



Everything you wanted to know about lab reports

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What are the main sections of a lab report?

- Title
- Abstract
- Introduction
- Method(s) or Materials and Methods
- Results
- Discussion/ Discussion & Conclusions
- References



Title Page

Information to Include

□ Title of the experiment

- Use a descriptive phrase for the title
 - Should be informative
 - May describe major results
 - *Descriptive* is better than *clever*

□ Course number and section if applicable

□ Your name

□ Your student number if required

□ Names of lab partners if applicable

□ Submission date

□ TA's name who will be marking your report



Title

Clever, vs. Descriptive

Too Hot to Handle: Temperature and Photosynthesis

Effects of temperature on photosynthesis in aquatic plants





Abstract

- Concise, detailed summary of the report
- Summarizes important aspects of the report:
 - Purpose
 - Key findings
 - Significance
 - Theory or methodology
- Do not include citations
- One short paragraph ~200 words



Introduction

What is it all about? Why do this experiment?

- Purpose

- Puts the experiment into context

- Background theory and knowledge needed to understand the experiment

- Literature reviewed refers to work of other researchers (primary literature)

- Primary sources (sometimes required)

- Rather than repeating the lab manual, show your comprehension of the problem



Introduction

Tips on using Past and Present Tense:

- The experiment is already finished. Use the *past* tense when talking about the experiment and what you *did*.
 - "The objective of the experiment **was**..."
- The report, the theory and permanent equipment still exist; therefore, these get the present tense:
 - "The purpose of this report **is**..."
 - "Bragg's Law for diffraction **is** ..."
 - "The scanning electron microscope **produces** micrographs ..."
 - Engineering Communication Centre Online Handbook, UofT.

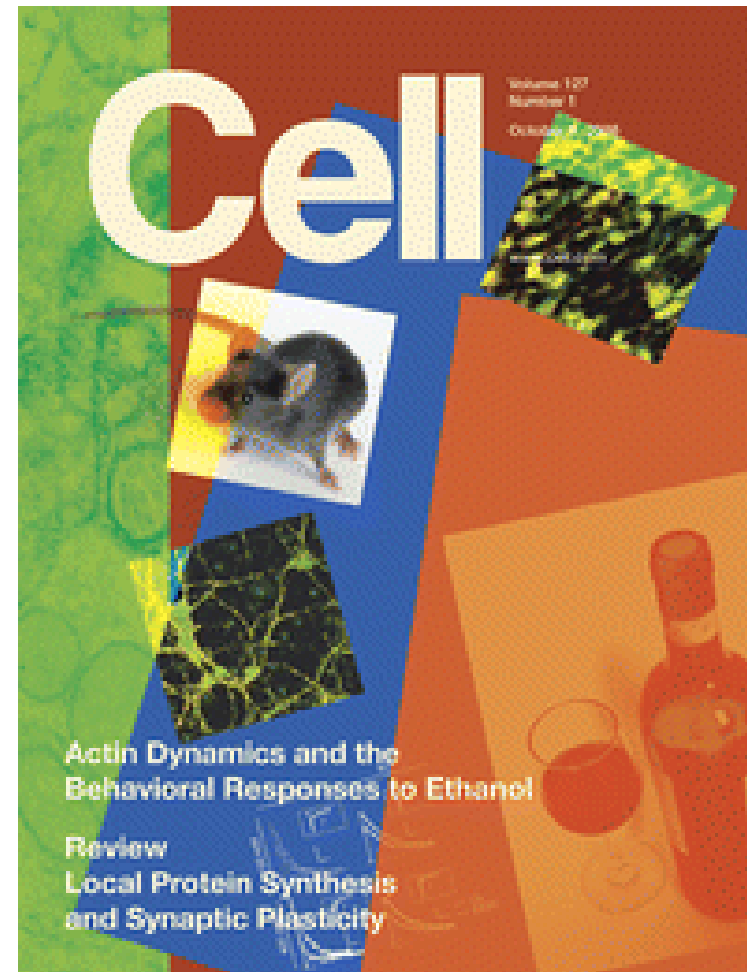


Finding References

- Where do you start your research?
- How do you evaluate your resources?
 - Primary
 - Secondary
 - Tertiary
 - Why is primary best?
- You don't need to find articles that are identical to your hypothesis – that is not the point
- How do you use the resources that you find?
 - Background information
 - Organisms, theories, knowledge
 - Justification of your purpose/hypothesis

Primary Literature

- Primary or Scholarly literature is the first formal write up of the experiment.
- Types of primary literature:
 - Dissertations and Theses
 - Conference Papers
 - Journal Articles***
 - ****Usually peer reviewed****



What is Peer Review?

