University of Crete

How to write a lab report

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Overview

- Parts of a lab report [Task 1]
- Purpose of a lab report [Task 2]
- Genre analysis: introduction [Task 3]
- Genre analysis: methods [Task 4]
- Genre analysis: results [Task 5]

Task 1: Pair work (or groups of three)

Parts of a Lab Report

Look at the picture and put the parts of a lab report in the right order

Discussion.
In the discussion you use the data to say whether or not the hypothesis was proven. You will also mention any mistakes that were made during your lab in this section.

Methods.
Describe the steps that were followed during the lab. Be sure to be as detailed as possible so that anyone could read your methods and mimic them.

Figures and Graphs.
These tools must be labeled with a descriptive title. You should be sure that your report refers to the figures and graphs. The first figure should be labeled Figure 1 and so forth.

Title.
Like all good papers, your lab report should have a title. The title should state what you did and the main objective for the experiment.

Results.
Describe what the data means. Sometimes the Results section is also put in the Discussion.

Materials.
List everything you needed to complete your experiment.

Data.
Numerical data is often displayed in a table or graph.

Introduction and Purpose.
The introduction is often one paragraph that explains the objectives and purposes of the lab. Be sure to state the hypothesis in one sentence. Often an introduction includes background information that briefly summarizes how the experiment was performed, as well as the findings and conclusions of the experiment.

Conclusion.
The conclusion is often a single paragraph that says what happened in the experiment, whether the hypothesis was proven or disproven and what that means.

References.
Be sure to list any sources that you used during your lab report. Often these will be cited in APA format.

Title Page.
Not all lab reports have title pages, but if your instructor requires one it will be APA formatted and include:

- The title of the experiment.
- Your name and your partner's names.
- Your instructor's name.
- The date the lab was performed or the date the report was submitted.

Task 1: Pair work (or groups of three)

Parts of a Lab Report

1. **Title Page (advisable)**
The title of the experiment.
Your name and your partner's names.
Your instructor's name.
The date the lab was performed or the date the report was submitted.

2. **Title.**
The title should state what you did and the main objective for the experiment.

3**. Introduction/Purpose.**
The introduction explains the objectives and purposes of the lab, and states the hypothesis in one sentence. It includes background information that briefly summarizes how the experiment was performed, as well as the findings and conclusions of the experiment.

4. Materials.
List everything you needed to complete your experiment.
5. Methods.
Describe the steps that were followed during the lab. Be sure to be as detailed as possible so that anyone could read your methods and mimic them.
6. Data.
Numerical data is often displayed in a table or graph.
7. Results.
Describe what the data means. Sometimes the Results section is also put in the Discussion.
8. Discussion.
In the discussion you use the data to say whether or not the hypothesis was proven. You will also mention any mistakes that were made during your lab in this section.
9. Conclusion.
The conclusion is often a single paragraph that says what happened in the experiment, whether the hypothesis was proven or disproven and what that means.
10. Figures and Graphs.
These tools must be labeled with a descriptive title. You should be sure that your report refers to the figures and graphs. The first figure should be labeled Figure 1 and so forth.
11. References (compulsory)
Be sure to list any sources that you used during your lab report. Often these will be cited in APA format.

Task 2 Complete missing information

Purpose of Lab report

Laboratory reports are a vital part of the scientific process:

Lab reports should communicate the important work you have done in lab so that someone who was not there can understand and ……. your results. They also propose future studies and experiments or suggest …… to pre-existing methods.

The three main purposes of a lab report are:

- communicate exactly what occurred in an experiment
- present and discuss ……../ results
- provide conclusions

Lab Reports are written so that:

a. someone else could read the report and understand ……. what you did
b. repeat the experiment and obtain the same results
c. read the introduction and …….. whether to take the time to read the full report

Task 2 Complete missing information

Purpose of Lab report

Laboratory reports are a vital part of the scientific process.

