# Lab 10: Microevolution and Natural Selection Lab Response Form

## Name and Course Section:

## Curiosity and Inquiry

“Why and how does a bacterium evolve to become a drug-resistant bacteria, like *A. baumannii*?”

## Formulating a Hypothesis

1. Develop a hypothesis based on the question above.
2. You will model 10 generations of a bacterial population with three alleles: least drug-resistant, drug-resistant, and most drug-resistant. The population will be exposed to antibiotics in each generation.

Prediction #1: Based on the scenario above, what do you predict the allele frequencies will look like by generation 10? In other words, will genetic diversity increase or decrease in the population?

## Testing the Hypothesis: Designing an Experiment

### Questions

1. What are the**independent** and **dependent variables**?
2. Which group represents the**control group**?
3. Which group represents the **experimental group**?
4. What are the starting **sample sizes** of your control and experimental groups?
5. How many replications are done in both the control and experimental groups?
6. What does procedure step #6 represent in the bacteria population?

## Testing the Hypothesis: Data Collection

1. **Table 10.1: Control Group Data Table**

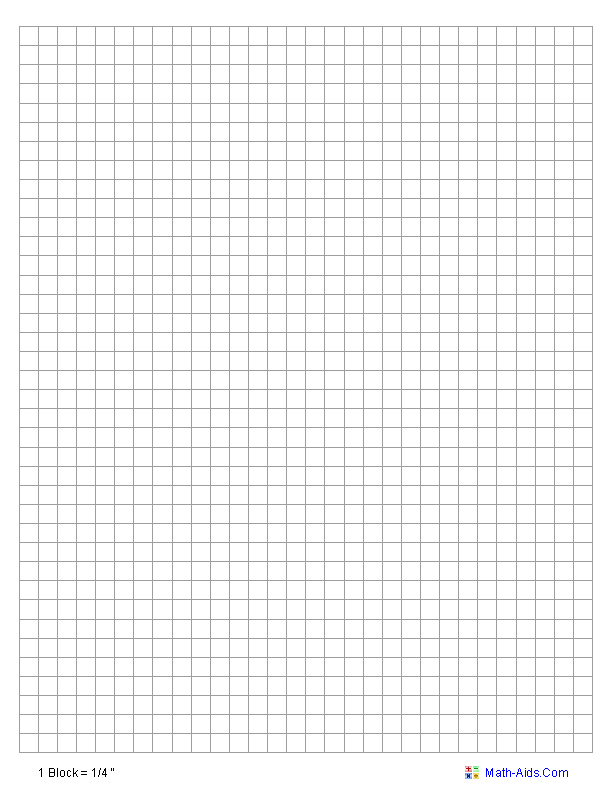
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Generation | Bacteria Trait and Allele | Start Population Allele Frequency (%) | # of individuals that died | # of individuals that survived | End population Allele Frequency (%) |
| 1 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 2 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 3 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 4 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 5 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 6 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 7 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 8 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 9 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 10 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |

1. **Table 10.2 Experimental Group Data Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Generation | Bacteria Trait and Allele | Start Population Allele Frequency (%) | # of individuals that died | # of individuals that survived | End population Allele Frequency (%) |
| 1 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 2 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 3 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 4 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 5 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 6 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 7 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 8 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 9 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |
| 10 | Least resistant (A) |  |  |  |  |
|  | Resistant (B) |  |  |  |  |
|  | Most resistant (C) |  |  |  |  |

## Interpreting and Visualizing Your Data

1. Now plot the data that your group collected. Label the **X** and **Y axes** and choose the appropriate number scale for each axis. Display the end population allele frequency for each generation between the control and experimental groups. Your instructor will inform you if they wish for you to manually or automatically create the graph. Refer to Appendix 1 for instructions on using Google Sheets to graphs with standard deviation bars. However, you can use any program that you are most comfortable with. *Helpful Tip: Apply your knowledge about independentand dependent variables when labeling the axes.*



1. What is the allele frequency from the starting population in generation 1?
2. What is the allele frequency from the end population in generation 10?
3. Do you notice patterns in the allele frequency throughout all generations?

## Interpreting and Visualizing the Class Data

1. What are the **mean** and**standard deviation** of the control group? (Your instructor will inform you if they wish for you to manually or automatically calculate the measures. Refer to Appendix 1 for instructions on using Google Sheets to automatically calculate measures. However, you can use any program that you are most comfortable with. to calculate allele frequency.)

