Handbook of

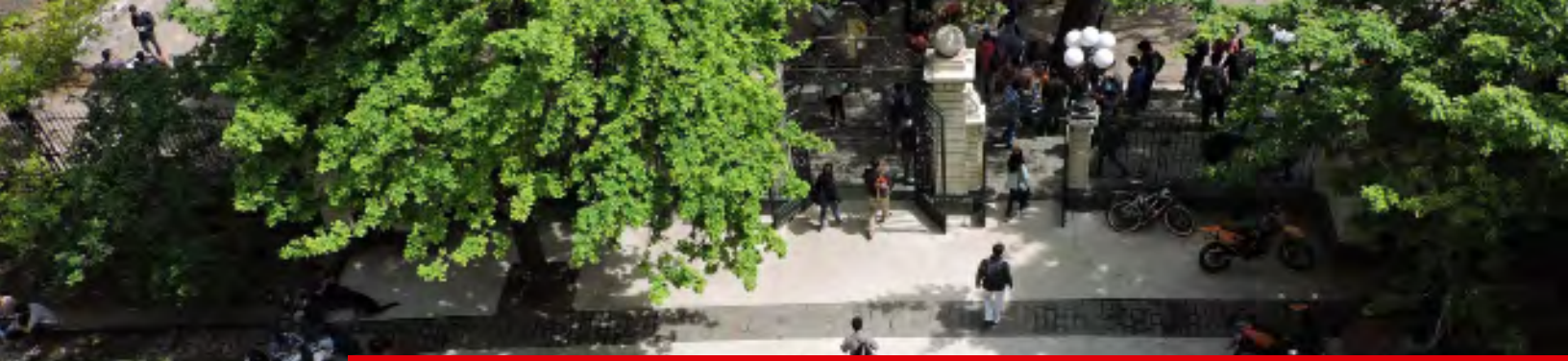
Thesis and Research Paper Writing in English for FCFM Students

Faculty of Physical and Mathematical Sciences
Universidad de Chile

FACULTAD DE CIENCIAS FÍSICAS Y MATEMÁTICAS
UNIVERSIDAD DE CHILE

Catalina Sandoval Muñoz
ESP consultant, **Armadillo Lab**

ARMADILLO
Laboratorio de Escritura



ACKNOWLEDGMENTS

I would first like to thank the authorities at the Faculty of Physical and Mathematical Sciences for the support and authorization of this Handbook. I would also like to thank the following people at the FCFM for their support through the process:

Enrique Sologuren Insúa and Paula Morgado, valuable members of the Armadillo's Team for their continuous support from the start of the project and because they made it happen.

Maria Pilar Mai, Ámbar Romero, and Elba Navarro from the Languages Department. Thank you for your feedback and support.

FCFM academics Diego Mardones, Xavier Emery, Patricio Felmer, J. Cristian Salgado, Rodrigo Espinoza, José Soto, Alejandra Serey, and Luisa Pinto Lincoñir. Thank you for taking the time to answer the survey, sharing your knowledge and impressions, and for sharing student samples.

FCFM students Diego Rojas, Jorge Zambrano, Victoria Bollo, Bastián Moya, Juan Pablo Romero Campos, Aníbal Zambrano, Darío Hübner, Bernardita Ried, José Diaz Villa, Matías Rojas, Matías Garrido, Belén Muñoz, Javier Ojeda, Sofía Pontigo, Juanita Antilén, Natalia Bustamante, Francisca Marchant, Emir Chacra, Nicolas Pérez, Pablo Torres, Claudia Aravena, Alejandro Poblete, Priyanjali Patel, Alfredo Hernández, Andrea Navarro, Francisca Andonie, Danny Espín, and every student I talked to in Armadillo tutorials. Thank you all so much for taking the time to answer the survey, sharing samples, and most of all, for inspiring me to write this handbook. Thank you for the hours shared in the tutorials, which I hope have helped you become better writers. You should be proud of being able to write academically in a foreign language! Thank you for teaching me about what you do and for trusting in what I know. You make me feel part of your achievements, which is extremely gratifying. This handbook is for you.

First edition,
Santiago, Chile, 2023

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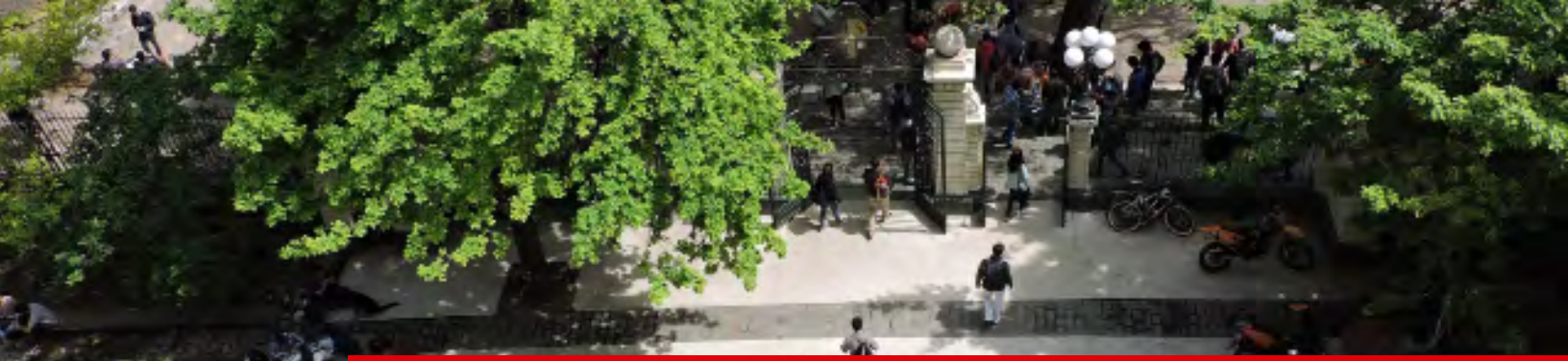


INTRODUCTION

As you may have already noticed, English is the language of science and most of the scientific journals require written English to be able to publish. Therefore, there is an increasing pressure on researchers worldwide to write in English and publish in academic journals either as a degree or a job requirement, if they work in academia. This means that besides the technical competencies, science and engineering students and professionals must be able to communicate effectively in written (and spoken) language across diverse contexts and audiences (e.g., from writing a research paper for experts to a brochure explaining a mechanism to a general audience; or writing an email or report to a supervisor).

Because the term "writing" is used throughout this handbook, some clarification is needed. *Writing* is not only correct spelling, punctuation, grammar, and connectors – which can be a common misconception. While those four aspects certainly contribute to a clear message, they alone do not equal writing. Developing writing skills considers the complete process: Brainstorming, collecting data, taking notes, organizing notes, planning (a section, a paragraph), drafting, asking for and getting feedback, revising (global changes), and editing (minor, surface changes).

Writing academically is all of that, but it is also being able to write directly, concisely, and with an academic tone (which is different from the kind of English you can use with a friend, or hear in series). What the whole process shows are two sides of writing: learning *to write* and writing *to learn*. For example, applying the steps of the writing process and knowing writing "rules" teaches you *to write*; on the other hand, by writing a thesis or a paper you are not only learning to write, but also writing *to learn* something new (e.g., when you draft and write the literature review section to demonstrate your understanding of the source by summarizing and evaluating the level of contribution of that source to your project).

As you can see, writing is a complex task, and even more so when done in a foreign language. Thus, this handbook's aim is to help FCFM students and researchers develop and strengthen their English academic writing skills. After almost 5 years of English writing tutorials held with more than a hundred students, online and in-person, a more systematic and complete tool was needed. Although there are numerous academic and professional genres in science and engineering, this manual focuses only on theses and research articles, since they have been the most frequent genres in Armadillo Lab tutorials. The topics have been chosen based on a needs assessment survey responded by 27 students, and 7 professors.

The handbook's organization is as follows: there are 2 main chapters, with 9 units each. The first chapter, "Thesis and Research Paper Writing in English" discusses how to organize your time and task before you write, the thesis/article structures, and each section in a traditional structure (introduction, literature review, methodology, results, discussion, conclusion). The chapter finishes with information about how to write abstracts. Each unit has the following sections: Preparation for the unit, main objectives and topics developed through sample analysis, Reflection, and Useful additional resources. Some units have Suggestions from FCFM scholars and Frequently asked questions by FCFM students. The second chapter is called "Academic Writing Foundations." It gives you all the tools to develop or strengthen your academic writing in English. It includes explanations, many examples from real writing samples, and in some cases, short practical exercises with an answer key. All references and the Appendix with useful dictionaries are included at the end.

So, how to use this handbook? You can study from start to finish, in a linear manner, or simply choose the unit(s) you need to work on for a specific purpose. For example, if you feel confident about your knowledge of thesis/paper sections, you may want to focus on units 1-9, related to academic writing; similarly, if you want to improve your sentences, go to that particular unit. Whichever order you choose, it is a good idea to have a real thesis/paper project to work on, so you can take more advantage of each unit and apply it in a real writing situation.

The handbook seeks to become a practical tool that can effectively contribute to academic literacy in English and to help students and researchers become better, autonomous writers; in doing so, they can be more confident writers and less dependent on a third person who "knows English," an automatic translation or an editing tool (these last two are useful, but not infallible or sufficient). As the handbook demonstrates, academic writing, and specifically, thesis and research writing is difficult and requires knowledge beyond English itself. Ultimately, this handbook aims to provide the tools to help you be more competitive in the research world, stand out, and most importantly, be able to participate in your disciplinary discussions.

To some extent, the handbook is also for FCFM professors. This is not only because they are writing about their research, but also because of their tutoring and teaching role. This seeks to be a pedagogical material that professors can use to guide students in the process, and to provide informed and constructive feedback. Put simply, this handbook is to give students "something to hold on to" while they are developing their projects. It shows that what may come as "intuitive" to professors, is not so for students, and that as advisors, they *must* provide the tools for their students to know *exactly* how to write according to their professors' expectations—as students begin to develop their own voice. It is finally an invitation for professors to collect good and bad writing samples to discuss with and teach their students.

Despite the contributions, there are some limitations. The samples included are limited to some disciplines and you may not see your area represented. This is only because the samples were obtained from students, and were therefore limited. Still, they are reliable, as they were shared as good models by professors, had a high grade, or are articles already published in recognized journals. Despite a few possible differences across disciplines, the units are applicable to a great extent to many of them. Another limitation was space constraints and lack of disciplinary knowledge, which limited the depth of theoretical explanations in science disciplines. The last limitation may be scope: it benefits mostly those students working on theses and papers rather than other genres. However, Units 1, 6, 9 in Chapter 2 can be just as useful to those who need to communicate in English in professional settings (e.g., through emails, reports, poster presentations, etc.).

On a final note, there are many, significant, informative academic writing books. Nevertheless, this one is different and better in several ways. It is local: It has emerged *from* and is developed *for* a particular school, so it has been carried out specifically for, and thanks to, the FCFM community. As I said before, the units chosen cover topics that have come up in years of one-to-one tutorials and workshops. It is also highly personalized: Some chapters address errors typical of Spanish speakers, which are not often discussed in much detail in mainstream writing books. Finally, it is free, so *use, learn, and share!*

Chapter 1

Thesis and Research Paper Writing in English

Unit overview:

Unit 1: Writing in English and in science disciplines
Unit 2: What to do before writing begins
Unit 3: Writing the introduction
Unit 4: Planning and writing the literature review, avoiding plagiarism, and connecting sources
Unit 5: Writing the methodology section
Unit 6: Writing the results section
Unit 7: Writing the discussion section
Unit 8: Writing the conclusion section
Unit 9: Writing the abstract

Chapter 1

Unit

Writing in English and in science disciplines

In this unit, you will learn about

- Academic Writing considerations
- Features of Academic English
- How to start "sounding" academic: Rhetorical moves and Metalanguage

Preparing for the unit

1. Do you agree or disagree with the following statements?

1) Translating a paper is enough for submission
2) Planning what you are going to write in your paper is a waste of time (planing: taking notes, creating outlines, etc.)
3) Searching for "model papers" is useful to notice organization and learn phrases to use in my paper
4) Sending a paper to someone who has "better English" than me ensures my writing will be better
5) Fixing all the grammar and punctuation ensures I will receive no negative comments about my writing in English

What does Academic Writing involve?

Writing academically (for example, writing a research paper or thesis) is different from *speaking* about a topic or writing about it in *everyday language* (for example, using the language you would hear in series, movies or lyrics). To be able to write academically and "sound" academic, you need to do this:

1) **Consider your audience and purpose:** *Who* are you writing to? Do they know *less*, the *same or more* than you? What are they *expecting* you to discuss? *Why* are you writing the article or thesis?
2) **Know how to "build" a thesis/paper section:** use the rhetorical moves required (discussed later in this unit).
3) **Demonstrate rhetorical moves with standard academic vocabulary:** use common academic phrases to indicate your purpose, such as "further investigations are needed."
4) **Organize ideas properly in a logical sense:** use connecting words and phrases to link ideas and make them understandable to readers, such as "For instance", "Furthermore", "However", and many others. (For more details, see Chapter 2, Unit 2).

