HELLENIC REPUBLIC
UNIVERSITY OF CRETE

Academic English

Section 11: Writing a Laboratory report

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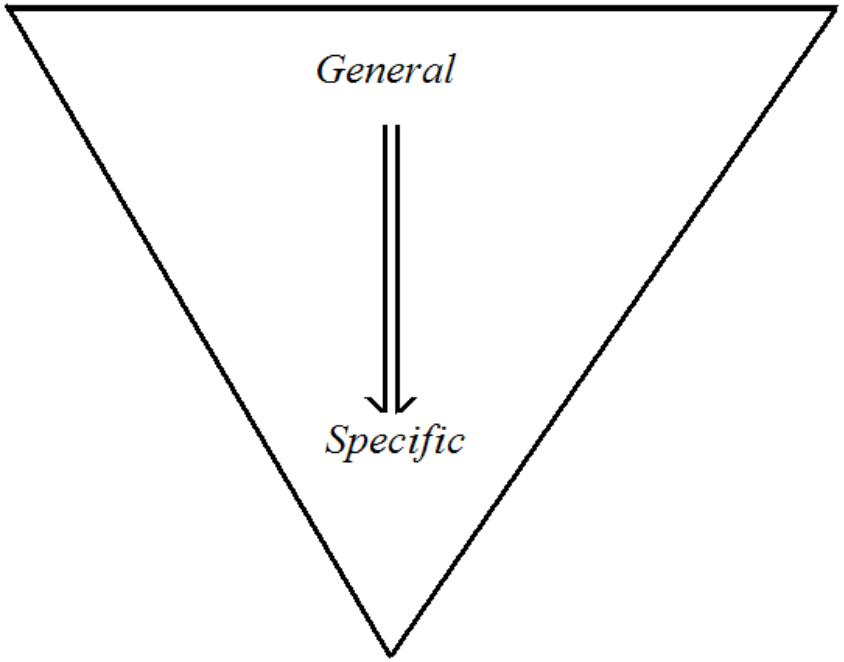
Grading Lab Reports ✓ ✗

- the lab report guidelines were followed
- Correct format with each section with title clearly labeled
- Grammar, punctuation and spelling checked
- sufficient & relevant background information
- In the Procedures/Results sections 3rd person passive voice
- Results thoroughly explained in the Discussion
- Sources of information correctly cited/referenced

Lab report Format

- **Introduction**
  - Background Information
  - Purpose
  - Hypothesis
- **Procedures**
- **Results**
  - Tables and Figures
  - Description of Data
- **Discussion**
  - Conclusions
  - Explanation of Results
  - Future Experiment
- **Literature Citations (References)**



Introduction

Look at the example intro given and evaluate its

- content
- format
- style

As described in the lab manual: 1. Record the barometric pressure. 2.Measure about 10 g of ice using the chemical balance and place it into a 100 mL beaker. Heat over a flame until half of the ice has melted. Remove from heat and measure the temperature as accurately as possible using your laboritory thermometer. Repeat with a 10.0 g sample of your unknown. Be sure to record your unknown number. 3. Measure 50 mL of water using your graduated cylindar and pour it into a 200 mL beaker. Bring the liquid to a boil over a flame. After the liquid has been boiling for approximately 1-2 minutes, measure the temperature of the boiling liquid. Repeat with a 10 g sample of your unknown. Record all data in your lab notebook and clean up.

We followed all the steps above pretty much closely and pretty much got the results for water expected, except that the stockroom had cheap thermometers because one of them broke (this was my lab partner's fault – she used it as a stirring rod which is exactly what you said not to do in your lecture) and the new one was off by a few degrees – but it was close enough for this simple experiment. The pressure in the room was 761.2 and the temperatures measured for our unknown were: -15 and17

Correcting our water results this made our measurements –15.2 and 17.4 after the corrections. Based on these temperatures and the data we looked up in the library, it was certainly "blabber gas." The error was really small and the experiment worked really good. Other errors include: possible math errors in our calculations and human error. Overall the lab was really good and we learned quite a lot of stuff. I especially liked the part where the blabber gas exploded when heated scaring my partner (I think that may be why she broke the thermometer). The only criticism of the lab is that the equiptment wasn't really great and that we ran out of time but otherwise it was a really good experinence and I think it taught us a lot of chemistry.

Notes: For references we used our textbook, lab manual, and the Chemical Handbook found on shelf 2 of the library (behind the reference desk).

From: **http://homepage.smc.edu/gallogly_ethan/sample_lab_reports.htm**

In this site you can also find an improved version of the same report!

Introduction

- Background Information
- Hypothesis
- Purpose

From general to specific

- **First:**
  - Why a non-scientist would be interested in the topic.
  - How the topic relates to human concerns.

