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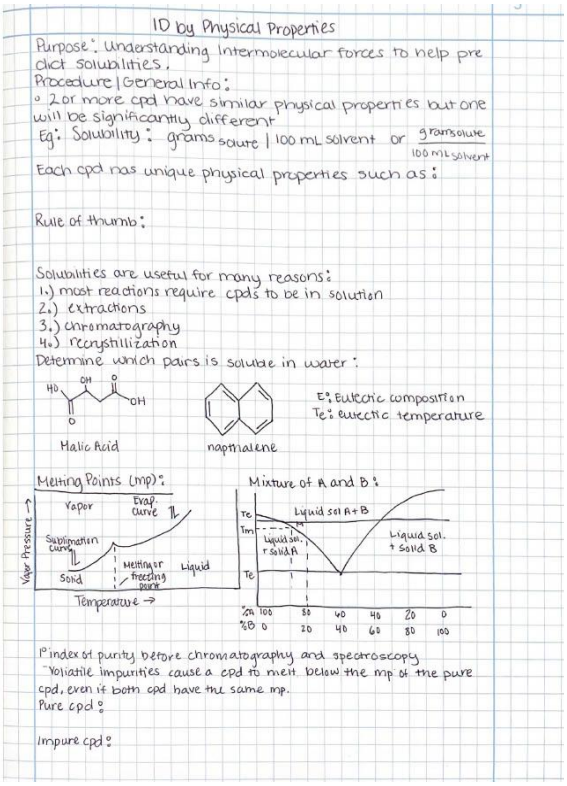
Crucial Role of Research in Biological Writing Genres

Many people going into college want to pursue biology as a degree. This tends to be the typical route for many pre-medical students in the nation. Majoring in biology comes with lots of challenges. Along with tedious and rigorous coursework, there's an overarching challenge of mastering the art of writing in biology. The most important writing genres in biology include scientific journals, notebooks, scientific studies, and reports. Proficiency in the various writing genres specific to biology is undeniably crucial. Among these genres, the significance of lab notebooks shines the brightest since it is the most utilized in and out of college. Research plays a pivotal role in the creation of lab notes and in documenting experiments, recording observations, and analyzing findings. Essentially, being able to produce clear and concise work in lab notebooks is important for those who plan on advancing in the biological or medical field. Furthermore, mastering biological writing helps students get familiar with the formal writing processes that will encompass their whole careers. To support this, I will present literature that shows the significance of biological writing for college students, provide details and showcase lab notebook examples to underscore the importance of research. This will therefore demonstrate and prove the importance of biological writing skills both in and out of college.

To begin, I am a third-year biological major who wants to pursue a career in medicine. When starting my college days I did not expect to be writing much in science. No one expects to

be writing in classes that require problem-solving, critical analysis, or just following directions. However, when you take a deep dive into biology, you see that the directions or procedures you're following have to be written by a scientist or biologist. Throughout the course of my writing, I have noticed that the majority of literature I had to write was reports, research papers, or provide analyses from other biological literature. As Alyssa Shapiro mentions, "Research is vital to Biology". This is describing that biology is all about discovering the unknown and then attempting to explain the findings in a way to show how the world really functions. This is usually done through a lab notebook.

Laboratory notebooks are single-handedly one of the most important tools to document results and write down procedures (Shapiro 82). This allows for the experiment to be replicated by other researchers or peers. Writing in a lab notebook consists of the following steps: writing each step of the procedure down, and documenting the date, including pictures, diagrams, and analysis of what happened during the procedure. This can be one of the more informal writing genres of biology since it doesn't require one to have an essay-style approach. This tradition of writing down procedures has been going on since Aristotle's time. He describes this practice as a type of literature and shows that it is central to research and the organization of ideas (Föllinger 243). This describes that an essential tool for college students to learn is the act of writing ideas and procedures down. This would in turn be crucial for pursuing a career in science. Many scientists, biologists, research assistants, and even professors partake in research for the majority of their careers. The only way for their research to be considered is if they have evidence and proof of the experiments they have done. The organization of the ideas and details is an important factor when it comes to writing in lab notebooks. It is essential to have the proper techniques to formulate successful research.



ID by Physical Properties

Purpose: Understanding intermolecular forces to help predict solubilities.