5) **Use an academic tone and style:** do not use informal expressions or contractions. Use precise language. (For more details, see Chapter 2, Unit 6).
6) **Check grammar and punctuation errors:** one or two errors in grammar and punctuation is fine, but too many of them can affect intelligibility (clarity of ideas). While you can use free online editing software, they may not be 100% correct. (For more details, see Chapter 2, Units 3 and 9).
7) **Demonstrate academic rigor and integrity:** you are responsible for the accuracy of the information you are reporting. When in doubt, ask your professor. You are also responsible for giving credit to other researchers you are referring to in your work. This means that when you summarize, paraphrase, or discuss someone else's findings, you MUST cite and do it properly. (For more details, see Chapter 1, Unit 4).

Features of Academic English

1. Read these statements to help you reflect on differences between writing in Spanish vs English. Write "English" or "Spanish" or "Both languages."

1) Be more explicit about its structure and purposes: _____
2) Be less tolerant of digressions: _____
3) Use shorter sentences with less complicated grammar: _____
4) Have stricter rules for subsections and titles: _____
5) Use many citations: _____
6) Rely on more recent citations: _____
7) Have longer paragraphs (more words per paragraph): _____
8) Point more explicitly to "gaps" or "weaknesses" in previous research: _____
9) Use more sentence connectors (e.g. however): _____
10) Make the writer responsible for clarity and understanding (not the reader): _____

Adapted from Swales, J. & Feak, C. (2003). English in Today's Research World. The University of Michigan Press.

2. Reflect: What are common expectations or conventions in your field? Are they the same as the list above or not? Why?

How to start "sounding" academic: Rhetorical moves and Metalanguage

In simple terms, rhetorical moves mean "doing something through language." In a paper introduction, for example, you *establish* the importance of the topic, *review* previous work, or *indicate a knowledge gap*. In addition, papers also include "Metalanguage," which is the way *authors talk about their writing* (e.g., "This study explores…"), and there can be differences between disciplines. To illustrate rhetorical moves and metalanguage, let's look at an abstract It has been taken from a mining research paper called "A comparison of search strategies to design the cokriging neighborhood for predicting coregionalized variables." (For how to write abstracts, see Unit 9).

1. Read the abstract and put a number (1 to 5) according to the represented move on the right.

ABSTRACT	MOVES
[ ] Cokriging allows predicting coregionalized variables from sampling information by considering their spatial joint dependence structure. [ ] When secondary covariates are available exhaustively, solving the cokriging equations may become prohibitive, which motivates the use of a moving search neighborhood to select a subset of data, based on their closeness to the target location and the screen effect approximation. [ ] This paper investigates the efficiency of different strategies for designing a sub-optimal neighborhood wherein the simplification of the cockriging equations is challenging. [ ] To do so, five alternatives (single search, multiple search, strictly collocated search, multi-collocated search and isotopic search) are tested and compared with the reference unique neighborhood, through synthetic examples with different data configurations and spatial joint correlation models. [ ] The results indicate that the multi-collocated and multiple searches bear the highest resemblance to the reference case under the analyzed spatial structure model, while the single search and the isotopic searches , which do not differentiate the primary and secondary sampling designs, yield the poorest results in terms of cokriging error variance.	1) State the importance of the topic 2) Identification of a knowledge gap or a problem to be solved 3) Aim(s) of the study 4) Methods 5) Results

2. Which standard phrases indicate these moves?

3. Which verbs signal each rhetorical move? Are they in present, past, or future tense?

These are the answers:

ABSTRACT	MOVE NUMBER AND ASSOCIATED VERB TENSE/USE
[1] Cokriging allows predicting coregionalized variables from sampling information by considering their spatial joint dependence structure. [2] When secondary covariates are available exhaustively, solving the cokriging equations may become prohibitive, which motivates the use of a moving search neighborhood to select a subset of data, based on their closeness to the target location and the screen effect approximation. [3] This paper investigates the efficiency of different strategies for designing a sub-optimal neighborhood wherein the simplification of the cockriging equations is challenging. [4] To do so, five alternatives (single search, multiple search, strictly collocated search, multi-collocated search and isotopic search) are tested and compared with the reference unique neighborhood, through synthetic examples with different data configurations and spatial joint correlation models. [5] The results indicate that the multi-collocated and multiple searches bear the highest resemblance to the reference case under the analyzed spatial structure model, while the single search and the isotopic searches, which do not differentiate the primary and secondary sampling designs, yield the poorest results in terms of cokriging error variance.	[1] Present simple to state general facts [2] Present simple to state general facts [3] Present simple to state general purpose of the study [4] Present simple to describe the methodology or procedures – passive voice to emphasize process [5] Present simple to state results

4. This is another abstract from a paper titled "Thermal history of type 3 chondrites from the Antarctic meteorite collection determined by Raman spectroscopy of their polyaromatic carbonaceous matter" (Bonal et al., 2016). Identify the moves and their associated verb tenses.

This paper is focused on the characterization of the thermal history of 151 CV, CO and unequilibrated ordinary chondrites (UOCs) from the NASA Antarctic meteorite collection, using an approach based on the 13 structure of the included polyaromatic carbonaceous matter determined by Raman spectroscopy. 114 out of these 151 chondrites provided Raman spectra of carbonaceous matter and allowing to assign a petrologic type, which mostly reflects the peak temperature experienced by the rock on the parent body. A thorough review of literature shows however that it is not possible to deduce a peak temperature because accurate calibration is not available. Twenty-three new weakly metamorphosed chondrites have been identified: MIL 07671 (CV3.1); DOM 08006 (CO3.0); DOM 03238, MIL 05024, MIL 05104, MIL 07193 (CO3.1); TIL 82408, LAR 06279 (LL3.05-3.1); EET 90628 (L3.0); GRO 06054, QUE 97008 (L3.05), ALHA 77176, EET 90066, LAR 04380, MET 96515, MIL 05050

(L3.1); ALHA 78133, EET 87735, EET 90909, LEW 87208, PRE 95401 (L3.05-3.1); MCY 05218 (H3.05-3.1) and MET 00506 (H3.1). This study confirms that the width of the D band (FWHMD) and the ratio of the peak intensity of the D and G bands (ID/IG) are the most adapted tracers of the extent of thermal metamorphism in type 3 chondrites. It also unambiguously shows, thanks to the large number of samples, that the width of the G band (FWHMG) does not correlate with the maturity of polyaromatic carbonaceous matter. This parameter is nevertheless very valuable because it shows that Raman spectra of CV chondrites preserve memory of either the metamorphic conditions (possibly oxidation controlled by aqueous alteration) or the nature of the organic precursor. Oxidation memory is our preferred interpretation, however an extensive petrologic characterization of this CV series is required to get firm conclusions. Pre-graphitic carbonaceous matter is reported in seven chondrites and is even the only carbonaceous material detected in the chondrites ALHA 78119 and DAV 92302. This pre-graphitic carbonaceous matter cannot be formed through radiogenic thermal metamorphism without metal catalysis. Shock metamorphism is another possible process for accounting its formation, but it appears less plausible.

5. This is another abstract from an MA in Engineering, specialized in chemistry: "Design of solar-biogas hybrid energy system for a mining process in Chile considering technical, economic and environmental aspects" (Vergara, J. 2021). Identify the moves and their associated verb tenses.

One of the main challenges of the mining industry from an environmental prospect is the growing increase in energy consumption. Over the next ten years, energy demand is expected to increase by 41% since mines are getting older and deeper, a change in the copper production structure and the increase in seawater consumption. Within the energy demand of a mining process, final energy consumption and electricity generation are the primary sources of greenhouse gas (GHG) emissions. Thus, decreasing energy consumption and studying new energy sources with a lower environmental impact becomes necessary. In this context, the use of hybrid renewable energy systems has proven to be an attractive option regarding costs, operability, and environmental impact. Besides, they are more resilient than single energy systems. The interest of this research is to design a hybrid renewable energy system to supply the electrical demand of a mining process and evaluate the possible trade-offs that may exist. For this purpose, a multi-objective optimization problem has been formulated considering two objectives: minimizing annual costs and minimizing GHG emissions. The calculation of GHG emissions includes direct emissions associated with fuel combustion and indirect emissions associated with electricity purchase. The proposed energy system considers solar energy and biogas generated from organic waste as primary energy sources, two energy storage systems (lithium-ion batteries and hydrogen storage), and a connection to the electrical grid. The approach is applied to a case study that considers a typical mine located in the North of Chile. The model has been implemented in the computational program Julia and solved using Gurobi. In the first instance, the problem has been solved considering each objective function separately, and then the multi-objective problem has been solved using the constraint method. Finally, a sensitivity analysis has been performed, considering the variation in energy demand, biogas availability, costs, and grid emissions factor. The results show that biogas and solar energy are attractive options to reduce costs and emissions in the mining industry. However, the biogas does not have the potential to cover the demand as it is limited by the biomass available. Regarding the system configuration, all the proposed technologies were selected in the simulations. The energy was primarily stored in batteries; nonetheless, there is no preference between storage systems considering GHG emissions. The use of energy storage systems showed to increase the costs.

However, these systems are needed to use more renewable energy and reduce emissions. A trade-off between costs and emissions was observed. Therefore, the prioritization of one criterion will significantly impact the other. Lastly, a second environmental criterion is suggested to evaluate the impact of renewable energy and energy storage systems such as abiotic depletion or the use of land.

6. Reflect: Select a research article from your discipline that you have already read. Which moves do you see? Do they follow the same order as the abstracts presented here? Is there a move(s) that is longer than the others? Why? What are the verb tenses used in each move?

ACADEMIC WRITING RESOURCES

- Bailey, S. (2011). *Academic Writing: A Handbook for International Students.* (3rd ed). Routledge.
- Caplan, N. (2020). *Grammar Choices for Graduate and Professional Writers.* (2° ed.). University of Michigan Press ELT.

Chapter 1

Unit 2

Before writing begins

At the end of this unit, you will be able to:

- Create a timeline for a paper and master thesis
- Know how to begin the writing process
- Know which thesis type you will write and apply the FCFM template

Preparing for the unit

1. Think of an academic writing project you have worked on or that you are working on. What steps do you follow before you write? Do you create a timeline or Gantt Chart to manage your time? What do you do first or last? Why? Do you plan what you are going to write or write immediately?

Create a timeline for a paper and a thesis

"To Achieve Big Goals, Start with Small Habits" (Nawaz, 2020, for full article click here). Does that sound familiar? Writing a paper or thesis can be a challenging and overwhelming task; however, it is not impossible. Although the suggestion is not starting with small "habits", we do suggest breaking up the paper or thesis writing process into small, manageable tasks.

As seen in the screenshot below, bigger tasks (academic and administrative ones) have been broken down into smaller tasks. Each of these has a progress indicator and submission date space. For the full explanation on how to get organized and see the complete, downloadable Excel sheet, click here.

Figure

Sample Dissertation Timeline (Screenshot)

	A	B	C	D	E	F	G	H	I	J
1	Dissertation Timeline									
2							September			
3	Task No.	Description	Additional information/ Dates	Resources Needed	Progress	To be completed by/ Submission date?				
4	1	Topic finding					week 1	week 2	week 3	week 4
5	1.1	Read through lecture notes and assignments for topic inspiration			In progress					
6	1.2	Create a mind map of possible topics and what interests me			In progress					
7	1.3	Select and start learning to use reference management software			In progress					
8	1.4	Preliminary research: is there enough sources data or literature available?			Not started					
9	1.5	Refine topic into research questions			Not started					
10	1.6	Write preliminary objectives for achieving my research question			Not started					
11	1.7	Meet with supervisor to discuss topic suitability, research question, and objectives			Not started					
12	1.8	Amend topic focus/ plan based on supervisor feedback			Not started					

Note. The screenshot shows only one large task out of many tasks. Extracted from *How to Create a Dissertation Timeline* (With Examples + Template), by Courtney Watson, Ph.D (https://mydissertationeditor.com/dissertation-timeline/). In the public domain.

How to begin the writing process

Once you have a timeline, you can start to plan your writing. There is no recipe that works for everyone, so try and see if what this manual suggests works for you or you need to start in a 16 different manner. In the case of theses, for example, some of the students surveyed for this handbook said they find the creation of the Table of Contents easy to do and helpful to write the chapters. For others, it is difficult to decide what to include or in which order to do so. Still, these are general suggestions:

1) **Familiarize with the type of document you have to write:** search for 1-2 theses or research papers that are similar to what you are studying. For theses, you can ask your professor for help to determine if the theses you found are good examples (in content, organization) or not. For papers, you can ask your professor for guidance as well, but you can also choose papers that come from reputable, discipline-specific journals, and well-known authors in your discipline.