A process by which articles are reviewed by researchers for scientific and technical merit.

- Researchers submit their article to the journal they wish to publish in.
- The publisher sends it to experts from outside the research team who assess the submitted article and report back to the publisher with their assessment.
 - This may include information about what applicants can do to improve the chances their article will receive a positive review.
 - Rerun some experiments
 - Provide more proof
 - Rewrite some parts – etc.
- Once the article has been brought up to the standards imposed by the journal, it is accepted for publication, and it joins the ranks of other peer reviewed articles.



What does a primary article in science look like?

- **Reference: Title, Authors, Source**
- **Abstract – Informative** rather than evaluative
 - Summarizes the article from an objective point of view
 - Contains the important results and conclusions
- **Introduction**
 - Provides the background for the research (literature review)
 - States the thesis (usually toward the end of the intro)
 - Answers the question: why is this research being done?
- **Materials and methods**
 - Subjects: experimental and control groups, tests run, apparatus and methods used.
- **Results**
 - Tables and Figures
- **Conclusions**
 - What the results mean in the framework of the research
- **Discussion**
 - How does this research fit into the big picture?
 - Why is it important to the field?
- **Reference list**
 - Usually extensive, and provides support and evidence for the research conducted and the statements made

Secondary Literature

- **Secondary literature** summarizes primary research for a scholarly audience
- **Abstracts:** summarize the content of the article – help indexers and searchers to determine what the article is “about”
- **Review articles:** written for researchers and professionals who want to gain a grasp of the developments in a field.
 - **Reference list:** contain further reading for those interested in going into more depth on the topic

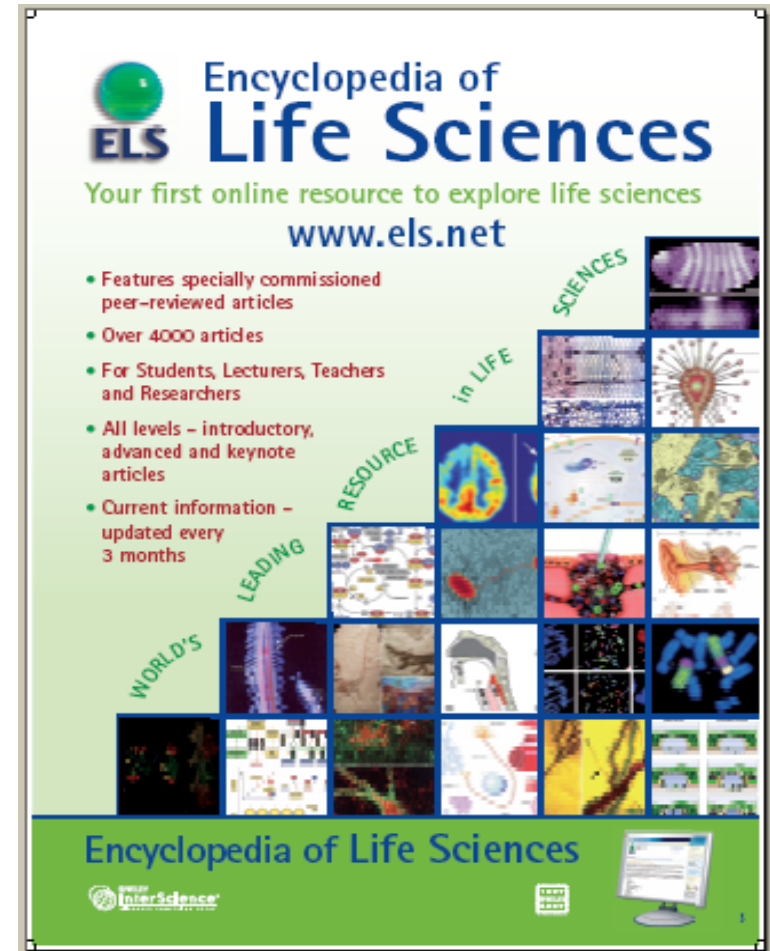


Tertiary Literature – accepted facts

Research has reached the
accepted theory stage

Examples of tertiary literature:

- Handbooks
- Field Guides
- Dictionaries
- Encyclopaedias
- Textbooks



Materials and Methods (Equipment)

- List all of materials and equipment used in your lab
- You may reference your lab manual or a standard procedure or source that provides this information
 - Note any changes or substitutions you made





Methods: Procedures

- Explain the steps for the experiment as they actually occurred in paragraph form
 - Note any changes/substitutions you made that differ from the lab manual
- Again, you may reference your lab manual or a standard procedure or other source that you used
- Should be detailed enough that someone could reproduce the results



Results

What happened?

