

BIOTECHNOLOGY FORMAL LAB REPORT PROTOCOL



A major component of the Magnet program is research. As you know, scientific research involves designing a study, collecting samples, measuring variables, analyzing data, and presenting the results in a formal report. The writing process makes the author think more deeply about the study. Accurate, clear and concise writing is essential to effective communication among researchers, teachers, and students. A scientific report provides a writing experience different from a library term paper because it is based on your own data and personal involvement in the investigation. Academy students in the Biotechnology pathway are required to write “formal” lab reports for some of our major laboratory investigations. We will utilize the same format that is required in college and in publishing scientific research. The overall process is the same as the research projects that you completed in Honors Biology and Honors Chemistry; however, formal lab reports are not as detailed. Please self-assess your work using the rubric on page three of this protocol.

Formal Laboratory Report (written in third person)

Your formal laboratory report must be written in third person and must also contain the following sections in this order using American Psychological Association (APA) format (typed; 12-point font; double spaced):

- **Title Page.** Project title, running head, name, school and grade (APA format). The title should be informative, specific, concise and understandable. It is admissible to use the title that is already provided for the specific lab.
- **Abstract.** A 250-word summary of the entire research paper. The abstract is the last section written since it is a concise summary of the entire research project. It is a summary of the introduction, methods, results and discussion. The abstract must also include your hypothesis and implications of your research. Keep your abstract around 250 words in length.
- **Introduction.** The introduction should explain all the background information about your topic and the reasoning behind this particular lab investigation. Assume the reader has very little background knowledge on the topic, so start broad and narrow your focus. You should be able to paraphrase and summarize information from the lab packet, but you are also required to extend this beyond the lab packet background information. Refer to previous research as well as your own experiments. Establish a strong rationale for the study by emphasizing unresolved issues or questions. Conclude by stating the research hypotheses. You should have literature citations included in American Psychological Association (APA) format. Purdue University maintains a helpful site to guide you through the details of APA formatting. Google “APA Owl” or follow links on my website. Use proper scientific names if applicable.
- **Methods & Materials.** Describe in detail the methodology used to derive your data and observations. This section is written in paragraph format (no bullets). Use photographs and drawings of your equipment to describe your experiment further. Include a precise description of the sample, any apparatus that was constructed or modified for the study, and methods of data collection. You want to be extremely detailed in your descriptions of the methods and materials.
- **Results.** Please note that students in the Biotechnology pathway are required to use inferential statistical analyses in the “Results” section of their report (see Inferential Statistics Protocol). The results section is not just a data summarization or a collection of tables and figures; it should contain an explanation and description of the data, including any qualitative observations you made during the study. Tell the reader exactly what you found, what patterns, trends, or relationships were observed. Present the data collected in the experiment using paragraph format and also reference and include all tables, figures and graphs. Each table, figure or graph should also include a short summary of the data in narrative form. For example, the sentence might read, “the researcher collected the following quantitative data on photosynthesis (see table 1)”. The reader would then

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find table 1 and read the short summary of the data. Include all statistical analyses of the data in this section of the paper. Do not interpret the data in this section.

- **Discussion.** This is where you interpret your data and discuss the implications of your research. Compare your results with theoretical values, published data, commonly held beliefs and/or expected results. You will need additional references in this section. You may also need to briefly revisit some of the background information from your introduction and discuss additional ideas and thoughts that have been generated as a result of your research and data. This section also includes a discussion of possible errors or problems experienced and how those errors/problems could have influenced your results. You should include proper APA citations when comparing your data to that of others. Lastly, discuss whether your data supported your hypothesis and what your next steps in experimentation may be. Discuss how a prospective researcher could extend, refine and modify your experiment to answer additional biological questions.
 - **References/Bibliography.** Your reference list should include any material that is not your own (i.e., books, web sites, papers, journal articles and communications cited in the paper). When in doubt, always reference the source. Follow the prescribed APA bibliographic style manual. Purdue University maintains a helpful site to guide you through the details of APA formatting. Google “APA Owl” or follow links on my website.
 - **Appendix.** Include critical information that is too lengthy for the main section of the paper, such as raw data, emails, photographs, additional tables and graphs, copies of surveys or tests, and diagrams of specialized equipment.
 - **Acknowledgments/Credits** Credit assistance received from mentors, parents, teachers, and other sources.
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Section 5: Additional Suggestions

- I will gladly critique rough drafts of your formal lab reports and help you to overcome any obstacles that you may encounter.
- Do not ignore results because they differ from textbook generalizations. Your data are not incorrect just because they do not agree with some general principle or a conclusion in another report. Do not discard data because of variability and biases. There are some errors in nearly all scientific data. If recognized and accounted for in interpretation of results, errors of reasonable size need not discredit your data.
- Round off final quantitative results to no more digits than can be reasonably justified. What sense does it make to compare two numbers such as 17.289761 and 19.82946? Do the last several digits have any special meaning? Reporting 17.3 and 19.8 may suffice in your case.
- Label figures and tables properly and thoroughly and cite them in your text. Too often figures and tables are inserted in a report without identifying their contents or explaining their purpose to the reader. Always clearly indicate the units of measurement. Number figures consecutively and in the sequence in which they appear in the text. Do the same with tables. Place each figure or table after, and close to, the first place it is referred to in the text.
- Play around with your data before preparing the final figures and tables. Work over the data to seek patterns and trends. Organize the data in various ways, as different presentations may elucidate patterns or trends. But be careful not to force a preconceived conclusion on the data. Do not select or reject data to make desired results apparent. This is considered scientific misconduct.