   Notice this: Headings, subheadings, organization and length of each section, the rhetorical moves and metalanguage the authors used (it is a good idea to highlight them in the text). The most standard sections (sometimes with different names) are these:

   1) Introduction
   2) State of the art or literature review
   3) Methodology
   4) Results
   5) Discussion
   6) Conclusion

   The idea of using samples is not to copy them, but to use the documents as **guidance and examples** of what is expected in general terms.

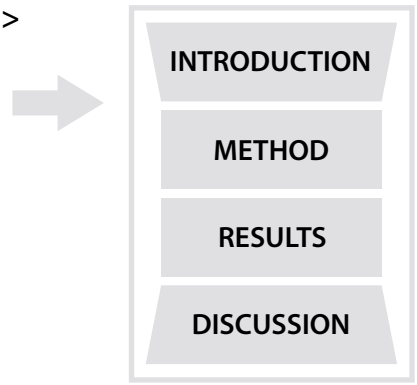
2) **Learn how to build each section:** each section is explained in detail in Chapter 1, Units 3 to 8

3) **Create an outline for each chapter and section:** guide yourself by a model thesis, the knowledge of what goes in each chapter and section. The Table of Contents can actually work as an outline you can use as the basis for paragraph writing later. Although some students write it last, doing it at the beginning can result in easier, more fluent writing later.

Thesis types: Structure

A **thesis** contains an original research developed by a student at the end of a master or PhD program. It must look into a specific topic with the aim of solving a complex problem originally, which is ultimately presented in an individual written document.

Thesis according to structure: Depending on the nature and purpose of the research, there are 3 types of theses: 'Simple' traditional, 'complex' traditional, compilation of research articles, and topic-based. All of these are presented in the table below:

THESIS TYPE	STUDIES	STRUCTURE
'Simple' traditional	1	**General to specific >** Introduction Review of the Literature materials and methods Results Discussion Conclusion **Specific to general** 
'Complex' traditional	More than 1	Introduction Background to the study and review of the literature Optional: Background theory Optional: General methods *Study 1* Introduction Methods Results Discussion and conclusions *Study 2* Introduction Methods Results Discussion and conclusions *Study 3* Introduction Methods Results Discussion and conclusions General Discussion Conclusions

Topic-based *more common in humanities and social sciences	N/A	Introduction Topic 1 Topic 2 Topic 3 Conclusions
Compilation of research articles	2 or 3 published or accepted for publication	Introduction Background to the study *Research article 1* Introduction Literature review Materials and methods Results Discussion Conclusions *Research article 2* Introduction Literature review Materials and methods Results Discussion Conclusions *Research article 3* Introduction Literature review Materials and methods Results Discussion Conclusions General Discussion Conclusions

Source: Paltridge, B. and Starfield, S. (2007). *Thesis and Dissertation Writing in a Second Language: A handbook for supervisors.* Routledge.

Paltridge and Starfield (2007) suggest that students look for theses similar to their research topic and perspective to use it as a model. It is then a good idea to consult with your thesis advisor for guidance on which theses are good models in terms of structure and content. Ultimately, you should take time to search and then analyze (with the help of the table above) how theses are written in your discipline and specifically, your research type.

Analysis of Examples:

Example 1: Master in Engineering, specialized in Chemistry

Length: 49 pages + Bibliography + Appendices

How many sections does the thesis have before the Introduction?
It has 8 sections: Cover, abstract in English, abstract in Spanish, personal phrase, acknowledgements, Table of Contents, List of Tables, List of Figures (up to page VIII).

How many sections does the thesis have? Which ones? It has 8:

- Introduction
- Theoretical Framework
- Research methodology and data
- Results and Discussion
- Conclusion
- Bibliography
- Appendices

What is the thesis type?
A traditional thesis type.

Are sections and subsections numbered? How many levels are there (e.g., 1.5.2 = three levels)?
Yes. There are up to three levels.

Example 2: Master in Sciences, specialization in Astronomy

Length: 33 pages + Acknowledgments + Bibliography

How many sections does the thesis have before the Introduction?
It has 8 sections: Cover, abstract in Spanish, abstract in English, personal phrase, acknowledgements, Table of Contents, List of Tables, List of Figures (up to page IX).

How many sections does the thesis have? Which ones? It has 6:

- Introduction
- Observations
- Analysis
- Discussion
- Conclusion
- Bibliography

What is the thesis type?
A traditional thesis type. However, the introduction includes a literature review.

Are sections and subsections numbered? How many levels are there (e.g. , 1.5.2 = three levels)?
Yes. There are up to three levels.

Example 3: PhD in Mining Engineering

Length: 179 pages + Bibliography + Annexes

How many sections does the thesis have before the Introduction?
It has 9 sections: Cover, Summary in Spanish, Summary in English, Acknowledgements, Table of Contents, List of Figures, List of Tables, List of abbreviations, List of Symbols (up to page XVII).

How many sections does the thesis have? Which ones? It has 7:

- Introduction
- Literature Review
- Theoretical Framework and Formulation
- Verification, implementation and discussion of results
- Conclusions and Future Work
- Bibliography
- Appendices

What is the thesis type? A traditional thesis type.

Are sections and subsections numbered? How many levels are there (e.g., 1.5.2 = three levels)?
Yes. There are up to three levels.

Example 4: PhD in Geology

Length: 118 pages + Bibliography + Annex

How many sections does the thesis have before the Introduction?
It has 8 sections: Cover, Abstract in Spanish, Abstract in English, Personal phrase, Acknowledgements, Table of Contents, List of Figures, List of Tables (up to page XI).

How many sections does the thesis have? Which ones? It has 9:

- Introduction
- Study Areas
- Methodology
- (Research Paper 1) Coseismic Landslides
- (In progress Research Paper 2) Landslides induced by the 2010…
- (Research Paper 3) Case study: Inventory of landslides
- Conclusions
- Appendix
- Bibliography

What is the thesis type?
Compilation of research articles that are linked together with an introduction, description of the study areas (common in Geology), the methodology, and a conclusion. According to this dissertation's author (Serey, 2020) at least for doctoral candidates in Geology, research article compilations are becoming increasingly popular, displacing the traditional thesis type. In fact, she adds that submitting one or two research articles for publication is becoming a graduation requirement in doctoral degrees.

Are sections and subsections numbered? How many levels are there (e.g. , 1.5.2 = three levels)?
Yes. There are up to three levels.

Reflect: Select a thesis that is similar to your research topic, perspective, and academic (Master or PhD). Analyze it in the same way as done above.

- Looking at the Table of Contents, how many sections does the thesis have before the Introduction?
- Looking at the Table of Contents, how many sections does the thesis have? Which ones?
- Using the Thesis Types Table above, which type of thesis is it?
- Looking at the Table of Contents, are sections and subsections numbered? How many levels are there (e.g., 1.5.2 = three levels)?
- Why do you think the author organized the thesis in this manner?

Apply the FCFM template

To help you get started in thesis planning and writing, you can download a template developed by FCFM students:
https://www.overleaf.com/latex/templates/memoria-tesis-slash-fcfm-slash-uchile/scfhvdjsvhvs.
It has already been formatted to comply with the School thesis guidelines, and it contains the main sections of a thesis.

Suggestions from the literature: importance of the title and the table of contents

"The table of contents may be the last thing a student writes, but is often one of the first things an examiner will read. The table of contents along with the thesis title are important 'sites of identity negotiation where the writer begins to align him or herself with a research tradition' (Starfield and Ravelli, 2006, p. 226). The contents pages present an overview of the thesis and, as such, act as an initial guide for the reader of the thesis. They also start to show how the student has located their work within a particular disciplinary, and research, culture." (Paltridge and Starfield, 2007, p.80).

Suggestions from FCFM's scholars

"Revisar artículos de la disciplina para conocer el estándar de la comunidad geocientífica."

Luisa Pinto Lincoñir – Profesora del Departamento de Geología

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"Ver ejemplos de tesis o papers de la disciplina, para adquirir vocabulario técnico y conocer la estructura de una tesis o un paper. [Además] definir primero la estructura del paper (los grandes títulos, con una idea de qué se debe relatar en cada sección/subsección para lograr generar un hilo conductor y luego, redactar."

Xavier Emery – Profesor de Ingeniería Civil de Minas y programas de postgrado de Ingeniería de Minas

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"Buscar otros artículos similares para tenerlos de referencia."

Patricio Felmer – Profesor del Departamento de Ingeniería Matemática

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"Que en la revisión [de papers del área] determine la estructura general y la específica para los papers similares al suyo… que ponga especial atención a la "terminología o palabras específicas" que se usan para referirse a conceptos del área."

J. Cristian Salgado H. - Profesor del Departamento de Ingeniería Civil Química e Ingeniería Civil en Biotecnología

THESIS/PAPER STRUCTURE ONLINE RESOURCES

- Hannabach, C. (2020, October 13). *Dissertation Writing Tips: Organizing Your Dissertation Chapters*. [Video]. YouTube. https://www.youtube.com/watch?v=mfwydL9vrkU&ab_channel=IdeasonFire
  TIP: For general orientation on where and how to begin, go to minute 35.

Chapter 1

Unit 3 Writing the introduction

In this unit, you will be able to

- Identify common rhetorical moves in thesis and research paper introductions
- Create an outline based on the necessary moves

Preparing for the unit

Think of a paper you have recently read. What information do you often see in introductions?

Common rhetorical moves in introductions

Whether the introduction belongs to a thesis or research paper, the main goals are establishing the topic or context of study, justify the study, and announce the organization of the work.

Thesis Introductions

The table below shows a comparison of Introduction components, organization, and length.

Thesis 1: MA in Engineering, specialized in Chemistry	**Thesis 2:** MA in Astronomy	**Thesis 3:** Phd in Mining Engineering	**Thesis 2:** PhD in Geology
1.1 Background 1.2 Research Questions and Goals 1.3 Research scope 1.4 Thesis structure **Length:** 5 pages	1. Introduction 1.1 Motivation: - Problem to be solved - Aim of the study - Study outline 1.2 to 1.6: Literature discusses each key concept of the thesis 1.7: Survey description **Length:** 7 pages	1.1 Introduction 1.2 Statement of the Problem 1.3 Summary of the Literature Review 1.4 Objective of Study 1.5 Scope and Limitations of the Research 1.6 Research Methodology 1.7 Scientific Contribution and Industrial Significance of the Research 1.8 Organization of Thesis **Length:** 17 pages	1.1 General background 1.2 Research rationale and objectives 1.2.1 Research hypotheses 1.2.2 General objectives 1.2.3 Specific objectives 1.3 Thesis outline **Length:** 8 pages

Let's look at each part in more detail:

1) Background and Motivation or Statement of the problem:

This part is the first section and establishes the context of the research. It states in a detailed manner why the research is important and what it aims to solve. The example below is from Thesis 1 titled: *Design of a solar-biogas hybrid energy system for a mining process in Chile considering technical, economic and environmental aspects*. To illustrate the parts of the motivation section, most of the first sentences in consecutive paragraphs are added, so you can see how the students transition from general to specific. (par. = paragraph). A question to show what the sentence/paragraph is doing is added on the side; key words are underlined and words to indicate a challenge or problem to be solved are in **bold**.

Example 1:

1.1. Background

The mining industry in Chile and its challenges [focus concept: mining industry]

[Par. 1]: Mining, specifically copper mining, is the most significant economic activity in Chile [1]	*Why is this topic/key concept important?*
[Par. 2]: Nowadays, the mining industry faces **many challenges and problems**.	*What is/are current and concrete issue(s)/challenge(s) that motivate the research?*
[End of par. 3] Therefore, it is necessary to decrease energy consumption and study new sources with lower environmental impact [9; 10]	*Reinforce why what you propose is needed or what problem it can solve either for your field and/or society and/or specific industries, groups of people.*

Integration of renewable energy in mining [focus concept: renewable energy]

[End of par. 2] Nonetheless, there is still a dependence on fossil fuels as renewable energy has an intermittency nature [13].	*What is the current scenario? (what has been done until now, is being used now?)*
[Par. 3] Some mines worldwide have started incorporating renewable energy, and several projects are planned for the following years.	*Is there a new trend on this topic coming up?*
[Par. 4] In the literature, there is ongoing research on the use of renewable energy in mining.	*What has been studied on this new topic? (e.g, : renewable energy, but specifically in the area of mining).*
[Par. 5] Other studies consider more than one renewable energy source in the design of energy systems for copper production.	*What does the literature say on the specific area of interest (e.g., a hybrid energy system, not a single one)?*

Use of Hybrid Renewable Energy Systems [focus concept: Hybrid renewable energy]

Energy systems that include more than one type of renewable energy are known as hybrid renewable energy systems (HRES).

How is your topic of interest defined and described in the literature? What are its advantages?

