it's just a matter of plugging into the formula:

X^2 =

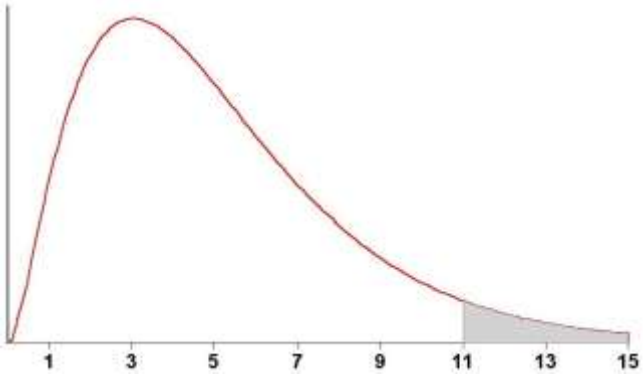
=

=

=

=

- ☐ This is our chi-square value: now we need to see what it means and how to use it.



- ☐ Note that all the values are greater than 0: that's because we squared the (obs - exp) term: _____.
- ☐ Sometimes you get really wild results, with obs very different from exp: the long tail on the graph. Really odd things occasionally do happen by _____ (for instance, you might win the lottery).

- ☐ A _____ in using the chi-square test is the "degrees of freedom", which is essentially the number of independent random variables involved.
- ☐ Degrees of freedom is simply the number of classes of offspring minus 1.

For our example, there are 2 classes of offspring: purple and white. Thus, degrees of freedom (d.f.) =

- ☐ Critical values for chi-square are found on tables, sorted by degrees of freedom and probability levels. Be sure to use p = _____.
- ☐ If your calculated chi-square value is greater than the critical value from the table, you "_____".
- ☐ If your chi-square value is less than the critical value, you "_____" (that is, you accept that your genetic theory about the expected ratio is correct).

Table 5-2
Critical Values of the χ^2 Distribution

df \ p	0.995	0.975	0.9	0.5	0.1	0.05	0.025	0.01	0.005	df
1	.000	.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879	1
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597	2
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838	3
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860	4
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750	5
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548	6
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278	7
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955	8
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589	9
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188	10
11	2.603	3.816	5.578	10.341	17.275	19.675	21.920	24.725	26.757	11
12	3.074	4.404	6.304	11.340	18.549	21.026	23.337	26.217	28.300	12
13	3.565	5.009	7.042	12.340	19.812	22.362	24.736	27.688	29.819	13
14	4.075	5.629	7.790	13.339	21.064	23.685	26.119	29.141	31.319	14
15	4.601	6.262	8.547	14.339	22.307	24.996	27.488	30.578	32.801	15