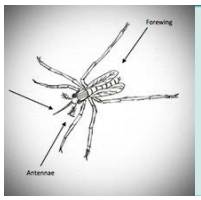

OVERVIEW

These guidelines support the experimental design and reporting requirements for the investigation in the activity Battling Vector-Borne Diseases: Factors That Affect the Mosquito Life Cycle.

EXPERIMENTAL DESIGN CONSIDERATIONS

Question: After preliminary observations or brainstorming, scientists generate questions about the topic under study.

Hypothesis: A hypothesis is a possible answer to a question or an explanation for some currently unexplained phenomenon. Good hypotheses are testable and falsifiable. Because we can never test every possible factor that might influence the outcome of an experiment, hypotheses are never proved right, but they can be supported or rejected by experimental data.

An example of a hypothesis is: Increasing the amount of sunlight will cause a garden pea plant to grow taller.

Variables: Variables are factors that might be expected to change during the course of an experiment. The investigator deliberately changes (manipulates) the **independent variable** (e.g., sunlight in the hypothesis above) to learn how these changes affect the **dependent variable** (e.g., the height of a plant). The investigator tries to hold other variables (the **controlled variables**) constant so that any changes in the dependent variable(s) can be attributed to changes in the independent variable.

Controlled variables might include water and temperature in the example above.

Controls: A simple experimental design involves two groups, one called the **experimental (or treatment) group** and the other the **control (or comparison) group**. In a way, they are like two experiments run simultaneously. Each group is treated exactly the same way with one exception: the independent variable is manipulated in the experimental group. The control treatment may involve setting the independent variable at a normal or standard value. The results from the control and experimental groups are then compared.

Random samples: Because an investigator usually cannot work with an entire population of organisms, he or she must instead rely on a **sample** (subset) of the population. Individuals should then be **randomly assigned to control and treatment groups**. Random assignment will make it more likely that those two groups are comparable in all variables that are the result of individual differences. If the two groups are different from the outset and they respond differently to treatment during the experiment, then you cannot be sure that the independent variable that you manipulated is the cause of the difference.

REPORT WRITING GUIDELINES

The experimental investigation lab report must be typed, double-spaced, and in a 12-point font. It should also have standard margins. A complete lab report includes an appropriate title and five labeled sections:

1. **Introduction:** The introduction should provide background information and explain the motivation for the design and pursuit of your experiment. Describe what led you to ask the question that became your hypothesis. If your pre-laboratory activity included an initial brainstorming session, provide notes from that session (rewritten in a logical way). Your hypothesis must be stated in your introduction, typically as the last sentence.

2. **Materials and Methods:** This section should be written in the first person, past tense. List, in paragraph form, the items needed to conduct your experiment and describe your methodology. Report exactly what you did in enough detail to allow a naive reader to repeat your experiment.

3. **Results:** Report the data you gathered in your experiment and any calculations you performed. Include the equations you used, if any, when analyzing your data. Properly labeled tables and graphs are often the most informative, concise way to present data. Do not discuss the results in any way in this section. Simply present the data.

4. **Conclusion:** Is your hypothesis supported? Rejected? How do you know? A hypothesis is never proved right. It can only be supported or rejected by the data gathered in the experiment. A rejected hypothesis is of scientific interest because it may lead to new ideas and hypotheses. Do not just state whether your hypothesis is supported. Instead, tell the reader what evidence leads you to conclude whether the hypothesis is supported.

5. **Discussion:** This section allows the scientist to consider the implications of his or her research. Can these results be applied to solve a problem in science or society? How do the results fit into the body of scientific knowledge? How could you improve this experiment? Do not be afraid to discuss errors in scientific procedures that may have affected the results. Are there specific sources of errors that could be addressed with a more careful experimental design? Were there limitations to your experimental design that could be addressed in a future experiment (assuming you had unlimited resources)? An excellent discussion always ends with a new question that could be tested through further experimentation.

GRADING RUBRIC

Criterion	Points Possible	Points Earned
Title and Section Format (4 points)		
Typed with correct format.	2	
Has an appropriate title.	1	
Sections are labeled properly.	1	
Introduction (12 points)		
Provides background information about the general topic.	4	
Explains what observations led to the research project.	4	
Explains why the study was done.	2	
States a hypothesis.	2	
Methods and Materials (6 points)		
Provides enough information so that someone could repeat the study.	4	
Written in first person and past tense.	1	
Written in paragraph form.	1	
Results (6 points)		
Findings summarized visually with pictures, maps, illustrations, tables, and/or graphs.	4	
Tables/graphs labeled correctly.	2	
Conclusion (6 points)		
States whether hypothesis is supported or rejected by the data.	2	
Explains *why* the hypothesis is supported or rejected.	4	
Discussion (12 points)		
Discusses the implications of the work. How does it fit into the greater body of knowledge on the subject? How can the data be applied to a problem that needs a solution?	4	
Discusses limitations of experimental design and suggestions for improvements or revisions.	4	
Discusses new questions the observations/results have raised and possible ways they might be answered.	4	
Writing Skills (4 points)		
Two or fewer sentence structure or spelling errors.	4	
Total	**50**	