Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_

**CHI-SQUARE (χ2) WORKSHEET**

# GWHS AP BIOLOGY

Genetics use a statistical test called a chi square test to see if the results of a cross match the expected results. The scientist states a null hypothesis is tested mathematically. The null hypothesis states that there is no difference between the observed ratio and the expected ratio.

**P generation:** Round & Yellow **x** Wrinkled & Green

F1: Round & Yellow **x** Wrinkled & Green

(Testcross)

(Genotypes) \_\_\_\_\_\_\_\_\_\_\_\_ **x** \_\_\_\_\_\_\_\_\_\_\_\_

**F2 Phenotypes:**  **F2 Genotypes: Expected Ratio:**

1. = =
2. = =
3. = =
4. = =

## Chi-Square Formula

χ2 = Sum of -----------------------

**or**

χ2 = Σ --------

(observed – expected)2

expected

(o – e)2

e

**Use this table to calculate your chi-square.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phenotype | Observed (o) | Expected (e) | (o-e) | (o-e)2 | (o-e)2  ---------  e |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Sum (Σ) = \_\_\_\_\_\_

Degrees of Freedom (# of classes – 1) = \_\_\_\_\_\_\_\_\_

P (from table) = \_\_\_\_\_\_\_\_

**Table of Chi-square values.** To use this table find the location of your sum **(Σ)** on this table and read the corresponding **P** from the top row. \*Biologists generally accept P=. 05 as the cutoff for accepting or rejecting a hypothesis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Degrees of Freedom | P = .95 | P = .90 | P = .70 | P = .50 | P = .30 | P = .20 | P = .10 | P = .05 | P = .01 | P = .001 |
| 1 | 0.004 | 0.016 | 0.15 | 0.46 | 1.07 | 1.64 | 2.71 | 3.84 | 6.64 | 10.83 |
| 2 | 0.10 | 0.21 | 0.71 | 1.39 | 2.41 | 3.22 | 4.61 | 5.99 | 9.21 | 13.82 |
| 3 | 0.35 | 0.58 | 1.42 | 2.37 | 3.67 | 4.64 | 6.25 | 7.82 | 11.35 | 16.27 |
| 4 | 0.71 | 1.06 | 2.20 | 3.36 | 4.88 | 5.99 | 7.78 | 9.49 | 13.28 | 18.47 |
| 5 | 1.15 | 1.61 | 3.00 | 4.35 | 6.06 | 7.29 | 9.24 | 11.07 | 15.09 | 20.52 |
| 6 | 1.64 | 2.20 | 3.83 | 5.35 | 7.23 | 8.56 | 10.65 | 12.59 | 16.81 | 22.46 |
| 7 | 2.17 | 2.83 | 4.67 | 6.35 | 8.38 | 9.80 | 12.0 | 14.07 | 18.48 | 24.32 |
| 8 | 2.73 | 3.49 | 5.53 | 7.34 | 9.52 | 11.03 | 13.36 | 15.51 | 20.09 | 26.13 |

**Accept Reject**

Compare you calculated value to the value in the P=. 05 columns.

* If your calculated value is **less** then this value your results have a GREATER then a 95% chance of fitting the expected ratio.
* If your calculated value is **greater** than this value your results have LESS than a 95% chance of fitting the expected ratio.

**Question:** Does your χ2 test result support the conclusion that the data fit the expected ratio? Explain. (Remember that biologists consider a P of .05 or less as statistically significant.)

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per. \_\_\_\_\_

**CHI-SQUARE (χ2) WORKSHEET**

# GWHS AP BIOLOGY

Genetics use a statistical test called a chi square test to see if the results of a cross match the expected results. The scientist states a null hypothesis is tested mathematically. The null hypothesis states that there is no difference between the observed ratio and the expected ratio.

**P generation:** Brown Hair & No Freckles **x** Red Hair & Freckles

F1: Brown & No Freckles **x** Red & Freckles

(Testcross)

(Genotypes) \_\_\_\_\_\_\_\_\_\_\_\_ **x** \_\_\_\_\_\_\_\_\_\_\_\_

**F2 Phenotypes:**  **F2 Genotypes: Expected Ratio:**

1. = =
2. = =
3. = =
4. = =

## Chi-Square Formula

χ2 = Sum of -----------------------

**or**

χ2 = Σ --------

(observed – expected)2

expected

(o – e)2

e

**Use this table to calculate your chi-square.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phenotype | Observed (o) | Expected (e) | (o-e) | (o-e)2 | (o-e)2  ---------  e |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Sum (Σ) = \_\_\_\_\_\_

Degrees of Freedom (# of classes – 1) = \_\_\_\_\_\_\_\_\_

P (from table) = \_\_\_\_\_\_\_\_

**Table of Chi-square values.** To use this table find the location of your sum **(Σ)** on this table and read the corresponding **P** from the top row. \*Biologists generally accept P=. 05 as the cutoff for accepting or rejecting a hypothesis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Degrees of Freedom | P = .95 | P = .90 | P = .70 | P = .50 | P = .30 | P = .20 | P = .10 | P = .05 | P = .01 | P = .001 |
| 1 | 0.004 | 0.016 | 0.15 | 0.46 | 1.07 | 1.64 | 2.71 | 3.84 | 6.64 | 10.83 |
| 2 | 0.10 | 0.21 | 0.71 | 1.39 | 2.41 | 3.22 | 4.61 | 5.99 | 9.21 | 13.82 |
| 3 | 0.35 | 0.58 | 1.42 | 2.37 | 3.67 | 4.64 | 6.25 | 7.82 | 11.35 | 16.27 |
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| 8 | 2.73 | 3.49 | 5.53 | 7.34 | 9.52 | 11.03 | 13.36 | 15.51 | 20.09 | 26.13 |

**Accept Reject**

Compare you calculated value to the value in the P=. 05 columns.

* If your calculated value is **less** then this value your results have a GREATER then a 95% chance of fitting the expected ratio.
* If your calculated value is **greater** than this value your results have LESS than a 95% chance of fitting the expected ratio.

**Question:** Does your χ2 test result support the conclusion that the data fit the expected ratio? Explain. (Remember that biologists consider a P of .05 or less as statistically significant.)