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Biotechnology Formal Lab Report Rubric:

Lab Requirements	10 – 9 - 8 Well Done	7 – 6 – 5 Moderate	4 - 3 Limited	2 - 1- Needs Improvement
Title/Standards	The title is concise and describes experiment. It is permissible to use the lab title in some instances. The standards are included.	The title is not complete and accurate. The standards are included, but missing 1 or more standards.	The title is not complete and accurate. No standards.	The title and standards are missing.
Abstract	Concise synopsis of the entire lab investigation follows format description	Concise synopsis of most of lab follows format description	Concise synopsis of most lab does not follow format description	Abstract is incomplete and not formatted correctly.
Introduction and Background Research (x2)	Research is thorough, many specific examples, ideas are explained and proper citations made. 2 or more citations . Clear explanation of how topic relates to biological concept. Ends with Hypothesis using if,then format. The standards are incorporated into the paper. Over 1.5 pages.	Research has some specifics and a couple of examples, few ideas are explained and proper citations made. 1-2 citations. Semi-clear explanation of how topic relates to biological concept. No mention of the standards. Under 1.5 pages	Research has little specifics and one example. Two or less ideas are explained. Citations not in proper format. 1-2 citations. Unclear explanation of how topic relates to biological concept.	Research has not specifics and one example. No ideas are explained. No citations are made. No explanation of how topic relates to biological concept.
Experimental Design/ Materials/Procedure	Procedure is appropriate and thorough. Steps of procedure are listed in sequential order; all material is listed with any safety issues being addressed. Sample size considered. Paragraph format used throughout.	Procedure is appropriate. Steps of procedure are listed and mostly sequential and most materials are listed. Safety may have been addressed. Sample size not considered	Procedure is appropriate. Steps are mostly listed and some materials are listed. Safety issues were not addressed. Not in paragraph form. Sample size not considered	Procedure is inadequate with few steps listed and no materials are listed. Safety not addressed. Sample size not considered
Writing Conventions	There are 3 or less minor spelling, punctuation, capitalization, and grammar errors in research paper.	There are more than 3 minor spelling, punctuation, capitalization, and grammar errors in research paper.	There are more than 5 major spelling, punctuation, capitalization, and grammar errors in research paper.	There are major spelling, punctuation, capitalization, and grammar errors throughout research paper.
Data Collection and Results	Proper use of the metric system. Adequate number of trials or sample size. Appropriate use of photos/charts/graphs to display data. 1 or more tables and/or 1 or more graphs used. All labeled properly. Paragraph format	Use metric system with adequate number of trials or sample size. Fair use of photos/charts/graphs to display data. Only 1 table/graph used. All labeled properly. Paragraph format	Use of English system, poor number of trials/sample size. Poor use of photos/charts/graphs to display data. No table and/or graph used and not labeled properly. No Para.	Use of English system. Poor number of trials, sample size and no photos. Charts graphs to display data. No data table or graph used and not labeled properly. No paragraphs
Discussion and Conclusion (x2)	Conclusions are supported by data. Sources of error have been considered and discussed thoroughly. Explanation is made for how or why the hypothesis was not supported or rejected. Experimental meaning is conveyed and reflection of what was learned and how it could be better was made. 2 or more additional citations made. Future direction for research discussed. The standards are discussed in detail. Over 1.5 pages.	Conclusions are not clearly supported by the data. Some sources of error have been considered. Explanation is attempted for how or why the hypothesis was supported or rejected. Reflection of how it could be better was made. 1-2 proper citations made. Future research not discussed thoroughly. The standards are mentioned, but not discussed. Under 1.5 pages	Conclusions are not supported by the data. A few sources of error have been considered. Explanation is attempted for how or why the hypothesis was supported or rejected. Reflection was poor. 1 or less citations made with error. No mention of standards	Conclusions are not supported by the data. No sources of error have been considered. Explanation is not attempted for how or why the hypothesis was supported or rejected. Reflection of what was learned and how it could be better was not made. No citations made. No mention of standards.
Literature Cited, References, APA	4 or more references are cited in proper APA format throughout the paper. APA followed entire paper; 3 rd person	2-3 references are cited in proper APA format throughout the paper. APA format not followed entire	1-2 references are cited in APA format throughout the paper, or not proper format	No references are cited in APA format throughout the paper.