In the next paragraph, the student states the general purpose of the research ("In this context, the interest of this research is to assess the potential of a hybrid renewable energy system that includes solar energy and the use of biogas for a mining process in Chile.") and justifies each of the energy sources chosen with their advantages taken from relevant literature.

Example 2:

Title: *Resolved carbon monoxide observations of Protoplanetary discs in OPHIUCHUS*

Motivation [focus concepts: observational techniques and instruments for substructures]

[Par. 1, Line 1-5]: Recent developments in observational techniques and instruments have made it possible to obtain images with unprecedented resolution and sensitivity, which have revealed a wide diversity of substructures in the components of circumstellar discs, such as spirals, concentric rings, gaps, and shadows (e.g. Casassus et al., 2013; Marino et al., 2015; Pérez et al., 2016; Andrews et al., 2018).

What is the current scenario on this topic? (what has been done until now, is being used now?)

[Line 5-6]: However, the origin of all these substructures, and their possible relation with embedded protoplanetary systems is **still poorly understood**.

What is/are current and concrete issue(s)/challenge(s) that motivate the research?

[Par. 2] In this context, a potential research approach has been proposed through the observations of the gaseous components using CO tracers (…) Indeed, there have been reports of protoplanetary candidates based on the study of kinematic structures sampled in CO lines. (e.g., Teague et al., 2018; Pinte et al., 2019). Besides being indicators of planet-disc interactions, observations of CO isotopologues **allow us** to characterize fundamental physical properties in discs such as the total gas mass, CO gas depletion, and temperature structures (e.g., Williams & Best, 2014; van Der Marel et al., 2016; Krijt et al., 2020; Zhang et al., 2021). Demographic studies **will provide essential information** for understanding the connection of the features seen in CO lines with disc evolution.

What has been used to study this topic? According to the literature, what are the advantages that make these research approaches ideal for your study purpose? (e.g., observations of CO isotopologues allow us to characterize fundamental physical properties in discs; Demographic studies will provide essential information for understanding the connection of the features seen in CO lines with disc evolution).

[Par.3] **The main purpose of this thesis is to** provide new constraints on the gas distribution of ten ODISEA discs by studying ALMA long baseline data of the 12CO(J=2−1) line. We measure the gas disc size in two cases, and in five cases, we compare the orientation of the traced gas with that of the continuum.

What is/are the aims of your research?

[Par.4] **This thesis is organized as follows**. Chapter 1 includes necessary concepts and background on planet formation; we describe the observations in Chapter 2, in Chapter 3, we explain the method used to measure the position angle and the gas disc size. In Chapter 4, we discuss the main results of this work, and finally, our conclusions are presented in Chapter 5.

How is the thesis organized?

2) Research questions or hypotheses:

Research questions refer to which question(s) your study aims to answer, so you must think of each question carefully and be specific. In the case of hypotheses, these also need to be specific. Hypotheses should be written in a way that they can be tested or verified through your research. They can test the relation between 2 or more variables or suggest the explanation of a phenomenon (usually written as prediction with "will").

Example from Vergara (2021)

The main goal of this thesis is to … More precisely, this study aims to answer the following research questions:

RQ1: How can an energy requirement of a mining process in Chile be supplied with solar energy and biogas?

RQ2: [not included due to space restrictions]

RQ3: Which trade-offs can be found?

3) General and specific objectives:

The general objective is the general, broad aim of your research, so use a verb that is broad enough (e.g., identify, explore, test, evaluate, etc.). The specific objectives, however, are much smaller. Ask yourself: What do I need to do so I can reach my main objective? What are the "smaller tasks" that I need to carry out first? Both types of objectives are important because they help you define the focus and also the limits (the scope) of your work (Open Learn, n.d.). Look at this example of the main objective (or goal) and the specific ones (from Vergara, 2021).

Main objective:

The main goal of this thesis is to design and evaluate a solar-biogas hybrid energy system for a mining process in the north of Chile, considering technical, economic, and environmental aspects.

Then the student links each research question to a specific goal (SG):

In order to answer each question and achieve the primary goal, this thesis has the following specific goals:

SG1: Characterize the energy demand of a mining process in Chile and define the components of a solar-biogas hybrid energy system to satisfy the electric energy requirements of a mining process. [it relates to RQ1]

SG2: [not included due to space restrictions]

SG3: Analyze possible trade-offs that can exist and their impacts. [it relates to RQ3]

If the student wants to demonstrate how hybrid energy systems can supply an energy requirement to mining in Chile, first, the student needs to provide specific information about what the current energy demand is in the country and also define each of the energy systems. Then if the student aims to know which trade-offs can be found, an analysis of these possible trade-offs is needed.

4) Research scope (or Scope of the Research):

This section states what your work will and will not include. In the 4 examples analyzed, "research scope" was present in 2 examples (Thesis 1 and 3). Interestingly, both theses share a goal. They both aim to design a system / model. In this section, they discuss what the model assumes, or specific model/system conditions that can influence the results. Length depends on your project features and conditions, so it can range from 1 to 3 paragraphs or more. Here are some example sentences from both theses, with key scope phrases underlined:

Example sentences from thesis 1 (Vergara, 2021)

1. The mining activities <u>are not modeled</u>, and the energy efficiency of the mining operations <u>is not considered.</u>
2. The electrical load estimation takes into account <u>all</u> the electrical requirements of the mine operations.
3. The effect of daily, seasonal, and climate-based variability on the sizing of the energy generation and storage units <u>is also considered.</u>

Example sentences from thesis 3 (Paravarzar, 2020)

1. The dependency of the sectors is considered in a simulation process, however, the sectors would not be able to produce more materials than the total mine daily target.
2. The daily plan divides to three shifts without considering the break times between shifts, and a shortage of targets in one shift will be considered in the next shifts.
3. It is assumed that LHD cannot unload the material to adjacent drifts because each drawpoint belongs to a specific ore pass. Materials extracted from a set of drawpoints in a drift should haul and unload to an ore pass associated with those drawpoints.

5) Thesis structure (or outline) or Organization of thesis:

As the name suggests, this section tells the reader what the next chapters will include. It can be a good idea to write it after you have written most, if not all of your work. This is because by then, you will have absolute clarity of your study. In terms of language, use present simple and combination of both active and passive forms (see passive voice in Chapter 2, Unit 3). Active verbs are in **bold**, and passive ones are underlined.

> This thesis is composed of 5 main chapters. In chapter 1, a brief introduction of the work is presented. The research questions, goals, and scopes of the present study are included. Chapter 2 **presents** a literature review on hybrid renewable energy systems and optimization techniques for designing and sizing them. Chapter 3 **describes** the research methodology used in this work, including a description of the case study, the data collected, and the optimizationproblem formulation. (Shorter version due to space restrictions).

Research Paper Introductions

Quite similarly to theses, research paper introductions consist of 3 main rhetorical moves (establishing a research territory, establishing a niche, occupying the niche). Each move has obligatory and optional steps. Learning the moves and their common steps can 1) help you to analyze model theses and papers; 2) help you to determine what an introduction looks like in your field; 3) help you to plan, write, and evaluate your own introduction. See these moves below:

MOVE 1	*Establishing a research territory* **a)** by showing that the general research area is important, central, interesting, problematic, or relevant in some way (optional). **b)** by providing background information about the topic (optional). **c)** by introducing and reviewing items of previous research in the area (obligatory). **d)** by defining terms (optional).
MOVE 2	*Establishing a niche* **a)** by indicating a gap in the previous research, raising a question about it, or extending previousb knowledge in some way (obligatory) **b)** by identifying a problem/need (optional).
MOVE 3	*Occupying the niche* **a)** by outlining purposes/aims, or stating the nature of the present research or research questions/hypotheses (obligatory). **b)** by announcing principal findings/stating value of research (optional). **c)** by indicating the structure of the thesis and providing mini-synopses (previews) of each subsequent chapter (obligatory). **d)** by outlining the theoretical position (optional). **e)** by describing the methods used in the study (optional).

Source: Paltridge, B. and Starfield, S. (2007). *Thesis and Dissertation Writing in a Second Language: A handbook for supervisors.* Routledge.

Example analysis of introductions

Field: Geology

Title: Impact of bending-related faulting and oceanic-plate topography on slab hydration and intermediate-depth seismicity

Journal: Geosphere

Note: The introduction also contains the review of the literature.

Subduction zones **are** among the *least understood* parts of the global water cycle. **[MOVE 1A – present simple]** It **is** *generally accepted* that subducting oceanic plates carry substantial amounts of water, which is partly released during the slab's descent into the mantle (Rüpke et al., 2004; Hacker, 2008; van Keken et al., 2011). Transform faults, basement outcrops such as seamounts or magmatic ridges, as well as oceanic fracture zones **can act** as conduits for fluids into an oceanic plate (Wolery and Sleep, 1976; Klügel et al., 2011; Faccenda, 2014; Cooper et al., 2020). **[MOVE 1B– present simple. Although this move is much longer in the original paper than the version presented here].**

Ranero et al. (2005) **documented** a correlation between focal mechanisms of outer-rise earthquakes and intermediate-depth earthquakes for Central America and Chile and suggested a causal link. However, a similar interrelation seems to be absent along the Tonga-Kermadec subduction zone (Warren et al., 2007).

In this study, we examine the hypothesis that intermediate-depth earthquakes spatially coincide with the expected depth of dehydration reactions inside subducting slabs. **[MOVE 3A – present simple]** We **correlate** the structure of the oceanic plate and the magnitude of tectonic faulting in the outer-rise region to the density of upper-and lower-plane earthquakes at intermediate depths. **[MOVE 3E – present simple]** *Using* high-resolution earthquake catalogs that distinguish between upper- and lower-plane events, **we can now obtain** information about spatial variations in the magnitude and the depth of hydration along individual subduction zones. *Correlating* this information with the structure and deformation of the ocean floor at the respective outer rise **allows us to** evaluate whether regions of intense upper- and/or lower-plane seismicity have an identifiable ocean-floor signature farther updip. **[MOVE 3B– present simple]** *We **perform** this analysis* for the Japan Trench and the northern Chile margin, the only regions where both seismicity and bathymetry data of sufficient resolution are available (Fig. 1). **[MOVE 3E – present simple]**

Reflect: Individually, analyze the introduction of the model papers you selected.

SOME ADVICE:
GO BACKWARDS + TALK ABOUT YOUR RESEARCH WITH DIFFERENT AUDIENCES

Go backwards: Instead of planning from Move 1 to 3, **do it in the opposite direction:** Think of Move 3, then 2, then 1, as reflected in the guiding questions below. You can use them to plan the introduction. This method can be even more effective if you **TALK** about it with a professor, fellow classmate, and especially, a person who does not have any science knowledge. Why? This will help you to explain it in every way possible, in the clearest manner, so you will be "forced" to rethink, reevaluate, and reformulate your ideas for people to understand you.

Guiding Questions for the Introduction (answer them and discuss them in this order)

1) What does my study do? – purpose of the paper (move 3)

2) What motivates the study? According to what has been done so far, what is missing/ insufficient? – lit review (moves 1 and 2)

3) Why is this topic important or interesting? (move 1)

Contextualize: What concepts need to be defined and explained so that your purpose/ contribution is understood? (move 1)

Note: If your research has more than one purpose or bridges more than one gap, repeat this process for every gap. In the final text, each "gap" and its set of moves will become a single paragraph:

1 purpose /gap = 1 paragraph.

Chapter 1

Unit 4 Writing the state-of-the-art or literature review section

At the end of this unit, you will be able to

- Identify the purpose and main elements of the literature review section
- Identify several organization principles and select the most suitable one
- Avoid plagiarism by distinguishing between acceptable vs unacceptable paraphrase
- Connect sources with reporting verbs, citations, and the appropriate verb tenses
- Plan your literature review (outline) for a thesis or paper

Preparing for the unit

Think of the papers you have read. What information comes in the literature review? How is it organized?

Purposes and main elements of the literature review section

Main purpose: Contextualize your research (Where does it come from?) by *describing/summarizing and evaluating* the sources you report on.

Elements:

Describe / Summarize	• Review previous research and/or review needed background theory: cover major studies on the research topic until the date of your work. You may want to consider these questions to decide what to include per study: - Who carried out the research and when? - Who were the subjects of the research? - Why was it carried out? - Where was it carried out? - How was it carried out? - What was the result of the research? (Paltridge and Starfield, 2007) • Consider including the main points of view and controversies
Evaluate	• Indicate the studies' strengths and weaknesses
Conclude	• Include general conclusions about the state of the art: - summary of missing / insufficient / research - show your study fills that research

Example 1 of Description/Summary + Evaluation + Conclusion

Research paper title: "A comparison of radial-flow and axial-flow packed beds for thermal energy storage" by McTigue and White (2018). The mining industry in Chile and its challenges [focus concept: mining industry]

[TOPIC SENTENCE] However, a number of innovative design features have been suggested with the aim of improving the heat transfer characteristics. [SUMMARY 1] **For instance, Zanganeh et al. [11]** developed a conical container which reduced the effect of thermal ratcheting, and also investigated the impact of incorporating phase change materials into the store [23,24]. [SUMMARY 2] **Crandall and Thatcher [25]** developed **another design** feature known as *segmentation* as a way to maintain thermal stratification in packed beds for solar air heating systems. [SUMMARY 3] Segmented stores were **subsequently developed by Isentropic Ltd. for PTES systems [26]** with the **additional aim** of alleviating the inherent conflict between heat transfer irreversibility and pressure loss.