- **Later:**
  - What was used in the study and why.
  - Background information on topics the reader should know to understand the basis for the experiment and its results.

- **Near the end:**
  - The variable tested and why it may have an effect.
  - What previous investigations have found.

Identification of a Compound using Melting and Boiling Points

Introduction

One of the primary methods used to characterize a new compound is the physical determination of its normal melting and boiling points. The "normal" melting and boiling point is the temperature at which a substance melts or boils when the barometric pressure is 760 mmHg or 1 atm. In this experiment we will first calibrate our thermometers using ice and water, whose normal melting and boiling points are well characterized as 0.0 °C and 100.0 °C, respectively [1]. Following this, we will measure the normal melting and boiling points of an unknown compound. We will use this data to determine the identity of our unknown from a list of possible unknown samples and physical data from the Chemical Handbook[2].

Procedures

- Experimental set up
- Instrumentation
- Materials (reagents)
- Variables (conditions)
- Calculations
  - calibration of instruments and
  - special features e.g.how well the temperature was controlled
  - barometric pressure
  - concentrations of solutions (with an indication of calculations)

Procedures

- Rewrite the original instructions in a clear, logical and concise sequence.
- The order instructions are given in the lab manual are not always the best for a Procedures section.

Experimental Procedure

As described in the lab manual,[3] ice was placed in a beaker and warmed until approximately 50% had melted. The temperature of the ice/water mixture was then measured with a thermometer. This was followed by a similar measurement of our solid unknown. In part II, water was heated until boiling and the temperature of the liquid/gas mixture measured with a thermometer. This was followed by a similar measurement using our unknown compound. To get the best results possible, the procedure in the manual was modified by repeating each trial three times.

From: http://homepage.smc.edu/gallogly_ethan/sample_lab_reports.htm

Lab Report Procedures section

"I measured the number of tree rings in cross-sections of 9 spruce trees."

Lab Report Procedures section

"The number and width of tree rings were measured in cross-sections of 9 spruce trees."

Lab Report Procedures section

- "I obtained 10 grams of NaCl from the front bench and dissolved it in 250 ml of water in a glass beaker. The data were recorded in a table"

Lab Report Procedures section

- “Ten g of NaCl were dissolved in 250 ml of water“

- It is assumed that data are recorded. Note also that a sentence should not begin with an arabic number (i.e., "10").

Lab Report Procedures section

- “The width of the tree rings was measured in millimeters using calipers while viewing the tree sections under a microscope.”

Lab Report Procedures section

- “The width of the tree rings was averaged for a 10 year span for all 9 trees.”

Results

- Tables and figures
- Description of data

Data & Results

The Barometric pressure in the lab was measured to be 761.2 mmHg.

Table One – Experimental Data

Trial	Water Melting Pt.	Water Boiling Pt.	Unknown 7 Melting Pt.	Unknown 7 Boiling Pt.
1	~~0.7 °C~~ *	101.2 °C	80.2 °C	272.7 °C
2	0.1 °C	101.1 °C	80.7 °C	272.8 °C
3	0.0 °C	100.9 °C	80.4 °C	273.0 °C
4	0.1 °C	n/a	n/a	n/a
Averages:	**0.15 °C**	**101.1 °C**	**80.4 °C**	**272.8 °C**
Standard deviation (s):	**± 0.06**	**± 0.15**	**± 0.15**	**± 0.06**
95% confidence limits:	**± 0.14**	**± 0.4**	**± 0.4**	**± 0.14**

* This trial was eliminated because the thermometer was broken (there was a bubble of air in the mercury). A new thermometer was obtained from the stock

Observations: The unknown was yellowish-orange in color and had a fruity smell.

As can be seen from our water data the experimental values for the melting and boiling points of water differed from the theoretical values by +0.15 °C and +1 to calibrate the average data for the unknown. Thus the corrected values for the unknown boiling and melting points are given in Table 2.

Table Two – Corrected Temperatures

	Unknown 7 Melting Pt.	Unknown 7 Boiling Pt.
Measured value	**80.4 °C ± 0.4** (95%)	**272.80 ± 0.14 °C** (95%)
Correction	+0.15 °C	+ 1.1 °C
Corrected value	**80.5 °C ± 0.4** (95%)	**273.90 ± 0.14 °C** (95%)

These values were used to identify our unknown. Table Three below lists possible unknowns and the melting and boiling points for these compounds found in

Tables and Figures

A correctly prepared table should:

1) be sequentially numbered (Table 1, Table 2,etc.)
2) have a **descriptive** title
3) have rows and columns clearly labeled.

Table 1. Effect of different pollutants on *Chlorella*.

Ecosystem	# of cells 10^6/ml	% of control
control	20	--
pollutant 1	23	115%
pollutant 2	3	15%
pollutant 3	10	50%
pollutant 4	19	95%

Table number and title.

