AP Biology Lab Reports

Your Lab Notebook

- Some labs will be worksheets that you write down data, do calculations and answer questions.
- Inquiry-based labs, where you design experiments yourself, will be done in a lab notebook.
- For a given experiment, your notes and data will be in the lab notebook, followed by the lab report.

The Lab Notebook

- The first 3 pages of the lab notebook should be reserved for the table of contents.
- Each page needs to be numbered – working pages and report pages.
- When you finish your lab report, be sure to update your table of contents.

The Lab Notebook

- Working pages can be on both sides of the page.
- Report pages on the right side page only.
- All work in the notebook should be in pen, except graphs. Cross outs are OK for lab reports.

Lab Report Format

- Convention dictates the form used in scientific reports:
    - Title
    - Introduction
    - Materials and Methods
    - Results
    - Conclusions
    - Literature Cited

Each section should begin on a separate page – leave space for my comments!!

Title (5 points)

“The Effect of (A) on (B)”

- *Example: The Effect of pH on the Activity of the Enzyme Lactase.*

- Which of these is the independent variable/dependent variable?
- Common name ***and*** scientific name of all organisms used in study should be in title

Introduction (10 pts)

a. Background (5 pts)

- Present a review of the topic. Place the research/experiment in the proper context of biology.
- Relate your experiment to the concepts learned in class. Review prior research directly related to the experiment.

Example: Protein structure determines enzyme function. The shape of the active site controls the catalytic properties of the enzyme. Because of this, most enzymes work within a narrow range of environmental/cellular conditions. In particular, changes in pH, temperature and salinity will significantly affect enzyme function but altering protein structure.

This research focused on the effect of changes in pH on enzyme activity. Changes in pH causes changes in hydrogen (H^+) and hydroxyl (OH^-) ions in solution. These changes in charge in the solution disrupt the secondary, tertiary and quaternary levels of structure of the proteins thereby changing the shape of the active site of the enzyme as the protein begins to denature.

In this research, an experiment was undertaken to test the effect of pH on the function of the enzyme lactase. Lactase digests the disaccharide milk sugar, lactose, into the monosaccharides, glucose and galactose…

b. Hypothesis (5 pts)

- “If this relationship exists, then when I change (increasing, decreasing, etc.) (A) it will cause (B) to change in a specific way (increase, decrease, etc.)
- *Example: If pH affects enzyme function, then when the pH is increased or decreased from pH 8 (the pH of the small intestines) the rate of lactose digestion by lactase will decrease.*

3. Materials and Methods (20 pts)

a. Materials

- List the materials used in the experiment.

b. Methods

- Describe the procedures in sufficient detail so that others can repeat your research.

c. Statistical Methods

- Discuss the statistical tests used to describe or test the data.

4. Results (30 pts)

a. **Dependent Variable**: State the dependent (or measured) variable, the (B) in your hypothesis. It must have units and must be measurable.

- *Example: The dependent variable is the production of glucose (the product of lactose digestion) in grams per mL of milk.*

Independent Variable

- State the independent (or manipulated) variable, the (A) in your hypothesis.
- State how the independent variable was modified. If it was measured, it must have units.
- *Example: The independent variable is the pH of the milk at integer values from pH 4.0 to pH 12.0.*

Confounding Variables (Constants)

- List all of the confounding variables that were kept constant during the experiment. Be thorough.

- *Example: Milk from the same source and same brand of glucose test strips were used for all the samples as well as the same beaker and pH meter.*

Replication / Sample Size

- State the number of trials for each modification of the independent variable.
- You must have a minimum of three trials for each modification of the independent variable.
- Be sure to also present the average of your data from the trials.
- *Example: Each pH trial was repeated 3 times*

Controls
(positive, negative, a base line, or all three)

- List the controls used in the experiment and explain what they were controlling for.
- *Example: The pH 8.0 trial served as the positive control since it is known that this is the pH of the "native"*
- *environment of lactase function in the small intestines. All data will be compared to this control.*

Organize Data

- Organize the collected data in a data table. Provide a title for your data table.

- The title of the data table should describe the research and include both variables (A) and (B).

- Describe each data table in the text of your report.

Presenting Data in Tables

Tables should have an accurate, descriptive title. Number tables consecutively through the report.

Heading and subheadings identify each set of data and show units of measurement.

Independent variable in the left column.

Table 1: Length and growth of the third internode of bean plants receiving three different hormone treatments (data are given ± standard deviation).

Treatment	Sample size	Mean rate of internode growth (mm day^{-1})	Mean internode length (mm)	Mean mass of tissue added (g day^{-1})
Control	50	0.60 ± 0.04	32.3 ± 3.4	0.36 ± 0.025
Hormone 1	46	1.52 ± 0.08	41.6 ± 3.1	0.51 ± 0.030
Hormone 2	98	0.82 ± 0.05	38.4 ± 2.9	0.56 ± 0.028
Hormone 3	85	2.06 ± 0.19	50.2 ± 1.8	0.68 ± 0.020

Control values (if present) should be placed at the beginning of the table.