The excerpt shows three consecutive works, each summarized and linked to each other through words as "another", "subsequently", "additional aim". Thus, each time a new work is introduced, the reader demonstrates the improvements in the area. As you can see, there does not seem to be much explicit evaluation of these studies.

Example 2 of Description/Summary + Evaluation + Conclusion

Review research paper title: ""In situ detection of welding defects: a review" (Madhvacharyula, A.S. et al., 2021)

2 Defect detection using acoustic signals

[Paragraph introducing the section]: The current section covers in situ weld defect detection using acoustic signals. It is classified into two classes, viz., audio signal- and acoustic signal-based defect detection. Audio signal-based defect detection analyzes audible sound signals emitted by the welding arc to identify weld defects. On the other hand, acoustic emission involves examining the acoustic waves emitted during the welding process to predict weld stability.

*[Paragraph chosen at random within section to illustrate summary and combination of sources; key phrases that link sources are shown in **bold**].* Another time-frequency method to identify and locate weld defects was proposed by Sudhanya et al. [40]. [SUMMARY 1] The work studied the usefulness of the adaptive chirplet transform to detect welding defects. [SHORT CLARIFICATION OF CONCEPT] Chirplet transform [41] is similar to wavelet transform, the only difference being that a chirp is used to take the transform in place of a mother wavelet function. [SUMMARY 2] The occurrence of high chirps in the sound signal correlated with weld defects. [SUMMARY 3 LINKED TO SUMMARY 1 AND 2 through use of "weld defect detection"] The use of audio signals is **not limited to weld defect detection** but also can be used to monitor **other aspects** [SUMMARY 4: "Depth of weld"] like depth of weld [42]. **Further**, the properties of the weld bead **can also be studied using this** analysis **technique**.

*[First line of last paragraph in this section—a few key sentences only. They illustrate the authors' evaluation on the techniques described. Key phrases that evaluate sources are shown in **bold**]:* Audible sound-based defect detection is therefore a **cost effective** way to identify and locate defects.

Possible Organization Principles

1. **Thematic:** organize around various central topics and sub-topics of your study
2. **Chronological:** oldest to more recent studies
3. **Methodological:** focus on the methods used by the researchers
4. **Question/Variable-based:** based on the various key questions/variables in your study
5. **Viewpoint-based:** based on different points of view
6. **Combined Organization:** mixed organization principles

WHATEVER THE ORGANIZATION PRINCIPLE YOU CHOOSE, SELECT ONE AND OUTLINE IDEAS ACCORDINGLY. START WITH HEADINGS, SUBHEADINGS, AND THEN SUMMARY + EVALUATION + CITATION.

How to select the most suitable organization principle?

The organization you choose depends on your research and its purpose. Let's see this in an example from a research paper titled "A comparison of radial-flow and axial-flow packed beds for thermal energy storage" by McTigue and White (2018).

Headings (Thematic organization)	Example section: 1.2. Axial-flow packed beds
1.1. Packed-bed thermal energy storage **1.2.** Axial-flow packed beds **1.3.** Radial-flow packed beds	Investigations of packed-bed thermal energy storage *typically assume* that the heat *transfer fluid flows axially* along a cylindrical store. **However, a number of innovative design features have been suggested** with the aim of improving the heat transfer characteristics. **For instance, Zanganeh et al. [11]** developed a conical container which reduced the effect of thermal ratcheting, and also investigated the impact of incorporating phase change materials into the store [23,24]. **Crandall and Thatcher [25]** developed another design feature known as segmentation as a way to maintain thermal stratification in packed beds for solar air heating systems. Segmented stores were subsequently developed by **Isentropic Ltd. for PTES systems [26]** with the additional aim of alleviating the inherent conflict between heat transfer irreversibility and pressure loss. Fig. 2 illustrates one possible implementation of a segmented (layered) store where each segment is individually gated (with valves B, C and D shut, as shown). Since each layer is independently controlled, the gas flow can be directed into only those segments where the thermal front is present – i.e. where heat transfer is occurring and there are thus significant temperature gradients. The flow is diverted around the remaining segments thereby

	reducing pressure losses. This allows smaller particles to be used, which in turn reduces heat transfer losses. **White et al. [21]** examined the extent to which this improved performance, taking into account both thermodynamic and cost factors. Broadly, loss reduction is most significant when the gas density is low (which for the PTES system considered was in the cold, unpressurised store) but other factors are also important and simplified guidelines are given in the appendix of Ref. [21]. Optimisation studies indicated segmented stores could be cheaper and/or more efficient than unsegmented ones [21,22], but these studies did not include the additional cost of valves and control systems.

In this example, the authors organize the literature section around the theme of packed-bed thermal energy storage, which they begin by discussing two types of energy storage types: axial-flow and radial-flow. They develop each type separately and in the same order as announced. When we look at how axial-flow type is discussed, the authors start with what is generally assumed about it before they highlight a gap with "However". The sentence which follows, "a number of innovative design features have been suggested with the aim of improving the heat transfer characteristics" becomes a main idea (or topic sentence) that frames all the sentences that come next: every sentence following contains examples of innovative designs for better heat transfer.

Avoid plagiarism by distinguishing between acceptable vs unacceptable paraphrase

A paraphrase means referring to the ideas of others in your own words. How do you know if you have paraphrased properly or not? These are the features of a good paraphrase:

1. It keeps just the technical jargon (concepts that are specific and unique).
2. It maintains the meaning of the original text.
3. It does not contain identical connectors, phrases or sentences that appear in the original.
4. It has a very different order of ideas, different grammatical structures, and various synonyms.
5. If it is a paragraph, sentences are arranged differently, not in the same order as they appear.
6. It has an in-text citation that gives credit to the original author.

Failing to apply these features results in plagiarism, even if it is unintentional. Using synonyms alone does not mean a good paraphrase.

Read an original text and its paraphrase. Evaluate it using the points 1 to 6 above. Is it a proper paraphrase or would it be considered plagiarized?

ORIGINAL TEXT	PARAPHRASE
Language is the main means of communication between peoples. However, so many different languages have developed that language has often been a barrier rather than an aid to understanding between peoples. For many years, people have dreamed of setting up an international universal language which all people could speak and understand. The arguments in favor of a universal language are simple and obvious. If all peoples spoke the same language, cultural and economic ties might be much closer, and good will might increase between countries (Kispert, 2001).	Language is the principal means of communication between peoples. However, because there are numerous languages, language itself has frequently been a barrier rather than an aid to understanding among the world population. For many years, people have envisioned a common universal language that everyone in the world could communicate in. The reasons for having a universal language are clearly understandable. If the same tongue were spoken by all countries, they would undoubtedly become closer culturally and economically. It would probably also create good will among nations (Kispert, 2001).

Source: Oshima A. and Hogue A. (2006). *Writing Academic English*. (4th ed.). Pearson Longman.

The same principles of paraphrasing apply to summarizing. The only two differences are that summaries are much shorter than the original text and tend to leave many details out, as they focus on the main idea of a text.

Connect sources with reporting verbs, citations, and the appropriate verb tenses

Definitions:

1. Reporting verb:
"A reporting verb is a word which is used to talk about or report on other people's work." (The University of Adelaide, 2014) Some common academic reporting verbs are "confirm, conclude, add, examine, question, disagree, etc."

2. Citation:
"Citations are a way of giving credit when certain material in your work came from another source. It also gives your readers the information necessary to find that source again...[w]henever you use sources such as books, journals or websites in your research, you must give credit to the original author by citing the source." (University of Washington Libraries, 2023)

3. Verb tense:
It refers to different verb forms: present simple, past simple, future with "will", present perfect, and other verb forms. You recognize a verb tense by 1) a specific ending letter or syllable attached to the verb (for example, the "s" indicating present simple in "The paper describes…", or "ed" in "the authors developed…" indicating past simple) or 2) an "auxiliary verb" such as "have/has" in present perfect: "Studies have shown", or "will" in future: "The following section will compare…"

Using reporting verbs

Although reporting verbs are quite useful, they have to be used carefully, as direct or generic translation may not show its subtle meanings (i.e., weaker, neutral, stronger view) and also, they are used with specific grammar structures. See the table below (for a full list, see the References at the end of the unit):

Reporting verb in Spanish	"decir"	Example sentence
Weaker view	comments (+ that)	He commented that the system was outdated.
Neutral view	discusses (+ a noun or –ing form)	The section discusses the advantages and disadvantages of the model.
Stronger view	reasons (+ that) *reason (verb): make judgment after considering facts carefully	After several failed attempts, the authors reasoned they needed to change plans before continuing tests.

Source: The University of Adelaide, 2014.

Using citations in APA and IEEE

You give credit to another author's ideas using citations. The format of these citations depends on the style manual you are asked to follow (by the professor, the discipline, the journal you are going to submit your work to). Regardless of the style manual, there are 2 possibilities to add the citation to your sentences: Author-prominent or information-prominent citation. Below are examples for APA and IEEE. You can see that while APA uses authors' last names and year of publication, IEEE uses the author's last name and a number in square brackets (in author-prominent citations), and just numbers in square brackets (for information prominent citations), which are later compiled in the References (for details on Style Manual and References rules, see the links included in *Useful Additional Resources* at the end of this unit).

1. Author-prominent citation:
The author (or their work) goes INTO your sentence, usually at the beginning (see words in bold below).

> **APA:** More recently, **Yan et al. (2017)** studied the impact of the CLV when attempting to study the atmosphere of this planet using high-resolution spectroscopy. **Casasayas-Barris et al. (2020)**, on the other hand, analyzed transit observations.
>
> **IEEE:** **Gal [22]** analyzed the formulas used to optimize the stochastic regularization techniques of an artificial neural network with dropout.

2. Information-prominent:
The ideas (summary/paraphrase) is finished and the author or their work) goes AFTER the sentence(s) in parenthesis. Frequently, more than one author is listed in parenthesis. In that case, author details are separated with a semicolon. The example below contains in-text citations signaled in bold.

> **APA:** So far, high-dispersion spectroscopy has been applied to both transiting **(e.g. Sánchez-López et al. 2019; Brogi et al. 2018)** and non-transiting planets **(e.g. Brogi et al. 2014; Guilluy et al. 2019)** and has led to the detection of several species in exoplanetary atmospheres, including: alkali lines and molecules in hot Jupiter atmospheres **(Redfield et al. 2008; Wyttenbach et al. 2015, 2017; Chen et al. 2020; Birkby et al. 2017).**
>
> **IEEE:** …other models have geometric approaches like Support Vector Machines (SVM) **[12]**, K-Nearest Neighbors (KNN) **[13]** and Linear and Quadratic discriminant analysis **[14]**. Another approach is to use a strategy similar to sensitivity analysis to find the features that most contribute to determine the outcome of predictions [6, 23].

Reflect: Select a paper you are interested in and analyze it:

1. How is the literature review section organized?
2. What is the structure? Notice: summary/description, evaluation, conclusion.
3. Circle the reporting verbs used. Are they in present simple, past simple, or present perfect?
4. Are there any direct quotes? Which ideas are quoted?
5. What is the citation style?
6. Count the author-prominent citations and the information-prominent ones. Which is more common? When is each of them used? Why do you think the authors made that choice?

Plan your literature review (outline) for a thesis or paper

To get started with the literature review, you can follow the steps below:

8 steps to create a literature review:

1. Be clear about WHAT you need to find in the sources: search with a clear purpose.
2. With key words in mind, search for and select relevant literature (abstracts can help determine the usefulness of the source).
3. Read the sources and take notes, trying to identify common themes or useful information you can use later anywhere in your research.
4. Organize your notes by creating an outline (e.g., general to specific): what does the reader need to know before discussing X topic/concept? Which topics are needed and which are not as relevant that can be left out?
5. Ensure strong paragraphs by "micro outlines": This means visualizing and organizing paragraphs before you write them. A helpful strategy is to create headings and subheadings. In this way, your paragraphs will be focused.
6. Write.
7. If possible ask your advisor for feedback on content: Have I missed any of the major sources/ papers, is it clear?
8. Make revisions and proofread the document before adding it to the thesis.

Questions from FCFM's students and their answers

Q1. How long should the literature review be compared to other parts?

It is difficult to have 1 proper answer for every field and academic level. Rather than length, a better question is the *quality* of the literature review. This means that you should spend a good amount of time reading, taking notes, organizing, and combining them before you start writing. In doing so, by the time you write, you will be able to present a literature review that demonstrates 1) your expertise, and most of all, 2) *where your study comes from and where it stands among the hundreds of papers written on the subject (stating the research gap(s))*.