Procedure | General Info:

- 2 or more cpd have similar physical properties but one will be significantly different

Eg: Solubility: grams solute / 100 mL solvent or $\frac{\text{grams solute}}{100\text{ mL solvent}}$

Each cpd has unique physical properties such as:

Rule of thumb:

Solubilities are useful for many reasons:

1.) most reactions require cpds to be in solution
2.) extractions
3.) chromatography
4.) recrystillization

Determine which pairs is soluble in water:

Malic Acid

naphtalene

E: Eutectic composition
Te: eutectic temperature

Melting Points (mp):

Vapor Pressure → Vapor, Evap. Curve, Sublimation Curve, Solid, Melting or freezing point, Liquid

Temperature →

Mixture of A and B:

Te, Tm, Liquid sol A+B, Liquid sol. + solid A, Liquid sol. + Solid B

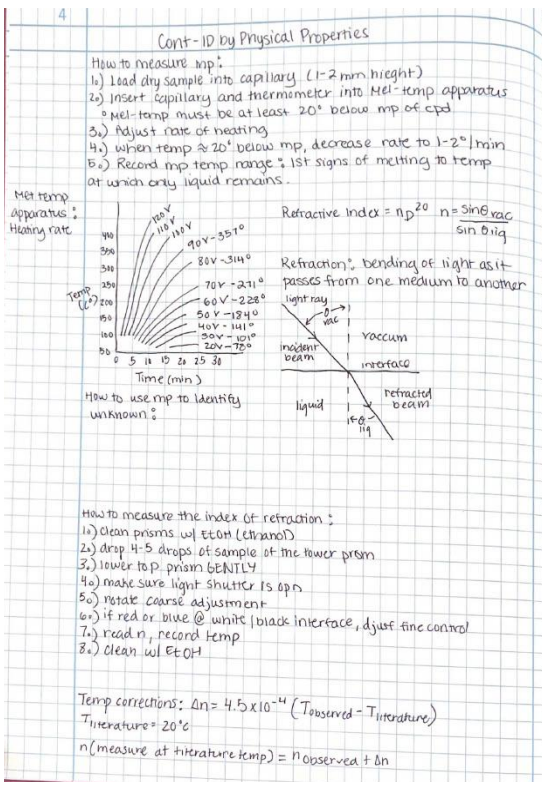
%A 100 80 60 40 20 0
%B 0 20 40 60 80 100

1° index of purity before chromatography and spectroscopy

- Volatile impurities cause a cpd to melt below the mp of the pure cpd, even if both cpd have the same mp.

Pure cpd:

Impure cpd:



Cont - ID by Physical Properties

How to measure mp:

1a) Load dry sample into capillary (1-2 mm hieght)
2a) Insert capillary and thermometer into Mel-temp apparatus
- Mel-temp must be at least 20° below mp of cpd

3a) Adjust rate of heating
4.) when temp ≈ 20° below mp, decrease rate to 1-2°/min
5a) Record mp temp range: 1st signs of melting to temp at which only liquid remains.

Mel temp apparatus: Heating rate

110 V, 110 V, 110 V, 90V - 357°, 80V - 314°, 70V - 271°, 60V - 228°, 50V - 184°, 40V - 141°, 30V - 101°, 20V - 75°

Temp (°C) 400 350 300 250 200 150 100 50
0 5 10 15 20 25 30
Time (min)

How to use mp to identify unknown:

Refractive Index = n_D^{20} $n = \frac{\sin\theta_{vac}}{\sin\theta_{liq}}$

Refraction: bending of light as it passes from one medium to another

light ray, θ vac, vacuum, incident beam, interface, liquid, refracted beam, θ liq

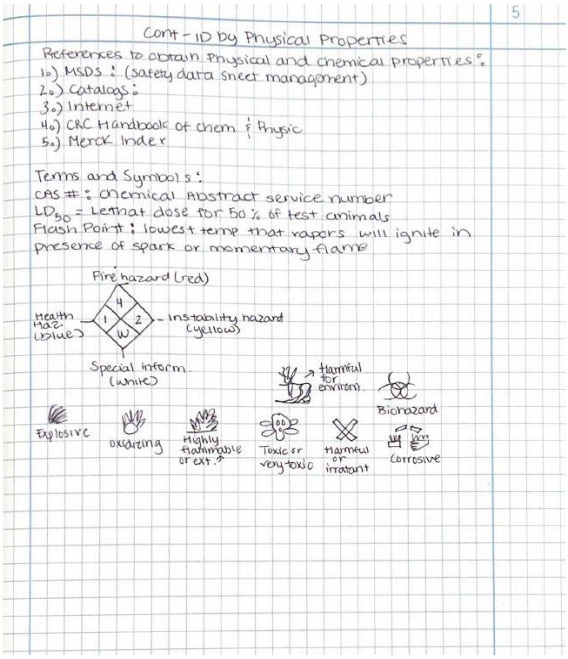
How to measure the index of refraction:

1a) clean prisms w/ EtOH (ethanol)
2a) drop 4-5 drops of sample of the lower prism
3.) lower top prism GENTLY
4a) make sure light shutter is open
5a) rotate coarse adjustment
6a) if red or blue @ white | black interface, djust fine control
7a) read n, record temp
8a) clean w/ EtOH