Headings neatly formatted.

Paragraph Topic sentence.

It is OK to include some procedures to clarify the results.

Description of key values and trends.

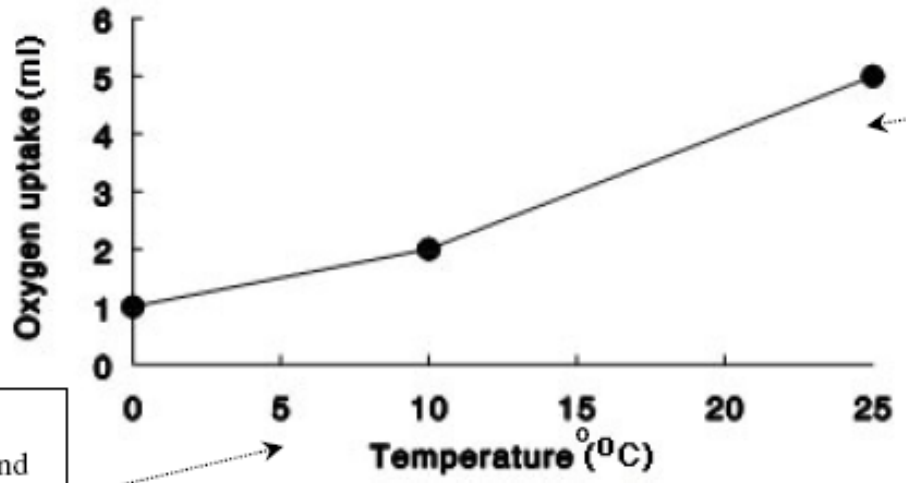
The description of this data might be:

The effects of the four pollutants on algal cell growth was also investigated. The number of *Chlorella* cells remaining after twenty days growth with each pollutant is shown in Table 1. The control (grown in spring water only) contained 20×10^6 cells per ml. Pollutant 2 had the most dramatic effect, reducing the cell count to 3×10^6 cell/ml (15% of the control). Pollutant 3 reduced the cell count to 10×10^6 cells/ml (50% of the control). Pollutants 1 and 4 had very little if any effect, yielding 115% and 95% of the control, respectively.

TABLE 2. SUMMARY OF RESULTS FROM INFRARED SPECTROSCOPY OF $^{12}C^{16}O$		
Parameter	**Experimental Value**	**Literature Value[a]**
$\omega_e - 2x_e\omega_e$	2142.2 ± 0.1 cm-1	2143.3 cm-1
Be	1.933 ± 0.008 cm-1	1.9313 cm-1
α_e	0.018 ± 0.002 cm-1	0.01748 cm-1
Re	0.1128 ± 0.0007 nm	0.11281 nm

[a] From Gordy, W.; Smith, W. V.; Trambarulo, R. F. *Microwave Spectroscopy*; Dover Publications: New York, 1953.

Examples of a correctly prepared Graph :



Data points clearly marked and connected by a line.

Titles and units presented for X and Y axes.

Figure 1. Oxygen uptake by barley seeds measured at different temperatures.

Figure number and title.

The description of this data might be:

Figure 1 presents the uptake of oxygen by barley seeds over a five minute period. Temperatures tested ranged from 0 to 25 degrees Celsius. At the lowest temperature, no oxygen uptake occurred. As the temperature was increased, oxygen uptake by the seeds increased in a linear fashion, to a maximum value of 5 ml O_2 at 25 ^{o}C.

Description of key values and trends.

Description of Results should:

- Locate your findings. (e.g.Table 1 shows…)
- Use **third person** passive voice.
- Describe the **key features** and trends that you perceive in the data presented in the figures and tables.
- Do **Not interpret** the data. Explaining what the results mean or why the results occurred is done in the Discussion section of the lab report.

Results: Numbers and units

- Numbers should never stand alone —they must be accompanied by appropriate units (e.g. ml, cm, cm/sec, etc.).
- Decimal numbers should always have at least one numeral before the decimal point (0.47g not .47g).
- Superscripts and subscripts should be used when needed: 25°C, $80cm^2$, H_2O

Discussion section

- Conclusions
- Explanation of results
- Future experiment

Discussion

Conclusions

The data did not support the hypothesis that increasing light intensity would cause a decrease in the number of stomata. Instead, between 1000 and 5000 lux, the stomatal density increased proportionally with the light intensity.

Conclusion relative to hypothesis.

Explanation of Results

It was expected that light intensity would cause a decrease in the number of stomata. Instead the opposite relationship was observed (figure 1). It is possible that the increase in the number of stomata was due to an increased rate of photosynthesis.

Proposed explanation of results.