Lab reports should communicate the important work you have done in lab so that someone who was not there can understand and **replicate** your results. They also propose future studies and experiments or suggest **alterations** to pre-existing methods.

The three main purposes of a lab report are:

- communicate procedures followed during an experiment
- present and discuss data/results
- provide conclusions

Lab Reports are written so that:

a. someone else could read the report and understand **exactly** what you did
b. repeat the experiment and get the same results
c. read the introduction and **decide** whether to take the time to read the full report

Analysis of each section/genre of a lab report

- Many believe that a scientist's most difficult job is not conducting an experiment but presenting the results in an effective and coherent way. [T/F]
- Even when your methods and technique are sound and your notes are comprehensive, writing a report can be challenging because organizing and communicating scientific findings requires patience and a thorough grasp of certain conventions. [T/F]
- Having a clear understanding of the typical goals and strategies for writing an effective lab report can make the process much less troubling. [T/F]

Lab report: Fact or Fiction?

- Many believe that a scientist's most difficult job is not conducting an experiment but presenting the results in an effective and coherent way. [T/F]
- Even when your methods and technique are sound and your notes are comprehensive, writing a report can be challenging because organizing and communicating scientific findings requires patience and a thorough grasp of certain conventions. [T/F]
- Having a clear understanding of the typical goals and strategies for writing an effective lab report can make the process much less troubling. [T/F]
- **Task:** Describe what you see in the picture

Communication is important

- Does this sentence best describes what you see in the picture?

1. Making sure that the centrifuge samples are equally distributed, my partner put the tube in the right hole.

Communication is important

- Which sentence best describes what you see in the picture?

1. Making sure that the centrifuge samples are equally distributed, my partner put the tube in the right hole.
2. Making sure that the centrifuge samples are equally distributed in the rotor and balanced, the tubes were placed opposite each other in the rotor.

Communication is important

- Which sentence best describes what you see in the picture?

1. Making sure that the centrifuge samples are equally distributed, my partner put the tube in the right hole.
2. Making sure that the centrifuge samples are equally distributed in the rotor and balanced, the tubes were placed opposite each other in the rotor.
3. Making sure that the centrifuge samples are equally distributed in the rotor and balanced, the sample was prepared at 3500 rpm [“revolutions per minute] for ten minutes.

Genre analysis: Introduction

- What is the problem?

  Describe the problem investigated. Summarize relevant research to provide context, define key terms, and concepts so that your reader can understand the experiment.

- WHY IS IT IMPORTANT?

  Review relevant research to provide a rationale for the investigation. What conflict, unanswered question, untested population, or untried method in existing research does your experiment address? How will you challenge or extend the findings of other researchers?

- WHAT SOLUTION (OR STEP TOWARD A SOLUTION) DO YOU PROPOSE?

  Briefly describe your experiment: hypothesis, research question, general experimental design or method, and a justification of your method (if alternatives exist).

Genre analysis: Introduction

- Move from the general to the specific – from a problem in research literature to the specifics of your experiment.
- Engage your reader – answer the questions: “What did I do?” “Why should my reader care?”
- Clarify the links between problem and solution, between question asked and research design, and between prior research and the specifics of your experiment.
- Be selective, not exhaustive, in choosing studies to cite and the amount of detail to include. In general, the more relevant an article is to your study, the more space it deserves and the later in the introduction it appears.
- Ask your instructor whether or not you should summarize results and/or conclusions in the Introduction.
- Decide whether the present tense or the past tense is appropriate for each sentence: …..is/was?

Genre analysis: Introduction

- Focus on language: tenses [was or is]
- “The objective of the experiment […]”
- The report, the theory, and permanent equipment still exist; therefore, describe these using the present tense:
- “The purpose of this report […]”
- “Bragg’s Law for diffraction* […]”
- “The scanning electron microscope [produces/produced] micrographs …”

*περίθλαση

Genre analysis: Introduction

- Focus on language: tenses was or is
- “The objective of the experiment was…”
- The report, the theory, and permanent equipment still exist; therefore, describe these using the present tense:
- “The purpose of this report is…”
- “Bragg’s Law for diffraction is …”
- “The scanning electron microscope produces micrographs …”

Genre analysis: Introduction [task]

- Put the following parts of the introduction in the right order:

Hypothesis – If this is not already given, you must formulate this in unambiguous terms.