Temp corrections: $\Delta n = 4.5 \times 10^{-4} (T_{observed} - T_{literature})$

$T_{literature} = 20°C$

$n_{(measure\ at\ literature\ temp)} = n_{observed} + \Delta n$



Cont - ID by Physical Properties

References to obtain Physical and chemical properties:

1a) MSDS: (Safety data sheet management)
2a) Catalogs:
3a) Internet
4a) CRC Handbook of chem & Physic
5a) Merck Index

Terms and Symbols:

CAS #: Chemical Abstract service number
LD_{50} = Lethal dose for 50% of test animals
Flash Point: lowest temp that vapors will ignite in presence of spark or momentary flame

Fire hazard (red)
Health haz. (blue)
Instability hazard (yellow)
Special inform. (white)
W

Harmful for environ.
Biohazard
Explosive
oxidizing
Highly flammable or ext.
Toxic or very toxic
Harmful or irritant
Corrosive

(All images from Lab Procedure Jaisleen Kaur)

To elaborate, the pictures shown above are 3 pages from my organic chemistry lab notebook. The pictures show that a lab notebook has multiple parts to it which need to be clear

and concise. To break this down, a lab notebook has to consist of key features such as page number and a title. This helps orient the reader and experimenter to know they are performing the correct procedure. It is also a form of organization since lab notebooks require a table of contents on the first page of the notebook.

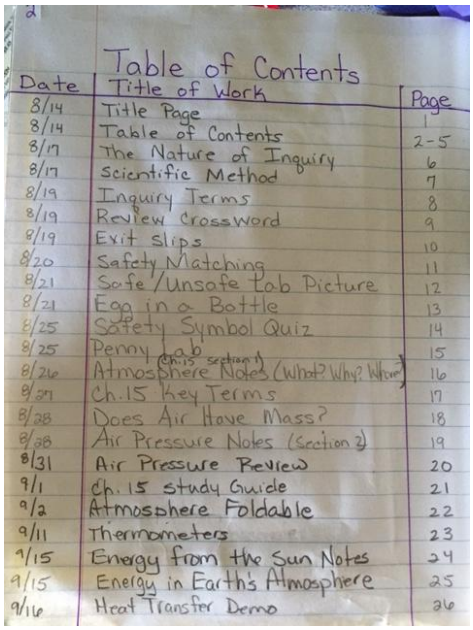


Table of Contents

Date	Title of Work	Page
8/14	Title Page	1
8/14	Table of Contents	2-5
8/17	The Nature of Inquiry	6
8/17	Scientific Method	7
8/19	Inquiry Terms	8
8/19	Review Crossword	9
8/19	Exit Slips	10
8/20	Safety Matching	11
8/21	Safe/Unsafe Lab Picture	12
8/21	Egg in a Bottle	13
8/25	Safety Symbol Quiz	14
8/25	Penny Lab	15
8/26	Atmosphere Notes (What? Why? Where? this section)	16
8/27	Ch.15 Key Terms	17
8/28	Does Air Have Mass?	18
8/28	Air Pressure Notes (Section 2)	19
8/31	Air Pressure Review	20
9/1	Ch. 15 Study Guide	21
9/2	Atmosphere Foldable	22
9/11	Thermometers	23
9/15	Energy from the Sun Notes	24
9/15	Energy in Earth's Atmosphere	25
9/16	Heat Transfer Demo	26

(Table of Contents Lab Notebook)

An example of a table of contents in a lab notebook is shown above. This page is handwritten with three specific items that need to be included. These items are a date category, the title of the work, and the page number. This is also reflected in the images I attached of the lab procedure above. All these categories are included basically on every page of the notebook which makes it easy to navigate. Furthermore, writing the lab procedure itself has guidelines and specifications that need to be followed. For example, in my lab notebook, when starting to write the procedure there must be a purpose. The purpose is an overview of what the experiment aims to perform and what needs to be understood. In my lab procedure, I mention, “Understanding intermolecular forces to help predict solubilities” as my purpose (Kaur 1). This encompasses the

whole experiment's main point and helps orient the reader. Next, the most important part of research or recreating research is the procedure section. The procedure section is highlighting and describing every step of the experiment. This is crucial for a lab notebook since they are used to reproduce experiments or create new ones for later reproduction. Every step must be listed and followed in order to perform the correct experiment. Another component of the lab notebook is including visuals such as tables, graphs, and diagrams. The lab procedure above has 4 tables and 2 diagrams which respectively identify trends in the experiment and the compounds used. This approach is essential for observing the patterns inherent in the experiment and formulating hypotheses regarding anticipated outcomes. It is important to note that writing in lab notebooks is essentially permanent, as mistakes cannot be erased or corrected and must be crossed out by a single line. This ensures that data is not being manipulated and ensures the integrity of the procedure. Returning to the research aspect of lab notebooks, ensuring that there are no deletions in the notebook is crucial as it facilitates the identification of experiment flaws, data discrepancies, and necessary improvements, while also enhancing the experiment's reproducibility. This once again solidifies that college students must be familiar with the practice of writing details down in order to be successful in biological writing in college.

