**Lab Notebook: Set Up, Maintenance, Report**

In research science, laboratory notebooks serve as important historical and legal records that document what work researchers did while performing experiments, modifying procedures and collecting data. When researchers discover a new compound, or devise a new theory based on data collected, lab notebooks are used to provide the evidence needed to support their claim(s). Lab notebooks must be kept with clarity, objectivity and most importantly, integrity. In “real world” research, lab notebooks are submitted as part of paperwork filed when a scientist applies for a patent based on the work they did.

While we will not likely be deriving new biological theories from our work in lab, we will be adopting the same practices employed by research scientists when it comes to lab notebooks. You will learn to document activities pursued in lab thoroughly with clarity, objectivity and integrity. This is a skill that will serve you well beyond your participation in this class, and is one that must be

developed over time. We will keep lab notebooks because they will serve as important documentation of your work done in class. This will be of critical importance if you are attempting to get college credit for this class beyond what credit you earn on the AP Exam. It is possible (and not unprecedented) for students to get laboratory course credit at the universities they attend for work shown in the lab notebook. In addition, all students are required to complete at least one video laboratory write up.

**Setup**

1. **Cover**: Put the title (laboratory notebook), your name, class, and period in permanent marker or something that will not rub-off on the outside cover. Since every student’s notebook looks alike, you need to be able to distinguish yours from your lab partners’ notebooks so that you don’t accidentally take each other’s notebooks home! Use color and decorate your title page.
2. **Inside Front cover**: Safety Guidelines
3. **First Page**: Science Standards for AP Biology.
4. **Second & Third Page:** This Laboratory Guideline (pages 1 & 2)
5. **Fourth & Fifth page:** This Lab Report format (pages 3 &4)
6. Sixth page: Grading rubric (Page 5)
7. **Seventh page:** Table of Contents
8. Number your pages from next pages. Start with 1 on the left and 2 on the right. Be sure to number all the pages. Number the page at the upper right corner.
9. **Back Cover and inside cover:** Paste your formula sheet.

**Using the Notebook:**

1. Since this is a handwritten notebook, your handwriting must be legible! If it cannot be read, it cannot be graded.

2. Write in blue or black ink pen **ONLY**—**NO PENCILS**! Do not use any other color of ink as this is a professional record of your lab work. Ballpoint pen is best. Do not use felt-tipped pens.

3. If you make a mistake while writing, draw a single line through the error. DO **NOT** scribble out errors or use whiteout. **Absolutely DO NOT tear pages out of the notebook**. If an entire page is in error, a single diagonal line through the page will indicate that it is not to be looked at for grading purposes.

4. Your lab notebook is a space to keep your lab notes both formal and informal. You can use it

to keep track of data, perform your calculations, and keep track of any questions you may think of while conducting your investigation.

5. All formal lab parts: questions, hypothesis, experimental design, relevant background info, safety precautions, data tables, graphs, analysis, and conclusions will be written on the right pages (numbered) of your notebook. I WILL ONLY GRADE THE FORMAL PARTS OF YOUR LAB NOTEBOOK.

6. All informal work such as small calculations or data notes should be kept on the left pages of your notebook. You may want to leave pages between the end of one lab and the start of another lab in case you decide to go back and add any information.

**Now that my notebook is set up, what’s next?**

The following sections will help you understand how to use your notebook and make it work as a learning tool.

**Starting a Lab Report**

You will be required to keep a lab notebook in which you will write prelabs, record data, and note any conclusions or thoughts that you have as you perform each lab. Start with the following:

1. Date of the Lab, Title of the Lab, Lab Partner Names (From left to right)

3. Your Title, Purpose, Introduction, and procedure/schematic diagram should be written before you begin the lab. (See the next/attached page for more detailed instructions on these)

**During the lab**

1. Fill in your data tables.

2. Note any changes that you make to the procedure.

3. Remember that the left pages of your lab notebook should be a space where you can jot down notes and other basic thoughts during the lab. This will help you to write your lab report later.