- Summary of the final data (could be tabulated or graphed)
- Short paragraph along with any relevant charts, graphs
 - Label and associate charts and graphs with the text
 - Provide legends for all graphs and tables
- Includes any sample calculations





Discussion:

Explain, Analyze, Interpret

□ **Analysis**

- What do the results indicate clearly?
- What have you found?
- Explain what you know with certainty based on your results and draw conclusions

□ **Interpretation**

- What is the significance of the results?
- What ambiguities exist?
- What questions might we raise?
- Find logical explanations for problems in the data



Strategies to Focus your Discussion:

- **Compare expected results with those obtained**
 - Do the results support your initial hypothesis?
 - Analyze and explain any experimental error
 - Explain how experimental design might be improved
- **Explain your results in terms of theoretical issues**
 - If your lab is intended to illustrate important laws then discuss the theory: How well has the theory been illustrated? Are there alternate explanations?
- **Relate results to your experimental objective(s)**
 - Eg if you are identifying an unknown substance, then be sure to know the attributes of the substance(s) that you think it might be so you can draw accurate conclusions and explain them.
- **Compare your results to similar investigations**
 - Compare outcomes with classmates, not to change your answer, but to look for any anomalies between the groups and discuss those.
- **Analyze the strengths and limitations of your experimental design**
 - Particularly if you have designed the thing you are testing



Conclusion:

- State what is known
- Justify that statement
- State the significance of your findings
- Suggest further research
 - The conclusion might be a place to discuss weaknesses of experimental design (if not dealt with in the discussion)
 - What future work needs to be done to extend your conclusions
 - What the implications of your conclusion are



References

- ❑ Avoid Academic Dishonesty by citing your sources and references
 - Include your lab manual and any outside reading you have done
- ❑ Use the reference style recommended by your Professor/Teaching Assistant
 - These usually follow the style of your discipline – ACS for Chemistry, CSE for biology, etc.
 - If none are recommended, then select an appropriate one and be consistent
- ❑ Use Refworks to manage your references



RefWorks



Appendices

- Optional
 - May be required by your assignment
- Includes supplementary elements
 - Raw data, calculations, graphs, pictures, tables not in the report itself
 - Each item in a separate appendix
- Refer to each appendix at least once in the report



Questions to ask While Reading a Primary Article

-Pechenik pg35

In a few sentences, summarize the topics that are covered in the article.

Why was this study undertaken?

What is the point of the article?

What are the researcher's main questions?

How was the study designed and how does the design answer the questions?

What are the controls for each experiment?

What are the results of the experiment; does it answer the questions posed?

What questions remain unanswered?

Evaluate the usefulness of this article

Is it a useful source?

What is the goal of this article?

Reflect on how this article fits into your topic.

How might it help you shape your argument?

Has it changed how you think about your topic?

Additional Resources

- How to write a lab report for Biology
 - http://www.union.edu/academic_depts/biology/ResearchReports.php
- Guide to Writing a Lab Report For Chemistry and Biochemistry Students
 - http://learning.concordia.ca/Help/handouts/WritingHO/lab_report.shtml
- Writing a Physics Lab Report
 - <http://www.umanitoba.ca/virtuallearningcommons/page/1270>
- Porush, David. (1995). *A Short Guide to Writing About Science*. (HarperCollins).
 - Although, this book uses the "scientific article" as the basic form for writing, it essentially views that as an extended lab report. Therefore, it has useful chapters on each of the sections of a lab report.
- Pechenik, Jan A. (2010). *A Short Guide to Writing About Biology*. 7th ed. (New York : Longman)

Acknowledgement:

- Engineering Communication Centre Online Handbook, University of Toronto.
Accessed August 2009.



Questions? Comments?

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