Objectives – State the aim of the experiment and state the methods used.

Problem – State the issue investigated by the experiment.

Background – Briefly summarise previous research on the topic and narrow the scope of the study.

Genre analysis: Introduction [task]

- Put the following parts of the introduction in the right order:

  Problem – State the issue investigated by the experiment.

  Background – Briefly summarise previous research on the topic and narrow the scope of the study.

  Objectives – State the aim of the experiment and state the methods used.

  Hypothesis – If this is not already given, you must formulate this in unambiguous terms.

Materials and Methods

- Provide a clear enough explanation of how the experiment was conducted so that someone wishing to replicate the procedure may be able to do so. It contains the following sections:
- materials
- experimental design
- the treatments *
- the apparatus [συσκευή] used**
- the procedures and methods of measurement used
- details of how you analysed the data (lengthy statistical calculations should be attached as an appendix)

*The mostly implemented chemical treatment processes are: chemical precipitation (καθίζηση), neutralization (εξουδετέρωση), adsorption (προσρόφηση), disinfection (chlorine, ozone, ultraviolet light) [απολύμανση (χλώριο, όζον, υπεριώδες φως)], and ion exchange.

** You should follow the rules for the conventional descriptions of chemicals. The standard practice is not to use trade names for chemicals. Instead you should use the generic or chemical names. Standard apparatus should be described in proper technical terms.

2 Experimental set-up

This section includes a schematic of the set-up, and a list of the instruments used throughout the experiment (including the error associated with each instrument).

Instruments

- Caliper +/- 0.02mm "Παχύμετρο"
- Digital scale +/- 0.001g "Ψηφιακή κλίμακα"

3 Experimental procedure

The experimental Procedure describes the process in chronological order. Using clear paragraph structure, explain all steps in the order they actually happened, not as they were supposed to happen. You can refer to the procedure described in the lab document, be sure however to document when you did not follow exactly the procedure (e.g. "At step 4 we performed four repetitions instead of three, and ignored the data from the second repetition"). If you've done it right, another researcher should be able to duplicate your experiment.

Results

- Results are usually dominated by calculations, tables and figures; however, you still need to state all significant results explicitly in verbal form, for example:
- Number and Title tables and graphs. Place them before the prose.
- Use a sentence or two to draw attention to key points in tables or graphs.
- Provide sample calculation only but state key result in sentence form “Using the calculated lattice parameter gives, then, R = 0.1244 nm.”*
- Graphics need to be clear, easily read, and well labeled (e.g. Figure 1: Input Frequency and Capacitor Value).

*In most cases, providing a sample calculation is sufficient in the report. Leave the remainder in an appendix. Likewise, your raw data can be placed in an appendix. Refer to appendices as necessary, pointing out ***trends and identifying special features.***

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Discussion: Analysis and/or Interpretation?

We found the density of our sample to be 1.99, which is lower than the grain density. Since the density of the sample is lower than the density of the grain, the sample is porous. The degree of porosity of the sample #32 has been established to π…

The value of the saturation [τιμή του κορεσμού] for the sample after 4.45 min did not fit the trend observed in the rest of the data. The temperature of the oven, which was higher for the first 2 minutes of the experiment, could have contributed to a faster evaporation rate [ταχύτητα εξάτμισης] than what is observed in later results.