**After the lab – clean up**

Once you are done with your experiment, it is vital that you clean up. It is a safety hazard for students who are coming in after you If you do not clean up. Therefore, when laboratory is not cleaned up, points will be deducted after a warning. (-10points)

Lab write-ups are due a few days after the completion of the lab in class. This gives you enough time to ask any questions about the lab or get help with concepts you don’t understand. Lab reports must be handwritten. Keep all returned lab reports. Labs constitute a significant portion of the AP exams and grade in this class

**I. TITLE**

**LAB REPORT FORMAT**

At the top of your page, you should give your report an appropriate title that reflects what variables were tested and measured. “Egg Osmosis” is not an appropriate title for a lab report; “The Effect of Various Osmotic Solutions on Egg Membranes” is.

**II. Purpose**

The objectives are important because they tell the reader what the purpose of the investigation was. These are directly from the lab handout, or are given to you by your instructor.

**III. INTRODUCTION – NO PERSONAL PRONOUNS**

The introduction is where you provide the reader context/background information for the lab investigation you performed. Remember, whoever reads your report isn’t going to be familiar with what you’ve done so it is your responsibility to give them information about what you’re investigating. Here’s how:

 Start by **clearly stating what the main biological concept the lab seeks to explore is**.

 Then **provide your reader with additional details they may need in order to understand the concept**. Make sure you are not simply filling the introduction with “fluff”— be concise but be sure to provide the reader with pertinent information.

 **State what your dependent and independent variables were in the investigation**.

 **Identify conditions you held constant**—there should be multiple conditions held constant to eliminate extraneous variables.

 **State the hypothesis you sought to test during the investigation, with justification**.

You MUST predict what you think will happen—remember a hypothesis is a tentative, testable statement based on observation, and the reason we investigate anything

 Be sure you can describe the relationship between the variables you identified above and how the independent variable influences the dependent variable. Support your hypothesis with information about how your knowledge of the biological concept of the investigation helped you develop your prediction.

**IV. PROCEDURE – PAST TENSE & NO PERSONAL PRONOUNS**

Here is where you will describe what steps you took to conduct the investigation. Because many labs are inquiry based, you will devise your own procedure for many investigations.

Use procedure schematic/drawing to show your understanding of the procedure.

 **THINK COOKBOOK**: Do not use “I” or “me” in this section! Pretend you are writing a

cookbook and you are giving someone else directions for how to conduct your experiments.

 **THINK GRANDMA**: Remember, Grandma isn’t in your lab watching you work, so you have to explain in clear language exactly what you did.

 **BE CONCISE:** The procedure section is not a story; it is a series of instructions.

 **BE HONEST:** Describe what you **actually** did in your own experiment. This is where any notes you take during the course of the investigation will come in handy.

* **BE SAFE:** Absolutely do NOT forget to include safety considerations!

A couple of other tips about Procedure:

 **Use the proper past tense and passive voice**. Methods are usually written in past tense because you are describing what you have already done. They are also typically written in passive voice ("Two ml. *were pipetted* into a test tube"). Do not start a sentence with a number unless you write out the word for the number.

 **When describing an apparatus or instrument, it's acceptable to include a sketch of it rather than to try to describe it fully in words.**

**V. DATA PROCESSING AND PRESENTATION**

In this section, you will transform and present the raw data you have collected. You will also visually represent your data (if appropriate) in this section, taking care to make sure your reader fully understands any representation you produce. Here’s how:

 **THINK: What kind of data do I have?** Establish what types of data you have, quantitative or qualitative.

 **THINK: How should I represent my data?** Determine if the data should be represented as a table or a graph. If you decide to use a graph to represent your data, determine which type of graph is one that **best** represents your data. If you are stuck, ask for help! Be sure your graphs are labeled and titled appropriately. If a table is the best format for your data, then modify the table you used to collect your data so that it is labeled and organized properly.