Q2. How detailed should the lit. review be? Will it be a review of ALL relevant material or will the scope be limited to more recent material, e.g., the last five years?

As for detail, it is difficult to say, but a PhD thesis (dissertation) requires more analysis and depth than a master's or an undergraduate thesis. Now, the time span covered will depend on the discipline. Newer areas such as Computer Science will have a much shorter history than perhaps, astronomy or geology; therefore, the time span will be shorter and you should consider adding only the most recent developments.

Q3. Can I use direct quotes?

Try not to do that. If you quote directly, you may give a bad academic impression. If you must do so, it must be due to very "unique" language or phrasing and it should be a few words long. Summarize or paraphrase instead.

Q4. Is the "literature review" the same as "theoretical framework", and "conceptual framework"?

They are not the same. See the complete explanation in Luft et al., 2022, or watch this video (references for both are given in the References page).

USEFUL ADDITIONAL RESOURCES

- American Psychological Association. (2023). *APA Style*. https://apastyle.apa.org/
- Bailey, S. (2011). Paraphrasing. In *Academic Writing: A Handbook for International Students* (3rd Ed.) 50-55.
- Bailey, S. (2011). Summarising. In *Academic Writing: A Handbook for International Students* (3rd Ed.) 56-61.
- IEEE (n.d.). *IEEE Editorial Style Manual*. [PDF]. https://www.ieee.org/content/dam/ieee-org/ieee/web/org/conferences/style_references_manual.pdf

Chapter 1

Unit 5 Writing the methodology section

At the end of this unit, you will be able to…

- Identify the purposes of this section
- Identify the most common rhetorical moves in the methodology section in research paper excerpts
- Apply the most suitable grammar choices (active/passive voice, purpose clauses, verb tense)

Preparing for the unit

Think of the papers you have read. What information comes in the methodology section? How is it called?

Purposes and most common rhetorical moves in the methodology section

The main aims of the methodology section are demonstrating your research is credible and making your project suitable for replication. You achieve this by doing the following:

- Being objective and not adding interpretations
- Explaining how you obtained your result
- Citing existing literature that supports your methodological choices
- Justifying every decision you made that did not follow the standard procedures

According to Swales & Feak, (2015, p. 291), these are the 7 most common rhetorical moves in the section:

MOVE	DEFINITIONS
1. Overview	A short summary of the research method, at or near the beginning of the section
2. Research aims, questions, or hypotheses	A description of the research goals, the questions to be answered or the hypotheses
3. Materials	A description of the materials and equipment
4. Location (if applicable)	A description of where the research took place and possibly why

MOVE	DEFINITIONS
5. Procedure	A discussion of the process used to obtain the data that was collected
6. Limitations	A focus on a shortcoming of the method, possibly with an explanation
7. Data analysis	A description of how the data was analyzed

Let's see the parts of the methodology section in an example taken from a research paper titled "Impact of bending-related faulting and oceanic-plate topography on slab hydration and intermediate-depth seismicity" (Geersen et. al., 2022). Each move is shown in square brackets before the corresponding sentence.

[*OUTLINE* of section subheadings that shows where the excerpt comes from]

Data and methods

- Bathymetric Data
- Fault Mapping and Characterization
- Seismicity
- Projection of Tectonic Features onto the Subducting Slab

Data and Methods

Bathymetric Data

[*Move 3: Materials or, in this case, data used for detection and characterization of bending-related faults*] Detection and characterization of bending-related faults was conducted by means of shipborne bathymetric data. [*Move 5 where they got the data from, for location 1*]: In the case of northern Chile (Fig. 2), we used the compilation provided by Geersen et al. (2018a), which includes data from German and U.S. research cruises as well as masked data from the Global Multi-Resolution Topography (GMRT) synthesis (Ryan et al., 2009). [*Move 5 where they got the data from, for location 2*]: For the Japan Trench and marine forearc (Fig. 3), we collated bathymetric information from multiple research cruises accessed through the Data and Sample Research System for Whole Cruise Information (DARWIN) database (Japan Agency for Marine-Earth Science and Technology, 2016). The data from the Japanese cruises were complemented by the data provided by Geersen (2019), masked data from the GMRT synthesis (Ryan et al., 2009), and bathymetric data collected during R/V SONNE cruise SO251-1 (Strasser et al., 2017).

Fault Mapping and Characterization

[*Move 5: How the data was collected*]: The fault outcrops at the seafloor **were digitized and stored** in an ArcGIS database. [*Move 5: procedures*] To estimate fault activity throughout the study region, **we calculated** the mean elevation on both sides of the faults within 1-km-wide segments parallel to the fault trace. By multiplying the elevation difference for each fault with the length of the respective fault, **we determined** the exposed fault area, which we use as a proxy for fault activity. The derived exposed fault areas therefore represent average values for each fault and *[Move 6: a limitation with a previous justification*] do not account for secondary effects such as localized erosion of the fault scarp or post-tectonic sedimentation. [*Move 3: Materials and equipment. Which one and why*]: Fault strike directions **were calculated** in ArcGIS using the "linear direction mean" tool and plotted with the NetworkGT toolbox (Nyberg et al., 2018) (Fig. 4). This toolbox **was** also **used** to analyze the connectivity of the faults on the oceanic plate. The "branches and nodes" tool distinguishes between isolated faults, faults that crosscut other faults, and faults that abut (splay) from other faults… [*Move 6: a limitation with a previous justification and how they solve it*]: Due to the local presence of some trench sediments (especially in the Japan Trench), i**t was not always possible to** map the surface outcrops of intersecting faults on both sides of the intersection. Because in these cases it is unclear whether the fault intersection forms an X or a Y node, we group X and Y nodes and only distinguish between isolated faults (I nodes) and intersecting faults (X nodes and Y nodes).

Suitable grammar choices for the methodology section

As you can observe in the previous example, most of the excerpt **describes the procedures followed** and the **tool/equipment used** to obtain and calculate the data. In addition, some parts of the excerpt include justifications for a few limitations. This section will show you *which* grammatical and vocabulary choices you can use in the methodology section, with examples from the excerpts.

1) Grammar choices to describe the procedures followed or equipment used: *active and passive voice*

- Active voice: "Someone does something" ("does" here represents any verb in *present, past, future*) = "Alguien hace algo."
- Passive voice: "Something is done (by someone)" ("*is done*" here represents any verb in passive: be + past participle) = "Algo *es hecho* (por alguien) or = "Algo *se* hace" (no importa quien lo haga, sino, qué se hace).

Note: Because it is frequent mistake, you should check the use of "se" in Chapter 2, Unit 3.

Although you may have heard that "we" must not be used and only passive is allowed in scientific writing, that is incorrect! The sentences below belong to another methodology paragraph of the same paper, published in a peer-reviewed article of a reputable journal. Thus, it is a good example of how **"we" (applying active voice) and verb forms in passive voice** *can and should* be **used in combination** for clear, cohesive, and fluent reading.

Examples of active and passive voice in context + explanations of use:

Example 1 (Active voice, past simple)

To systematically quantify spatial changes in oceanic-plate faulting, *we introduced* 10-km-wide oceanic-plate segments that strike in the direction of plate convergence (Figs. 2–3).

Explanation: Active voice was probably preferred for 2 reasons: 1) to give more importance to the researchers' justification of the chosen procedure, which may not be standard; and 2) to avoid an awkward sentence; although the passive voice would make this a grammatically correct sentence, it would be hard to process. Compare the active with the passive version:

Active: "To systematically quantify spatial changes in oceanic-plate faulting, we introduced 10-km-wide oceanic-plate segments that strike in the direction of plate convergence (Figs. 2–3)."

Passive: "10-km-wide oceanic-plate segments that strike in the direction of plate convergence (Figs. 2–3) *were introduced* to systematically quantify spatial changes in oceanic-plate faulting" (14 words to get to the sentence's main verb is rather long, compared to 8 words before the main verb in the active version of the sentence).

Example 2 (Active voice, past simple)

For each segment, *we summed up* the cumulative fault length and the cumulative exposed fault area for groups of faults with different strike directions. *We* further *analyzed* the number of nodes as well as X and Y nodes for each segment.

Explanation: Active voice was preferred because the authors want to highlight their own procedures. If you try changing both to passive voice, which one works and which one does not? The first one does not for the same reason as example 1; the second one could be changed, but the authors probably decided to be consistent and kept using active voice.

Example 3 (Active voice, past simple / passive)

For both margins, we used existing fault maps (Kobayashi et al., 1998; Nakanishi, 2011; Nakata et al., 2012; Geersen et al., 2018a), which were updated and extended based on the new collection of shipborne bathymetric data.

Explanation: This is a great example for how active and passive voice can be used in combination. First, the active voice: "we used". Then the sentence is followed by 2 passive constructions: "were updated and extended," as the authors already said they used the maps. Interestingly enough, the first clause could have been passive: "For both margins, the existing fault maps were used", but it generates a grammar and cohesion error with the clause after ("which" starts an adjective clause that must be next to what it describes: "existing fault maps").

Example 4 (passive voice)

The fault outcrops at the seafloor were digitized and stored in an ArcGIS database.

Explanation: Passive voice was preferred because what the authors wanted to highlight was *the procedure,* not who did it, as it can be inferred.

2) Grammar choices to justify decisions + explanations of use:

Methodological decisions are generally written with purpose clauses or some variations of them. The examples below show the purpose clauses in *italics*.

Purpose clauses: "To + verb" + info + comma, (*Why you did something in a particular way*)
Position of purpose clauses: Start or end of sentence

Reason clauses: "Because" + sentence or "Due to" + noun phrase
Position of reason clauses: Start or end of sentence

Examples of purpose clauses to justify decisions + explanations of use:

Example 1

To estimate fault activity throughout the study region, we calculated the mean elevation on both sides of the faults within 1-km-wide segments parallel to the fault trace.

Explanation: The purpose clause starts the sentence and has an appropriate length.

Example 2

This toolbox was also used *to anyze the connectivity of the faults on the oceanic plate*.

Explanation: The purpose clause ends the sentence. Try it at the beginning. How does it sound?

Examples of reason clauses to justify decisions + explanations of use:

Example 1

[*Due to* + noun phrase]: Due to the local presence of some trench sediments (especially in the Japan Trench), it was not always possible to map the surface outcrops of intersecting faults on both sides of the intersection. [*Because* + sentence]: *Because* in these cases it is unclear whether the fault intersection forms an X or a Y node, we group X and Y nodes and only distinguish between isolated faults (I nodes) and intersecting faults (X nodes and Y nodes).

3) Grammar choices to procedures used: manner clauses:

Manner clauses: Verb + "ing" / "By" + Verb + "ing"
Position of reason clauses: Start or end of sentence

Example 1

Fault strike directions were calculated in ArcGIS using the "linear direction mean" tool and plotted with the NetworkGT toolbox (Nyberg et al., 2018) (Fig. 4).

Explanation: The clause specifies *how* they calculated in ArcGIS.

Example 2

By multiplying the elevation difference for each fault with the length of the respective fault, we determined the exposed fault area, which we use as a proxy for fault activity.

Explanation: They explain *how* the exposed fault area was determined.

USEFUL ADDITIONAL RESOURCES

- University of Wollongong – Learning Development (2014). *Thesis writing Methods ENGINEERING EXAMPLE*. [PDF].
  https://documents.uow.edu.au/content/groups/public/@web/@stsv/@ld/documents/doc/uow195699.pdf

Chapter 1

Unit 6 Writing the results section

At the end of this unit, you will be able to

- Identify the purposes and moves of the results section
- Decide how best to present and comment on your results with suitable vocabulary

Preparing for the unit

Think of the papers you have read. How important is the result section? Do you read it entirely or just focus on the visuals (tables, figures, graphs?) In your opinion, what is the biggest challenge of writing the results section? Are the results presented independently or together with their discussion?

Purposes and most common rhetorical moves in the results section

Before starting, make sure you know what is the expected organizational pattern (from your advisor, a journal, etc.). Once you have determined that, you are ready to begin planning what to say and *how*.

All the sources consulted for this chapter agree on these 3 ideas:

1) You must not report ALL the results.
2) The results do not speak for themselves, meaning that in this section you not only *present* or *describe* results, but most importantly, you must *comment on* them, *interpret* them.
3) Through your interpretation or highlighting specific data, YOU guide the reader's attention to what is important to consider. To do this, ask yourself these guiding questions:
    - What do the results mean?
    - How significant/important are these results?
    - What do you want the reader to notice from a table or figure? (a trend through a comparison, individual data values in a table).

Paltridge and Starfield's analysis determines 3 rhetorical moves in the results section:

Move 1: Presenting metatextual information (link to previous chapter, presents the results chapter and how it is organized)

Move 2: Presenting results

Move 3: Commenting on results

Let's see *Move 1* in an example from a PhD thesis in engineering (Timms, 2001 as cited in Paltridge and Starfield, 2007).