Next, while lab notes serve as important sources of information, not all of them are equally effective. Hence, what attributes contribute to the effectiveness of lab notes? The structure of lab notes is most crucial as I have explained in the paragraph above however, the last part which is analysis is equally as important. The analysis portion is usually the last part of the lab notes for a specific experiment. The analysis examines the experiment's outcomes and addresses questions such as the correctness of your hypothesis and the alignment of results with the experiment's purpose. By engaging in this process, the experimenter can identify any

procedural flaws and devise solutions to enhance their findings and procedures. During analysis, calculations are performed to show the level of success attained in the experiment. These calculations recorded in lab notebooks serve the purpose of quantifying and evaluating the outcomes, while also allowing for an assessment of the experiment's effectiveness. These components altogether are crucial for a college student in the biological major since the majority of their time will be spent doing research and experimentation. Thus, the lab notebook is an important tool to succeed in college.

The process of a lab notebook or journal also extends to other fields than college. For example, the act of students being able to compile data and statistical models is an essential skill to be able to present their findings and conclusions (Dirrigl Jr et al. 164). This may seem like it only applies to fields of medicine or biology, however, this is an overarching theme used in many jobs. This is a major aspect of financial analysts, economists, and marketing jobs. A crucial skill for them is to crunch numbers and data and also be able to prove that their product is valid through supporting evidence. This obviously is true for researchers in biology, they also have to take their findings and statistics to be able to prove the significance of their studies. Scientific journals serve as the primary channels through which the academic community communicates (Measey 11). The availability of journals as they are today has played a pivotal role in fostering significant advancements in the field of biological sciences. This shows another reason why documentation in biology is so important. It allows others to build off of prior knowledge and then build upon that knowledge.

Moreover, I will delve into the correlation of biological writing within and beyond the college context. To start, being able to comprehend and navigate biological writing can help one achieve good grades in college. Most biology professors are firm on the guidelines they establish

for their students. So knowing how to write proper lab reports and scientific papers will ensure getting good grades. Scientific writing can also help do better in other core classes since "Science provides an effective context for reflection and consolidation"(Yore et al. 2). This explains that science itself is important however, it can also be used as a means to have more understanding in other classes. The process of writing in biology is very similar to that of other literacies such as English comprehension. When writing both papers one must plan, translate, and revise (Yore et al. 4). Essentially, much of the same steps go into writing different genres of biology. This can greatly benefit college graduates in their professional pursuits as it equips them with the necessary writing skills that are in high demand for many job positions. For example, Dr. Burks and Dr. Todd state that when studying biology and then pursuing a job as a biologist, one spends about a third of their time writing in some form (Burks & Todd 1). Pursuing a career in the biological field entails a lot of writing as I have explained above. Therefore, having a strong foundation in the lab notes genre of biology can ensure success out of college. It is a highly valuable skill, especially in the biological field as it allows individuals to effectively communicate their findings and procedures. Having this skill early on will be advantageous for professions that require concise documentation.

Biology also encompasses many other professions. For example, many philosophers, physicists, and classicists rely on the data provided through biology to draw conclusions in their own fields (Sharpley et al. 586). Many philosophers' primary jobs are to try to explain the phenomena of biology and how the findings relate to physical entities in the world. Philosophy related to biology relies on the experiments conducted by researchers and the detailed descriptions and analyses of the results they obtain. Researchers gather empirical data which then serves as the foundation that philosophers base their observations and inquires on. Therefore, by

elaborating on the significance of scientific writing, particularly the role of lab notebooks, students can develop a more comprehensive understanding of the multifaceted nature of biology and its intertwining relationship with written communication. Acquiring the skills necessary to excel in different genres of biological writing not only enhances academic success but also prepares individuals for the demands of their future careers in research, medicine, or related fields.

In conclusion, pursuing a degree in biology is a common path for many pre-medical students entering college, but it is not without its challenges. Besides the demanding coursework, there is a significant hurdle in mastering the art of writing in biology. Various writing genres, more specifically scientific lab notebooks play a crucial role in the field. Many students going to college for this major must know how to write details and procedures down, analyze data and present it effectively, and also be able to make hypotheses and conclusions based on their evidence and results. Proficiency in these genres is essential for aspiring professionals in the biological or medical fields, as it not only enables them to advance in their careers but also familiarizes them with the formal writing processes that will accompany them through their professional lives. By honing in on their writing skills in biology, students can position themselves for success and effective communication in scientific and other professional communities.

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