- Since none of the samples reacted to the Silver foil test, therefore sulfide, if present at all, does not exceed a concentration of approximately 0.025 g/l. It is therefore unlikely that the water main pipe break was the result of sulfide-induced corrosion [διάβρωση λόγω σουλφιδίων].
- Although the water samples were received on 14 August 2000, testing could not be started until 10 September 2000. It is normally desirably to test as quickly as possible after sampling in order to avoid potential sample contamination. The effect of the delay is unknown

Discussion: Analysis or Interpretation?

Analysis

We found the density of our sample to be 1.99, which is lower than the grain density. Since the density of the sample is lower than the density of the grain, the sample is porous. The degree of porosity of the sample #32 has been established to π…

Interpretation

The value of the saturation [τιμή του κορεσμού] for the sample after 4.45 min did not fit the trend observed in the rest of the data. The temperature of the oven, which was higher for the first 2 minutes of the experiment, could have contributed to a faster evaporation rate [ταχύτητα εξάτμισης] than what is observed in later results.

- Since none of the samples reacted to the Silver foil test, therefore sulfide, if present at all, does not exceed a concentration of approximately 0.025 g/l. It is therefore unlikely that the water main pipe break was the result of sulfide-induced corrosion [διάβρωση λόγω σουλφιδίων]. **Analysis**
- Although the water samples were received on 14 August 2000, testing could not be started until 10 September 2000. It is normally desirably to test as quickly as possible after sampling in order to avoid potential sample contamination. The effect of the delay is unknown **Interpretation**

Discussion

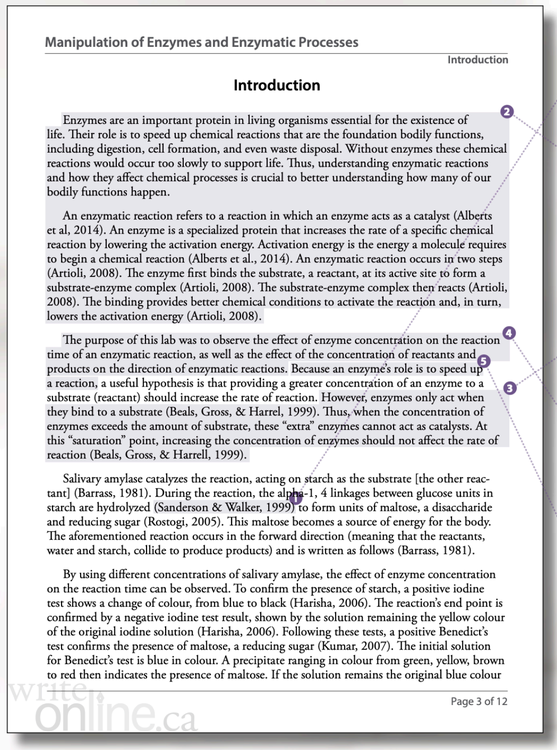
- **Compare expected results** with those obtained.
- **Analyze experimental error.** If there were differences, how can you account for them? Saying human error implies you're incompetent. Be specific; for example, the instruments could not measure precisely, the sample was not pure or was contaminated, or calculated values did not account for friction.
- Was it avoidable? Was it a result of equipment? If an experiment was within the tolerances, you can still account for differences from the ideal. If the laws result from the experimental design, explain how the design might be improved. Explain your results in terms of theoretical issues.
- Illustrate important physical laws. Usually you will have discussed these in the **introduction.** In this section move from the results to the theory. How well has the theory been illustrated? Relate results to your **experimental objective(s).**
- **Compare your results to similar investigations.** If you set out to identify an unknown metal by finding its lattice parameter [παράμετρος πλέγματος] and its atomic structure, you'd better know the metal and its attributes.
- Analyze the strengths and limitations of the experimental design.

Recommended online resource:
https://writeonline.ca/media/documents/LabReport-AnnotatedFull.pdf

Lab Report

Annotated Lab Report

write online.ca



Manipulation of Enzymes and Enzymatic Processes

Introduction

Introduction

Enzymes are an important protein in living organisms essential for the existence of life. Their role is to speed up chemical reactions that are the foundation bodily functions, including digestion, cell formation, and even waste disposal. Without enzymes these chemical reactions would occur too slowly to support life. Thus, understanding enzymatic reactions and how they affect chemical processes is crucial to better understanding how many of our bodily functions happen.

