**The 2 Test Practice Problem** **Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ #\_\_\_\_ Blk \_\_\_**

**Use this test when:**

The measurements relate to the number of individuals in particular categories;

The **observed** number (data collected in lab) can be compared with an **expected** number (Punnett square) which is calculated from a theory.

The 2 test is a statistical test to compare observed results with theoretical expected results.

The calculation generates a 2 value; the higher the value of 2, the greater the difference between the observed and the expected results.

**1. State the null hypothesis**

This is a statement, basically saying that there is no statistical difference between the observed and the expected results.

Ex- There is no difference between the observed results and the expected results.

**2. Calculate the expected value**

This may be the mean of the expected values.

**Or, when studying inheritance**, **you add up the expected values and apply a ratio**.

**3. Calculate 2**

The formula is: 2 = ∑ (o-e)2

 e

 o = observed value

e = expected value

 ∑ = the sum of

**4. You will also need to know the degrees of freedom.**

* This is calculated using the formula (n-1)
* where n = the number of sets of results.

**5. Compare the 2 value against a table of critical values.**

* Refer to the degrees of freedom
* Look up the critical number at the p = 0.05 level

**6. Make a conclusion:**

* Biologists need to feel confidence in their results in order to say that a difference occurred due to a biological reason.
* They will only “accept” this if they have greater than 95% confidence.
* If they have less than 95% confidence, they are only willing to say that the difference between the results occurred due to chance alone.
* If the number exceeds the critical number at the 0.05 level then, as a biologist, you can reject the null hypothesis.
* If the 2 value is less than the critical number then you can fail to reject (meaning, accept) the null hypothesis.
* If the calculated value is greater than the critical value, the null hypothesis is rejected and there is a significant difference between the observed and expected results at the 5% level of probability.

**Chi-squared test example**

Naked mole rats are a burrowing [rodent](http://en.wikipedia.org/wiki/Rodent) native to parts of East Africa[.](http://en.wikipedia.org/wiki/East_Africa) They have a complex social structure in which only one female (the queen) and one to three males reproduce, while the rest of the members of the colony function as workers. Mammal ecologists suspected that they had an unusual male to female ratio. They counted the numbers of each sex in one colony.

|  |  |
| --- | --- |
| Sex |  Number of animals  |
| Female |  52 |
| Male |  34 |

**State the Null hypothesis**

**Calculate the expected results (SHOW WORK)**

**Calculate the chi-squared value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sex |  Observed  |  Expected  |  O - E |  (O – E)2 |  (O – E)2/E |
| Female |  52 |  |  |  |  |
| Male |  34 |  |  |  |  |
|  TOTAL |  |  |  |  |  |

 2 =

**What are the degrees of freedom?**

DF =

**Compare the calculated value with the critical value**

|  |  |
| --- | --- |
|  Degrees of freedom |  Significance level  |
|    |  5% (.05) | 2% (.02) | 1% (.01) |
|  1 |  3.84 | 5.41 | 6.64 |
|  2 | 5.99 | 7.82 | 9.21 |

**Make a conclusion** *(\*Remember, you must either ‘fail to reject’ or ‘reject’ the null hypothesis. State the reason(s) for whichever one you choose)*