 **THINK: What do my data mean?** Under each graph or table you construct, explain the relationships between the variables as demonstrated by your data. If you have trouble shaping a one-sentence summary, look for a unifying feature among the data sets. This is likely to be the dependent variable. The sentence will be a general statement that summarizes your findings about that variable or related variables. You can start the sentence in several ways: "The results of the lab show that …"; "The data from the experiments demonstrate that…"; "The independent variable X increased as Y and Z were…."

Other tips for this section include:

 **If you have any calculations, show them once, with formulas (if appropriate).** This is equivalent to showing your work in math class.

 **Graphs and tables should be easy to read and large enough to see all the data presented.** Do not make graphs smaller than one-quarter of a page.

**VI. DISCUSSION, ANALYSIS AND CONCLUSION – Use CERR Format**

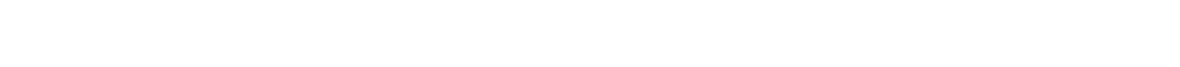
In this section, you will bring everything together to show your reader what you learned from the data you collected and what you learned from having followed the procedure to acquire that data. You will also discuss any limitations you encountered during your investigation and how these can be improved. Finally, you will discuss any further investigations that could be spun off of the work you did and how these might help you to learn more about the topic you investigated. Here’s how:

 **THINK: WERE YOU ON THE RIGHT TRACK?** State, in a sentence or two, whether or not your data support or do NOT support your hypothesis. Do NOT say “my hypothesis was correct” or “I proved my hypothesis.” You must use the data you collected to determine if your hypothesis was fully supported, not supported at all, or only partially supported.

 **THINK: WHAT DATA SUPPORT MY ASSERTIONS?** In a paragraph, identify specific data from your lab that led you to either support or reject your hypothesis. **Do not make statements about your hypothesis that you cannot support with evidence!**

* **THINK: HOW DO MY RESULTS COMPARE TO OTHERS?** Write a few sentences about how your findings compare to the findings of other students in the lab and an explanation for any differences, using your data to support your assertions.
* **THINK: WHAT COULD HAVE GONE WRONG?** No lab investigation is ever 100% perfectly flawless. In a paragraph, you should discuss any problems or difficulties that arose during the investigation that may have had an impact on your results, or that could have an impact on someone else attempting to replicate your experiment.
* **THINK: HOW CAN I MAKE THIS INVESTIGATION BETTER?** In a paragraph, give realistic suggestions for improving the lab, and elaborate on them. Write about how this investigation could be modified for further study, or what an extension of this investigation could be.

**AP Biology Lab Report Rubric**



|  |  |  |
| --- | --- | --- |
| **Report Item** | **Points**  **Possible** | **Points Earned** |
| **Title** | 2 |  |
| **Purpose** | 2 |  |
| **Introduction** | **(10)** |  |
| - Biological Concept | 4 |  |
| - Dep & Indep Variables | 2 |  |
| - Control(s)& Constants Identified | 2 |  |
| - Hypothesis | 2 |  |
| **Procedure** | **(8)** |  |
| - Materials | 2 |  |
| - Procedures stated | 4 |  |
| - Written in past tense | 2 |  |
| **Data & Analysis** | **(20)** |  |
| - Data recorded in tables | 6 |  |
| - Calculations (include SE) | 6 |  |
| - Graph(s) | 4 |  |
| o Titled | 2 |  |
| o axes labeled | 2 |  |
| **Conclusion** | **(10)** |  |
| - summarize results (scientifically valid) | 4 |  |
| o hypothesis supported/ rejected and why or what evidence lead you to this conclusion |  |  |
| - Biological concept explains results? | 2 |  |
| - Errors | 2 |  |
| - Improvements Recommended | 2 |  |
| **Literature Citations (if appropriate)** | 2 |  |
| **Lab Questions** (complete sentences & correct) | 15 |  |
|  |  |  |
|  |  |  |
| **Total Points** | 70 |  |