An enzymatic reaction refers to a reaction in which an enzyme acts as a catalyst (Alberts et al, 2014). An enzyme is a specialized protein that increases the rate of a specific chemical reaction by lowering the activation energy. Activation energy is the energy a molecule requires to begin a chemical reaction (Alberts et al., 2014). An enzymatic reaction occurs in two steps (Artioli, 2008). The enzyme first binds the substrate, a reactant, at its active site to form a substrate-enzyme complex (Artioli, 2008). The substrate-enzyme complex then reacts (Artioli, 2008). The binding provides better chemical conditions to activate the reaction and, in turn, lowers the activation energy (Artioli, 2008).

The purpose of this lab was to observe the effect of enzyme concentration on the reaction time of an enzymatic reaction, as well as the effect of the concentration of reactants and products on the direction of enzymatic reactions. Because an enzyme's role is to speed up a reaction, a useful hypothesis is that providing a greater concentration of an enzyme to a substrate (reactant) should increase the rate of reaction. However, enzymes only act when they bind to a substrate (Beals, Gross, & Harrel, 1999). Thus, when the concentration of enzymes exceeds the amount of substrate, these "extra" enzymes cannot act as catalysts. At this "saturation" point, increasing the concentration of enzymes should not affect the rate of reaction (Beals, Gross, & Harrell, 1999).

Salivary amylase catalyzes the reaction, acting on starch as the substrate [the other reactant] (Barrass, 1981). During the reaction, the alpha-1, 4 linkages between glucose units in starch are hydrolyzed (Sanderson & Walker, 1999) to form units of maltose, a disaccharide and reducing sugar (Rostogi, 2005). This maltose becomes a source of energy for the body. The aforementioned reaction occurs in the forward direction (meaning that the reactants, water and starch, collide to produce products) and is written as follows (Barrass, 1981).

By using different concentrations of salivary amylase, the effect of enzyme concentration on the reaction time can be observed. To confirm the presence of starch, a positive iodine test shows a change of colour, from blue to black (Harisha, 2006). The reaction's end point is confirmed by a negative iodine test result, shown by the solution remaining the yellow colour of the original iodine solution (Harisha, 2006). Following these tests, a positive Benedict's test confirms the presence of maltose, a reducing sugar (Kumar, 2007). The initial solution for Benedict's test is blue in colour. A precipitate ranging in colour from green, yellow, brown to red then indicates the presence of maltose. If the solution remains the original blue colour

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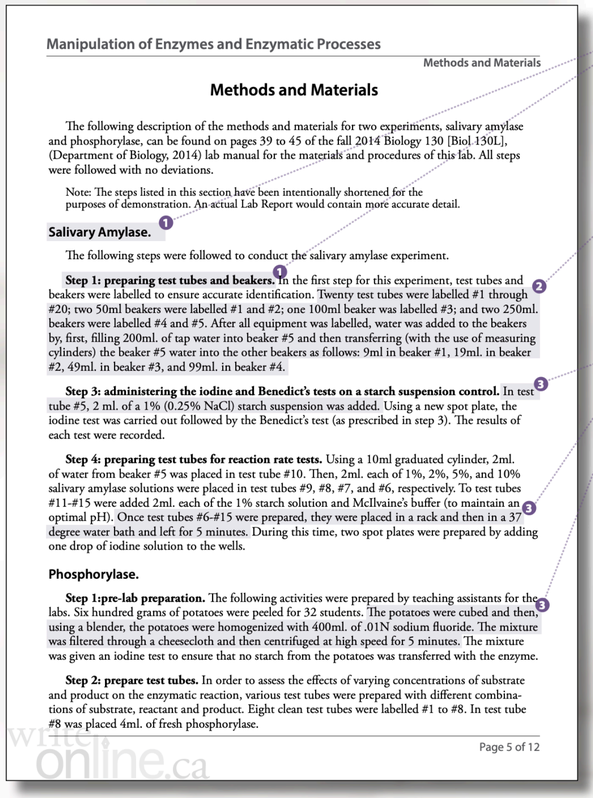
1. In-text citations appear throughout the report, especially in the introduction, discussion, and conclusion sections.
2. Writer discusses scientific concepts and background information for the lab.
3. Refers to previous research on the subject.
4. Writer presents the purpose of the lab.
5. Writer includes reasons for her hypothesis.

