Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_

**Mitosis Chi Square Activity**

AP Biology, U6P1

**Background:** In this activity, you will receive two cards showing cells from onion root tips. The DNA within the cells has been stained to make it visible. You will be counting the number of cells that are in interphase vs. mitosis on each of the cells.

One of the cards (A) shows cells that have been treated with a protein called lectin that was extracted from kidney beans. The other card (B) shows cells that have not been treated with lectin.

By counting the cells in interphase vs. mitosis on each card, we are trying to determine if lectin affects the rate of mitosis in onion root tips.

**Hypotheses:** Identify the null hypothesis and alternate hypothesis for this activity.

***Null Hypothesis:***

***Alternate Hypothesis:***

**Procedure:** When counting the number of cells in interphase vs. mitosis, look for the following indicators.

|  |  |  |
| --- | --- | --- |
| **Stage of the Cell Cycle** | **Picture** | **Explanation** |
| Interphase |  | The DNA in the nucleus appears blurry because it is still uncoiled (chromatin).  |
| Mitosis (specifically prophase)  |  | The chromatin has coiled up into chromosomes, which is why we see distinct solid lines in the nucleus.  |
| Mitosis (specifically metaphase)  |  | The chromosomes are lining up at the center of the dividing cell.  |
| Mitosis (specifically anaphase) |  | The chromatids in each chromosome have been split and are moving to opposite ends of the dividing cell.  |
| Mitosis (specifically telophase) |  | The daughter chromosomes have reached opposite ends of the dividing cell. The chromosomes are starting to uncoil into chromatin because the nucleus appears a little blurry, though there are still dark lines inside the nucleus. A cell plate has appeared between the two daughter cell nuclei. We would still count this as one cell undergoing mitosis. Note: If the nuclei were completely blurry, it would be more accurate to say that the there were two separate cells (each in interphase).  |

***Note: Do not count cells that appear empty. These cells may not have taken in enough stain to make the DNA visible, or the slice of onion root tissue that was prepared for the microscope slide did not include the portions of these cells that contained DNA.***

**Data:** Record your cell counts for card A and card B in Table 1 below. Then, determine the percentage of cells from each card that are in interphase vs. mitosis. Record these percentages in Table 2.

***Table 1. Number of Cells in Interphase vs. Mitosis***

|  |  |  |  |
| --- | --- | --- | --- |
|  | # of Cells in Interphase | # of Cells in Mitosis | Total Number of Cells on Card |
| Treated with Lectin (A) |  |  |  |
| Untreated (B)  |  |  |  |

***Table 2. Percent of Cells in Interphase vs. Mitosis***

|  |  |  |
| --- | --- | --- |
|  | % of Cells in Interphase | % of Cells in Mitosis |
| Treated with Lectin (A) |  |  |
| Untreated (B)  |  |  |

**Chi Square Analysis:**

1. ***Determining the observed and expected values.***

The cells treated with lectin (Card A) will represent our observed values. Remember, we must use whole numbers of cells from Table 1 for observed values rather than the percentages of cells from Table 2.

We will determine our expected values based on the data from the untreated cells (Card B). However, we must make sure our total number of cells is the same as the total number of cells from our observed values. Therefore, we will take the percentage of untreated cells (Card B) in interphase and mitosis and multiply each by the total number of cells from the observed values (i.e., the total number of cells on Card A). ***We will then round these values to the nearest whole number of cells.***

***B. Calculate 2***

* The formula is: $X^{2}=\frac{(o-e)^{2}}{e}$
* Where o = observed value, e = expected value, and ∑ = the sum of
* So you would need to calculate $\frac{(o-e)^{2}}{e}$ separately for each data set (ex: interphase vs. mitosis cells) and then add the results together

|  |  |  |  |
| --- | --- | --- | --- |
| Data Set | o | e | $$\frac{(o-e)^{2}}{e}$$ |
| Cells in Interphase |  |  |  |
| Cells in Mitosis |  |  |  |
| $X^{2}$ (sum of all values from the last column together) |  |

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

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

How many degrees of freedom do you have for this experiment? \_\_\_\_\_\_\_\_\_\_\_\_\_

***D. Compare the X2 value against a table of critical numbers.***

* On the table to the right, refer to the row that corresponds to the correct number of degrees of freedom for your data set
* Look up the critical number at the p = 0.05 level. “p” stands for probability

***E. Make a conclusion***

* If the X2 value that you calculated in Step 3 is higher than the critical number at the p = 0.05 level then you can reject the null hypothesis. In other words, there is a statistically significant difference between the observed and expected results. (i.e. the observed results do not match the expected results)

*Note: A high X2 value corresponds with a low p value (below 0.05)*

* If the X2 value is less than the critical number then you fail to reject the null hypothesis. In other words, there MAY NOT be a statistically significant difference between the observed and expected results (i.e., any differences between the observed and expected results are probably due to chance alone.)

*Note: A low X2 value corresponds with a high p value (above 0.05)*

What is your conclusion for this Chi square test? (Do you reject or fail to reject the null hypothesis?)

What does that mean in the context of this experiment? Does the data indicate that lectin affects the rate of mitosis in onion root tip cells? If so, does lectin increase or decrease the rate of mitosis?