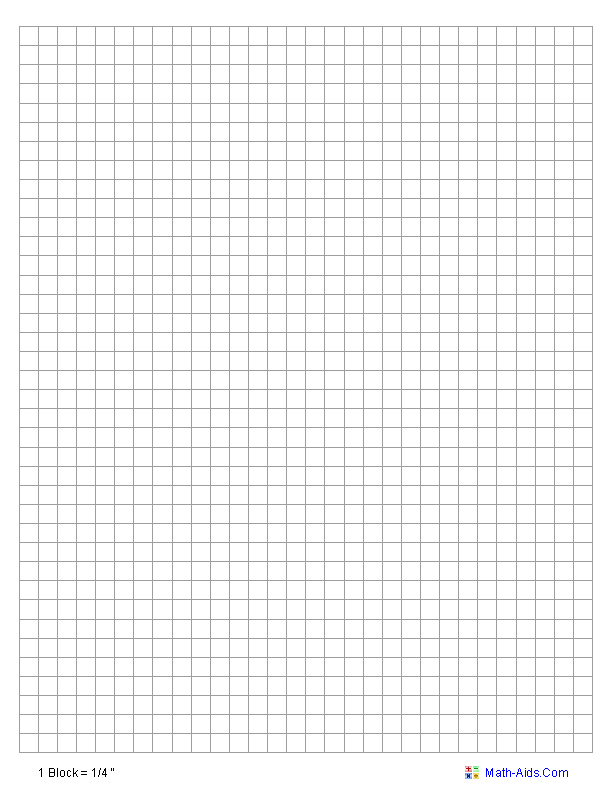
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Start Population Allele Frequency (%) of Least Resistant generation 1 | End population Allele Frequency (%) of Least Resistant generation 10 | Start Population Allele Frequency (%) of Resistant generation 1 | End population Allele Frequency (%) of Resistant generation 10 | Start Population Allele Frequency (%) of Most Resistant generation 1 | End population Allele Frequency (%) of Most Resistant generation 10 |
| Mean |  |  |  |  |  |  |
| Standard Deviation |  |  |  |  |  |  |

1. What are the mean and standard deviation of the experimental group?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Start Population Allele Frequency (%) of Least Resistant generation 1 | End population Allele Frequency (%) of Least Resistant generation 10 | Start Population Allele Frequency (%) of Resistant generation 1 | End population Allele Frequency (%) of Resistant generation 10 | Start Population Allele Frequency (%) of Most Resistant generation 1 | End population Allele Frequency (%) of Most Resistant generation 10 |
| Mean |  |  |  |  |  |  |
| Standard Deviation |  |  |  |  |  |  |

### Class Data Analysis and Graphing

1. Now plot the data that the class collected. Label the X and Y axes and choose the appropriate number scale for each axis. Graph the mean and the standard deviation bars of both the control and experimental groups. Your instructor will inform you if they wish for you to manually or automatically create the graph. Refer to Appendix 1 for instructions on using Google Sheets to graphs with standard deviation bars. However, you can use any program that you are most comfortable with.



1. Do you notice patterns between the independent and dependent variables? Explain the relationship.

## Making a Conclusion

1. Do your results validate or reject your group’s hypothesis? Why or why not?
2. Do your data display the same relationship as the class data? If not, describe the difference(s).
3. When analyzing the data, would you use your data or the class data to formulate your conclusions? Why?
4. Does the class data validate or reject your group’s hypothesis? Why or why not?

Using the class data, answer the following questions:

1. Which population had the greatest genetic diversity by the 10th generation?
2. Which population had the greatest allele C frequency by the 10th generation?
3. Which organism had the greatest fitness by generation 10 in the experimental group? How did the organism achieve this?
4. What was the selective pressure or agent in the activity and which group was not under selective pressure?
5. Which microevolution mechanism favored the increased fitness and adaptiveness of the bacterial trait?
6. Which mode of natural selection does the phenotype/genotype best represent in both the control and experimental groups?
7. Does a prevalent trait in the experimental group make this organism adapt perfectly to its habitat? Why?
8. Do you feel that doctors should be prescribing antibiotics for pathologies other than bacterial infections? Justify your stance with an evidence-based argument based on this activity.
9. Based on what you have learned in this activity, how would you educate others about why evolution is important?
10. According to Diancourt, et al., their study suggests that one of the *A. baumannii*clones may spread through the bottleneck effect. What is the bottleneck effect and how would this microevolutionary mechanism cause outbreaks in hospitals?