The function of stomata is closely related to photosynthesis. Mesophyll cells are the most important cells for photosynthesis in the leaf and need a source of CO_2 (Raven et al., 2008, 737). Somata form pores in the leaf to allow exchange of CO_2 and water through the leaf cuticle layer to the underlying mesophyll cells (Buchanan et al., 2000, 651). Photosynthesis also increases as the amount of light increases (Rabinovich and Govingee, 1995, 223), and it is possible that more stomata allow higher rates of photosynthesis to occur.

Literature sources to support explanation.

Other researchers have reported that stomatal density corresponds to other environmental factors, such as humidity and CO_2 concentration (Fraser et al., 2008, 773). Furthermore, mutant plants with abnormally high numbers of stomata were observed to have higher rates of photosynthesis.

Comparison to previous research.

Future experiment

If the number of stomata does allow for more photosynthesis, then we should be able to measure this. The increase in photosynthesis could be measured directly, or by comparing the size and weight of the plants.

Future experiment builds upon results of this one.

Experimental Errors

- Human errors
- Measurement errors
- Statistical errors

How to use source information

- Never directly copy or quote sentences from your sources
- Ideas should be conveyed in your own words
- Sources should be cited and referenced

In-text Citations

If the source has **a single author**, then the citation is written as:(Smith, 1992, 97)

If the source has **two authors**, then the citation is written as: (Smith and Jones, 1997, 184)

If the source has **three or more authors**, the abbreviation ‘et al.’ is used after the first author’s name: (Smith et al., 1997, 184)

End-text references

- Hilsenhoff WL. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist 20: 31-39.

Cover page

- Title of lab experiment performed
- Professor’s name
- Your name
- Team members
- Submission date

Title

- Is relevant, brief but specific
- Includes key research variables, research methodology used, and overall findings
- Written not as a full statement but a phrase describing the experiment ~~(A, An, The)~~

Rubric

Lab Report Rubric (General)

	Points Awarded				
	4	3	2	1	0
Introduction	* Includes the question to be answered by the lab * States the hypothesis and provides a justification to support position. Justification is based on sound reasoning and/or research * Title is relevant, concise, and provides the reader with a clear understanding of what the lab is about * Hypothesis is testable	One of the previous conditions is not met satisfactorily	Two of the previous conditions are not met satisfactorily	Three of the previous conditions are not met satisfactorily	
Procedure			A description or step-by-step list of how the experiment was performed	Description is unclear and/or could not be repeated	
EDD		* All required parts are present * IV and DV are clearly defined, avoiding qualitative statement when possible * Control is present and reasonable * Constants table is complete and displays a well thought out list	One of the previous conditions is not met satisfactorily	Two of the previous condition are not met satisfactorily OR the IV and/or DV are not clearly defined	

Rubric (continued)

Results/Data	* Results and data are clearly recorded, organized so it easy for reader to see trends	Trends not obvious and/or incorrect type of table or chart is used to display data	Results are unclear	Results are present, though too disorganized or poorly recorded to make sense of.	
	* All appropriate labels and units are included	Labels present but units are not included	Labels missing		
	* Titles are clear and informative for all tables and graphs	Titles are unclear and/or lack enough information	Titles are basic (e.g. Graph 1)		
Analysis	The data and observations are analyzed accurately, trends are noted and explained, enough data was taken to establish conclusion	Analysis is somewhat lacking in insight (more background research may have been needed), there is enough data although additional data would have been more powerful	Analysis is lacking in insight, not enough data was gathered ot establish trends OR analysis does not follow data	Analysis poor, not enough data, inaccurate analysis	
Conclusions	* Summarizes the essential data used to draw the conclusions	One of the previous conditions is not met satisfactorily	Two of the previous conditions are not met satisfactorily	Three of the previous conditions are not met satisfactorily	
	* Conclusions follow data (wild guesses or leaps of logic are not present)				
	* Discusses applications of experiment				
	* Hypothesis is rejected or accepted based on the data				
	* Error analysis				
Format		Organized with the correct headers	Somewhat lacking in organization; incorrect headers	Organization is haphazard or organization that is present impedes the ability of the reader to follow the document	
		Wiki links/link-backs are operational and present	Present but not operational or link to incorrect pages	No page links/link-backs present	
		Images and pages are properly labeled within the Wiki		Incorrect labeling or non-existent	
		No spelling errors and/or grammer errors	Few spelling and/or grammer errors present	Multiple spelling and/or grammer errors present	

References

- http://www.ncsu.edu/labwrite/lc/lc-improvinglaprep.htm
- http://www.writing.utoronto.ca/advice/specific-types-of-writing/lab-report
- https://lfcdsscience8.wikispaces.com/Lab+Report+Template
- http://www.udel.edu/pchem/C446/example.pdf
- http://www.marietta.edu/~biol/introlab/labreprt.pdf

End of Section

Financing

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Notes

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