Each row should show a different experimental treatment, organism, sampling site etc.

Columns for comparison should be placed alongside each other. Show values only to the level of significance allowable by your measuring technique.

Organize the columns so that each category of like numbers or attributes is listed vertically.

Tables can be used to show a calculated measure of spread of the values about the mean.

Data Table Example

Table 1. The Effect of pH on Lactase Activity

	Glucose production (grams/ml of milk)								
	pH 4.0	pH 5.0	pH 6.0	pH 7.0	pH 8.0	pH 9.0	pH 10.0	pH 11.0	pH 12.0
Trial 1									
Trial 2									
Trial 3									
Average									

- Title: Effect of (independent variable) on (dependent variable)

Data Analysis

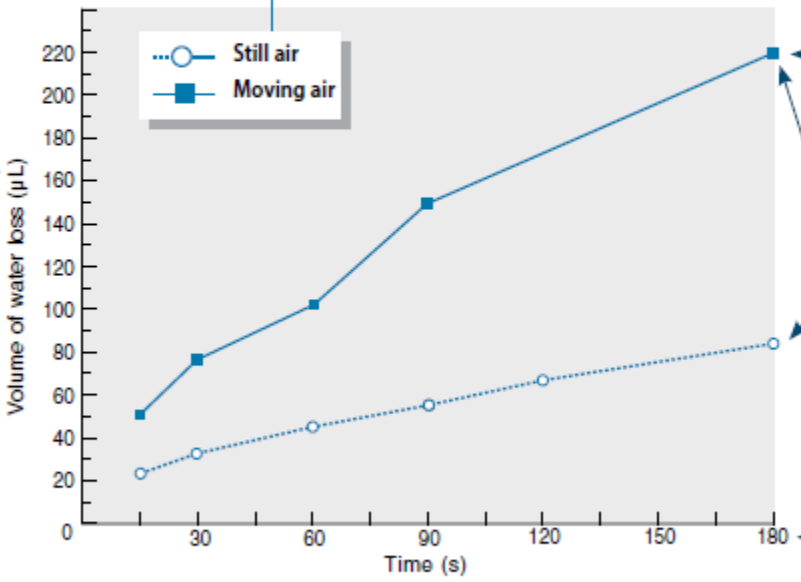
- Present the data in a graph: independent variable vs. the dependent variable in the appropriate graph form (line vs. bar) with proper X and Y axis labels, keys, and numerical scales.
- By interpreting the graph, discuss the trends in the data. Highlight the most noteworthy data points.

Presenting Data in Graph Format

Fig. 1: Cumulative water loss in µL from a geranium shoot in still and moving air.

Graphs (called figures) should have a concise, explanatory title. If several graphs appear in your report they should be numbered consecutively.

A key identifies symbols. This information sometimes appears in the title.



Plot points accurately. Different responses can be distinguished using different symbols, lines or bar colors.

Label both axes and provide appropriate units of measurement if necessary.

Two or more sets of results can be plotted on the same figure and distinguished by a key. For time series it is appropriate to join the plotted points with a line.

Place the dependent variable e.g. biological response, on the vertical (Y) axis (if you are drawing a scatter graph it does not matter).

Each axis should have an appropriate scale. Decide on the scale by finding the maximum and minimum values for each variable.

Place the independent variable e.g. treatment, on the horizontal (X) axis

Data Analysis Example

- *Graph 1 depicts the amount of glucose found in each of the samples after the milk was treated first with a specific pH buffer and then with lactase enzyme. The graph shows that the optimal pH for enzymatic activity of lactase is pH 8.0. The graph also indicates the enzymatic activity decreased sharply when the pH was either increased or decreased from this optimal with no activity below pH 5.0 or above pH 11.0…*

5. Conclusions (30 pts)

- Discuss implications of the data.
- Discuss what your results mean when you consider the original question or hypothesis.
- Discuss whether the hypothesis was supported or not supported by the data.
- Point out the statistical significance of your results.
- Relate your conclusions to the concepts learned in class.
- If the results are unexpected or contradictory, you should attempt to explain and point out possible avenues for further research.

Example of Conclusion

- *Example: Enzyme function is determined by protein structure. The shape of the active site is the critical determining factor for enzyme activity, because that is the catalytic site. Lactase digests the milk sugar, lactose, into the monosaccharides, glucose and galactose. During the experiment, the activity of lactase was measured by the production of glucose in the milk samples. Optimal lactase activity was found at pH 8.0. This is the pH of the lumen of the small intestine where lactase functions in the human body.*
- *The enzyme has evolved to function within this environment so the protein has been selected for optimal functioning at this pH. As the hypothesis predicted, enzyme activity declined sharply as the pH decreased or increased beyond this optimum, thus the experimental hypothesis was supported. The change in pH causes changes in hydrogen (H^+) and hydroxyl (OH^-) ions in solution. These changes in charge in the solution disrupt the secondary, tertiary and quaternary levels of structure of the proteins thereby degrading the active site of the enzyme as the protein begins to denature…*

Literature Cited (5 pts)

- Include all published works consulted in your research. List in bibliographic form.