Lab Report

Annotated Lab Report

write online.ca



Manipulation of Enzymes and Enzymatic Processes

Methods and Materials

Methods and Materials

The following description of the methods and materials for two experiments, salivary amylase and phosphorylase, can be found on pages 39 to 45 of the fall 2014 Biology 130 [Biol 130L], (Department of Biology, 2014) lab manual for the materials and procedures of this lab. All steps were followed with no deviations.

Note: The steps listed in this section have been intentionally shortened for the purposes of demonstration. An actual Lab Report would contain more accurate detail.

Salivary Amylase.

The following steps were followed to conduct the salivary amylase experiment.

Step 1: preparing test tubes and beakers. In the first step for this experiment, test tubes and beakers were labelled to ensure accurate identification. Twenty test tubes were labelled #1 through #20; two 50ml beakers were labelled #1 and #2; one 100ml beaker was labelled #3; and two 250ml. beakers were labelled #4 and #5. After all equipment was labelled, water was added to the beakers by, first, filling 200ml. of tap water into beaker #5 and then transferring (with the use of measuring cylinders) the beaker #5 water into the other beakers as follows: 9ml in beaker #1, 19ml. in beaker #2, 49ml. in beaker #3, and 99ml. in beaker #4.

Step 3: administering the iodine and Benedict's tests on a starch suspension control. In test tube #5, 2 ml. of a 1% (0.25% NaCl) starch suspension was added. Using a new spot plate, the iodine test was carried out followed by the Benedict's test (as prescribed in step 3). The results of each test were recorded.

Step 4: preparing test tubes for reaction rate tests. Using a 10ml graduated cylinder, 2ml. of water from beaker #5 was placed in test tube #10. Then, 2ml. each of 1%, 2%, 5%, and 10% salivary amylase solutions were placed in test tubes #9, #8, #7, and #6, respectively. To test tubes #11-#15 were added 2ml. each of the 1% starch solution and McIlvaine's buffer (to maintain an optimal pH). Once test tubes #6-#15 were prepared, they were placed in a rack and then in a 37 degree water bath and left for 5 minutes. During this time, two spot plates were prepared by adding one drop of iodine solution to the wells.

Phosphorylase.

Step 1:pre-lab preparation. The following activities were prepared by teaching assistants for the labs. Six hundred grams of potatoes were peeled for 32 students. The potatoes were cubed and then, using a blender, the potatoes were homogenized with 400ml. of .01N sodium fluoride. The mixture was filtered through a cheesecloth and then centrifuged at high speed for 5 minutes. The mixture was given an iodine test to ensure that no starch from the potatoes was transferred with the enzyme.

Step 2: prepare test tubes. In order to assess the effects of varying concentrations of substrate and product on the enzymatic reaction, various test tubes were prepared with different combinations of substrate, reactant and product. Eight clean test tubes were labelled #1 to #8. In test tube #8 was placed 4ml. of fresh phosphorylase.

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1. Headings and subheadings help to organize the methods described in the lab.
2. Materials are introduced as each step in the method is presented.
3. Important details are included to ensure repeatability.

FINAL TASK

In your textbook, evaluate the sample (undergraduate chemistry) lab report and make suggestions for revisions.

Then, listen to the professor’s feedback and compare your revisions with hers.