Topic based chapter title:	Chapter 5 AQUITARD HYDROGEOLOGY
Metatextual move that previews/outlines the chapter	In this chapter, the hydrogeological importance of aquitards is considered by examining geological controls on vertical leakage, such as permeability of the aquitard matrix and spatial heterogeneity within the aquitard-aquifer system.
Definition of terms used. Reader is given outline of chapter organization:	*5.1 Results* The various units identified in this chapter are referred to as upper, middle and lower silt units (based upon grain size analysis) and as numbered aquifer units. The specific location of these units within the Shepparton or Calivil Formations is considered after the detailed analysis data are presented.

Source: Paltridge, B. and Starfield, S. (2007). Thesis and Dissertation Writing in a Second Language: A handbook for supervisors. Routledge.

Below is another example of Move 1 from a paper titled "A Description of Quasar Variability Measured Using Repeated SDSS and POSS Imaging" (MacLeod et al. 2010) . The useful phrases illustrating the move are in italics.

2. Data Overview

In this section, we briefly summarize the relevant SDSS and POSS data. We focus our description on the quasars with multiple observations (similar to MacLeod et al. 2010; 2011).

These are examples of *Move 1, 2, and 3* from the thesis "Resolved carbon monoxide observations of protoplanetary discs in Ophiuchus" (Antilén, 2022). Each move is indicated in brackets and specific phrases for each move in italics.

3.3. Individual sources and channel maps

[Move 1] *In the following section, we discuss* the 12CO(J =2–1) molecular line observations for each source. In five cases *we compare* the P.A. measured for the gas component in this work with the P.A. of the dust previously measured in Cieza et al. (2021). For a detailed description of the fundamental parameters of each star's SED and previous observations of the dust emission we recommend seeing (Cieza et al., 2021) and references therein.

3.3.1. DoAr 44

[Move 2: Describing results with definitions and previous findings first] This source is *also known as* WSB 72 and HBC 268. It *has* a pre-transition disc SED. A large cavity *has been observed* in the submillimiter by van Der Marel et al. (2016) and Cieza et al. (2021) and *resolved* in the near IR by Avenhaus et al. (2018). Besides, the observations of Avenhaus et al. (2018) *showed shadows* in the

outer disc, and a central warp of the inner disc *was proposed* to explain those features (Casassus et al., 2018). **[Move 2 and 3: the student's results supported by figures ("*comparing*") and their interpretation ("there is a significant difference")]** *When comparing* the P.A. measured for the gas and the one measured for the continuum emission, *there is a significant difference* of 34.1 +- 9.0 degrees (Fig. 3.1). **[Move 3: student's causal conclusion based on results ("*therefore", "there is clear evidence in favor of…*")]** *Therefore,* our long-baseline observations (Fig. 3.8) *display a difference in orientation* between the gas and the dust. *This is clear evidence* in favor of the warped morphology that has been proposed for this source. *Further, in Fig. 3.8, we identify* gas emission inside the inner dust depleted zone.

A final example of Moves 1 and parts of 2 are presented in the paper titled "Thermal history of type 3 chondrites from the Antarctic meteorite collection determined by Raman spectroscopy of their polyaromatic carbonaceous matter" (Bonal et al., 2016). You can see how the information is structured through heading and subheadings and supported by figures and tables (They have not been added due to space restrictions). Most interestingly, in 3.1, the authors recognize that they were not able to obtain satisfactory Raman spectra for all the 151 chondrites they considered. This shows that if things do not "go according to plan" you can, and actually *should*, report it. In fact, as you see in the example, the authors justify their limitation—and so should you.

3. Determination of the structural grade of the polyaromatic carbonaceous matter

151 type 3 chondrites from the Antarctic meteorite collection *were considered* in the present work. Results obtained on CV, CO, and ordinary chondrites *are successively described below*.

3.1. Unsuccessful acquisition of Raman spectra of carbonaceous matter

It was not possible to obtain satisfactory Raman spectra on 37 of the chondrites (Table 1). The *two most likely explanations are:* (i) intense terrestrial weathering and/or (ii) high degree of thermal metamorphism, although these difficulties were not anticipated based on their classifications.

Table 1
List of assigned type 3 chondrites for which the acquisition of Raman spectra was not successful.

3.2. CV chondrites

Satisfactory Raman spectra were obtained on 17 out of 22 CV chondrites. The Raman spectral parameters are reported in Table 2 and plotted on Fig. 5.

3.3. CO chondrites

3.4. Ordinary chondrites

How best to present and comment on your results with suitable vocabulary

Presenting your results: To decide *what* and *how* to present, go back to the guiding questions at the start of the unit. Tables need a number and a title at the top, and a description at the bottom (see more here for APA formatting rules). Figures should be numbered and easy to see. They must also include a legend or description to guide the reader in terms of position, color, line type, etc. (e.g., "left, right, top, bottom", "white, color bars") or clarify abbreviations.

Example Figure description:

Figure 3.8: Observed channel maps of 12CO(2-1) of DoAr 44. An image of the 1.3 mm continuum is shown at the top and to the left (continuum map from Cieza et al. (2021)). Contours of 1.3 mm continuum emission at the 5σ level are indicated in white, and the white ellipses represent the synthesized beam. For the beam size, we refer to Table 2. Both color bars have units of Jy beam−1

(Source: Antilén, 2022)

Relevant grammar/phrases for presenting results: (for more details, see the additional resources at the end of this unit).

- **Present simple (indicated by the "s" next to the verb):** Table 1 *shows/compare*s… the intercorrelations among the nine measures of X.
- **Initial phrases** such as "*As shown in Figure 1*," + **past tense** "the X group *reported* significantly more Y than the other two groups."

Commenting on your results:

This is the one of the most important parts of the section. To illustrate, read these 3 statements (taken from Glasman, 2010) and classify them into "weak, neutral, strong."

Statement 1: As can be seen in Fig. 1, the effect occurred in 23% of cases.

Statement 2: As can be seen in Fig. 1, the effect occurred in as many as 23% of cases.

Statement 3: As can be seen in Fig. 1, the effect occurred in only 23% of cases.

Statement 1 is quite neutral, so it is not recommended. Go for type 2 (strong result) or type 3 (weak result) depending on your intention. In those statements, weak vs strong is done through frequency and quantity phrases, although there are more ways to do so, such as comparatives and superlatives, as shown below. (For detailed language see Glassman, 2010 and Academic Phrasebank, n.d.).

- **Comparatives:** X tended to perform *better/worse than* Y on tests.
- **Superlatives:** MIL 07671 is then *the least* metamorphosed sample (petrologic type = 3.1) and LAP 02206 *the most* metamorphosed (petrologic type >3.7). (Source: Bonal et al, 2016).

Other possible ways to interpret results can be highlighting significant data in a table or chart, stating a positive and/or result/reactions, highlighting interesting or surprising results (see Academic Phrasebank for details).

Suggestions from FCFM's scholars

"En astronomía, el análisis y discusión de los resultados (el cómo se explican) son el punto más fuerte de un trabajo."

Diego Mardones – Profesor en Astronomía

(Sobre la importancia de las imágenes en geofísica) "Cuando voy a leer un artículo, lo primero que veo son las imágenes, luego el abstract, la conclusión y vuelvo a las imágenes."

Alejandra Serey – Profesora en Geología

"[De un buen texto, espero] material gráfico en calidad y características similares a publicaciones similares."

J. Cristian Salgado H. – Docente en Ingeniería Civil Química e Ingeniería Civil en Biotecnología

USEFUL ADDITIONAL RESOURCES

- Swales, J. and Feak, C. (2015). Unit four: Data Commentary. In J. Swales and C. Feak, *Academic Writing for Graduate Students.* (pp. 139-187). Ann Harbor.

Chapter 1

Unit

Writing the discussion section

At the end of this unit, you will be able to

- Identify the purposes and moves of the discussion section
- Identify and apply four types of claims about your research

Preparing for the unit

Think of the papers you have read. Is the discussion section a separate one, or is it combined with the results or conclusion? Possible distributions may be the following:

- Results and discussion combined or separate
- Results and Conclusions (separate)
- Results, Discussion, and Conclusions (separate)

Purposes and most common rhetorical moves in the discussion section

Before discussing the purpose of the discussion section, let's clarify what the discussion is NOT: It is not a repetition or description of the results, and it is *not only* your own interpretation of results. The two main purposes of the discussion section are 1) to *go beyond* your results and integrate them with the existing studies in the field, that is, **confirming, comparing, contrasting** what *you* obtained with what already has been published; and 2) show your position in relation to your results by expressing different degrees of **generality, probability, and certainty** (e.g., "The synthetic and real case studies *demonstrate that* – see Unit X) about your results. By doing so, you are building new knowledge or changing knowledge in the field.

The structure can somewhat vary across disciplines, but this is considered the typical structure for this section:

Move 1: Background information (restate the purposes of the study, theory, methodology)

Move 2: Statement of key results/advantages of your model (key results can be chosen by thinking on how much the potential reader of your work knows. What does this person really need to know vs what they already know that can be omitted.).

Move 3: Commenting on the key results by

a) Making claims about results

b) Explaining results (e.g., expected or unexpected outcome)

c) Comparing (confirm) and/or contrasting (contradict) results with previous studies

d) Offering explanations for contrasting results

3a through **3d** is a sequence: one after the other. If you combine results and discussion, follow this sequence per result.

Move 4: Stating the limitations of the study

Move 5: Making recommendations for future implementation and/or for future research.

Adapted from: Paltridge, B. and Starfield, S. (2007). Thesis and Dissertation Writing in a Second Language: A handbook for supervisors. Routledge.
Swales, J. and Feak, C. (2015). Academic Writing for Graduate Students. Ann Harbor.

IMPORTANT INFORMATION

- Moves 2 and 3 are obligatory for all disciplines.
- Move 3 is what makes the discussion section strong and distinct from other sections. In fact, it is one of the sections professors and fellow researchers pay the most attention to.
- Moves 3a, 3b, 3c, 3d is done for each result you report.

Let's see moves 1-5 in an example research paper (Examples 1-3) and in a thesis (Example 4) – some sentences have been omitted due to space restrictions, and key phrases are underlined.

Example 1

[Move 1: background information (restate study purposes and methodology)] We have assembled, organized and publicly released a dataset including ~3.5 million photometric measurements for 80,000 spectroscopically confirmed quasars. The available time lags span 0.8 days to almost 20 years in the observer's frame. We have analyzed and quantified the observed variability in the observer's and rest frames. **[Move 2. statement of key results]** Our principal results are as follows (…) **Move 3:** Long-term quasar variability measurements, constrained using SDSS and POSS data for time lags up to 50 years (in the observer's frame), [**3a: making a strong/certain claim about result]** conclusively show that a simple power-law dependence for the structure function cannot be extrapolated beyond a decade, **[3b: explaining/exemplifying results]** and suggests an average characteristic time scale for quasar variability in the rest frame of ~2 years and an average long-term dispersion of ~0.26 mag (for rest wavelengths 2000–3000˚A).) **[3c: comparing results with previous studies: confirms]** This behavior extrapolates well to the UV results of Welsh, Wheatley & Neil (2011), who find that the SF for GALEX NUV data reaches about 0.4 mag and flattens at ΔtRF > 300 days (…) **[3c: comparing results with previous studies: partially confirms]** Voevodkin (2011) found that a broken power-law provides a good fit to the S82 ensemble SF with a slope of 0.33 at long time scales steepening to 0.79 below 42 days. Our 2-epoch SDSS data are consistent with the shallower slope of 0.33, but our data do not support the conclusion of a much steeper SF(Δt) for small Δt found by Voevodkin (2011). **[3d: offering explanations for contrasting results]** While we cannot rule out a broken power-law dependence with the available data, the observed SF is fully consistent with the form expected for a DRW (Eq. 5).

Example 2

[3b: explaining results with a degree of probability] The high structural order of some of the carbonaceous matter present in ALHA 81030, ALHA 81121, ALHA 81229, ALH 83008 (…) could be interpreted as related to (i) long-duration thermal metamorphism more intense than in a chondrite of petrologic type 3.7, (ii) shock metamorphism, or (iii) thermal metamorphism similar to other type 3 chondrites, but in which the presence of catalyst favored the graphitization of the carbonaceous matter **[3c: confirming results with previous studies: with the citation at the end of the results, the writer shows the similarity with other studies]** (Charon et al., 2014).

Example 3

[3c: contrasting results with previous studies: contradicts] This alternative to a continuous cooling provided by the above experimental work is at odds with thermal histories inferred from shock wave models (e.g. Desch and Connolly, 2002; Desch et al., 2005, 2012), in which… **[they continue 3c, but they start to make their own claim by critiquing another study]** Despite the fact that shock models explain satisfactorily such slow cooling of chondrules over tens of hours (Desch et al., 2012), it is worth noticing here the important caveat that **[critique]** such chondrule thermal histories were deduced from closed system experiments in which only kinetic effects (cooling rate) governed the crystal growth rate and the corresponding texture of the chondrule analogues. **[the authors' claim]** However, we have shown by this set of isothermal open system experiments, i.e. oxidation process, that chemical disequilibrium reproduces not only the same porphyritic textures but also the chemical diversity of type IA and type IIA chondrules observed in chondrites. **NEW KNOWLEDGE** This finding clearly challenges both the common view that cooling rate is the only driving force during chondrule crystallization, and the reliability of cooling rate values for producing porphyritic textures inferred from dynamic crystallization experiments.

Example 4

(Background information: MA thesis proposing a model, so the methodology takes up the most pages – 18 – while the results and discussion 1) go together and 2) are the second longest chapter, with 8 pages).

4.2. Multi-objective function design

Move 1. background information (restating methodology for a particular purpose] In a second stage, the problem was solved considering a multi-objective function: minimizing costs and minimizing the system's GHG emissions. Different relative importance weights were considered to obtain a subset of the Pareto front.

Pareto front

[Move 2 and 3: states, explains, and comments on one result; underlined parts correspond to result features, not discussion ones] (…) The Pareto curve obtained **[2-3a]** confirms the opposing character of the proposed economic and environmental functions: minimizing costs implies increasing emissions and viceversa. A more significant variation can be seen in the emissions compared to the costs as it varies by 70% versus 56%. The behavior of the curve shows that the costs tend to increase more significantly when the minimization of emissions takes primary importance; meanwhile, the emissions tend to decrease significantly. This result is interesting in the context of the system design, as it points out that prioritizing one function will significantly impact the other. Additionally, the nonlinear form of the curve is a consequence of having integer variables and a different system configuration in every scenario.
[Figure 4.6 here]

[Move 5. making recommendations for implementation] From the Pareto front, it can be concluded that a carbon tax between 100 and 1,000 USD/CO2-eq is needed to promote the minimization of emissions in the energy system proposed. **[Move 3c: comparing with real values due to the nature of the study]** These values differ significantly from the actual carbon taxes in Chile (around 5 USD/CO2-eq) and other developed countries [128; 129]. **[Move 5. making further recommendations for implementation]** It means that to promote the reduction of GHG emissions, not only carbon taxes are needed, but it is also necessary to reduce the investment costs of technologies.

Questions from FCFM's students and their answers

Q1. How long should the discussion be?

Although the discussion section structure can be quite similar for theses, dissertations and research articles, the length may vary. Discussion sections may be shorter in papers than they are in theses, as there is less space available for the section in papers.

What is more important than length is the *quality* of the discussion. According to the sources consulted, a good discussion does not simply *summarize* results, but *comments on* what the results mean and how they connect with existing research. In doing so, you are stating *how your work contributes to the field.*

Keep in mind that the discussion may be one, if not the most important, part of a research article, which could explain why it tends to be much longer than the conclusion.

Chapter 1

Unit 8 Writing the conclusion section

At the end of this unit, you will be able to

- Identify the purposes and moves of the conclusion
- Become aware of conclusion variations across disciplines
- Compare and contrast the moves presented with those common in your field

Preparing for the unit

Think of the papers you have read. Is the conclusion section a separate one, or is it combined with the discussion?

Purposes and the most common rhetorical moves in the conclusion

There are 3 main purposes of the conclusion. First, it connects to the introduction by responding to the aims or research questions previously stated in your work. Second, it connects to the discussion, so, it does not add more details to the discussion. Third, it states the significance of the results (e.g., practical applications, implications for research).

Even though conclusion structures vary across disciplines, the conclusion typically includes five moves:

1) **A restatement of aims and/or research questions:** It is recommended in theses. As theses are usually long, this move helps the reader to remember what the project aims were.
2) **A restatement of findings:** The findings reported here must match or answer each aim in move 1. It answers the question: "What have I done?"
3) **Acknowledging research limitations:** The move is included as a way to anticipate potential criticisms.
4) **Discussing practical applications and/or implications for research:** This move is a chance to "promote" your project, despite its possible limitations. It answers the questions: "What does the project contribute?""Why what I have done matters?"
5) **Providing recommendations for further research:** What remains unstudied that is worth researching more about?

Adapted from Paltridge, B. and Starfield, S. (2007). *Thesis and Dissertation Writing in a Second Language: A handbook for supervisors.* Routledge.

Becoming aware of conclusion variations across disciplines

Let's see moves 1-5 in two example theses (examples 1 and 2) and two research papers (examples 3 and 4). Some sentences have been omitted due to space restrictions, key phrases are underlined, and "move variations" are signaled in italics (e.g., **[Move 1: A restatement of aims + methods]).** As you read, answer these questions:

a) Can you notice the similarities and differences between them?

b) Based on the examples, what are the differences across disciplines?

THESES EXAMPLES

Example 1: Vergara, 2021

Length: The conclusion is 3 pages long of a total of 82 pages.

Structure and content: All moves except move 3 are included, although they are written in separate sections.

Conclusion outline and example excerpts:

5.1 Summary of thesis and key contributions:

"The main purpose of thesis work has been to design and evaluate…""Hybrid renewable energy system was proposed to….. It included… "The findings also indicate that renewable energy could help…"

5.2 Summary of findings:

"The following are the answers to this work's research questions."

Research question 1: XXXXX?

This study analyzed the potential of using solar energy and biogas to supply the electrical demand of a mining process. The results showed a great potential to…

5.3 Future recommendations:

"Finally, future works should study operation strategies…""A potential direction for this work is a tri-criteria design…"

Example 2: MA Thesis in Astronomy

Length: The conclusion is half a page long of a total of 47 pages.

Structure and content: All moves except move 3 are included, and they are written in a single paragraph:

[Move 1: A restatement of aims] We present long-baseline ALMA observations of ten protoplanetary discs from the ODISEA survey, and in seven cases, WSB82..., we present the first line observations. **[Move 4: Discussing practical applications and/or implications for research]** The line data can be used to constrain the gas disk size and the orientation of the inner disk. We measured the gas size for the two discs less affected by contamination from the cloud, and in five cases computed the position angle and compared the orientation of the gas traced by the 12CO(2-1) line with that from the continuum. **[Move 2: A restatement of findings]** We found a significant difference between the orientation of the high-velocity gas, near the star, and the orientation of the dust in the outer ring for… Eight discs in our sample show evidence of gas inside inner dust cavities or dust gaps. All discs show bright 12CO(2-1) emission, regardless of their pre-main-sequence class, except ISO-Oph 196… The channel maps of the flat spectrum source WLY2-63 provide evidence of a possible outflow. **[Move 5: Providing recommendations for further research]** These results motivate further, more sensitive, observations in CO rotational lines and isotopologues of selected sources from the ODISEA survey.

RESEARCH PAPER EXAMPLES

Example 3: Bonal et al., 2016

Length: The conclusion is significantly shorter than the results and discussion sections, which are presented together.

Structure and content: 2 moves are present, and it is a separate section.

Conclusion outline and example excerpts:

[Move 1: A restatement of aims + methods] This present study was focused on the characterization of the thermal history of 151 CV, CO and UOCs from the NASA Antarctic meteorite collection, using an approach based on the structure of the included polyaromatic carbonaceous matter determined by Raman spectroscopy. **[Move 2: A restatement of findings]** The main conclusions are the following:
(findings are presented in bullet points)

Example 4: Su et al., 2016.

Length: The conclusion and discussion are presented together in one section. The conclusion is only 13 lines long in a 12-page paper.

Content: (complete section is shown here).

6. CONCLUSION AND DISCUSSIONS

[Move 4: Discussing practical applications and/or implications for research derived from results] We have improved the state-of-the-art on differentially private k-means clustering in several ways. We have introduced a non-interactive method for differentially private k-means clustering and improved one interactive method based on a systemized error analysis.
[Discussion move 3a: claims or evaluation of results] Concerning the question of non-interactive versus interactive, the insights obtained from k-means clustering are as follows.

The non-interactive EUGkM has clear advantage, especially when the privacy budget ϱ is small. Considering the further advantage that non-interactive methods enable other analysis on the dataset, we would tentatively conclude that non-interactive is the winner in this comparison. We conjecture that this tradeoff will hold for many other data analysis tasks. **[Move 5: Providing recommendations for further research]** We plan to investigate whether this holds in other analysis tasks.

Language note:

A common mistake made by Spanish speakers when they write the recommendations for future research is the following: *"*it is recommended to study"*. This structure (is grammatically incorrect. Fix it by saying this: "Future research *should study* [solution is: *should + verb in infinitive*]." This version is grammatically correct and a more concise version of "recommend."

Compare and contrast the moves presented with those common in your field

Now that you have analyzed the examples above, look for a paper in your field that you are familiar with. Carry out a similar analysis to that of the samples above. How is your example similar or different?

Suggestions from FCFM's scholars

"Debe haber una clara conexión o alineación entre los objetivos de investigación, la discusión de resultados y conclusiones. En este sentido, las conclusiones no son el mero resumen de los resultados. Lo que más importa en la conclusión es expresar claramente los resultados más relevantes de la investigación (especialmente lo que sea innovador, nueva información, lo que no existía antes, es decir, cuál es el nuevo aporte) y su relevancia en la Geo Ciencia y comunidad nacional e internacional."

Alejandra Serey – Profesora de Geología

Chapter 1

Unit 9 Writing the abstract

At the end of this unit, you will be able to

- Identify the purposes of abstracts
- Distinguish between two types of abstracts
- Identify the parts and verb tenses in a thesis abstract
- Identify abstract types in your field

Preparing for the unit

Think of the papers you have read. What is the first part you read? Why?
How useful are abstracts for you? Why?

The purposes of abstracts and two common types: Descriptive vs Informative

As you can imagine, abstracts have several purposes. The first one is being a "quick filter": If you are selecting a research topic, abstracts are useful to help you to determine an initial state-of-the-art in an efficient manner, and later, discard those articles that do not relate to your research. Second, as a student/researcher, an abstract makes your research stand out from hundreds of others, making other researchers interested in reading the full paper. Considering that abstracts are free access (compared to full papers), it is the very first "sample" of your work others will see. Therefore, although it may be the last part you write in your paper, abstracts should not be written so fast: presenting your work in a **clear, coherent, concise and interesting** manner in a written piece that stands alone is key to stand out in this fierce "competition."

Some abstracts are written for papers, theses, and conferences. This unit focuses only on the first two. The two most common abstract types are descriptive and informative. An example of each and a definition is given in the table below. Ellipsis (…) indicates erased lines due to space restrictions.

Descriptive (abstract from Su et al., 2016)	Informative (abstract from Villeneuve et al., 2015)
[Literature-related move introducing key words] There are two broad approaches for differentially private data analysis. The interactive approach aims at developing customized differentially private algorithms for various data mining tasks. The non-interactive approach aims at developing differentially private algorithms that can output a synopsis of the input dataset, which can then be used to support various data mining tasks. **[Move states the aim of the research]** In this paper, we study the effectiveness of the two approaches on differentially private k-means clustering. **[Methodology-related move]** We develop techniques to analyze the empirical error behaviors of the existing interactive and noninteractive approaches. **[Results]** Based on the analysis, we propose an improvement of DPLloyd, which is a differentially private version of the Lloyd algorithm. We also propose a non-interactive approach EUGkM, which publishes a differentially private synopsis for k means clustering. **[Contribution/Implications]** Results from extensive and systematic experiments support our analysis and demonstrate the effectiveness of our improvement on DPLloyd and the proposed EUGkM algorithm.	**[Literature-related move introducing key words]** In unequilibrated chondrites, the ferromagnesian silicates in chondrules exhibit wide ranges of … it is generally inferred that type II chondrules are formed in more oxidizing conditions than type I. **[Move states the aim of the research]** In order to check whether this redox difference was established during chondrule formation… we have undertaken a set of experiments aimed at… **[Results]** We show that high temperature (isothermal) oxidation of type IA-like assemblages is a very efficient and rapid process (e.g. few tens of minutes) to form textures similar to type IIA chondrules. Due to the rapid dissolution of Fe metal blebs… Crystallization of ferroan olivine occurs either as new crystal in the mesostasis or as overgrowths on the remaining unresorbed forsterite grains (relicts). Interruption of this process at any time before its completion by rapid cooling allows to reproduce the whole range of textures and chemical diversity observed in type A chondrules, i.e. from type I to type II. **[Implications]** Several implications on chondrule formation processes can be inferred from the presented experiments. Type I chondrules…are very likely the main precursor material involved in the formation of most type II chondrules. This questions the reliability of chondrule thermal history (e.g. cooling rate values) hitherto inferred for producing porphyritic textures from dynamical cooling rate experiments only (…)
Definition: The abstract does not go into much detail about the results, the writer "announces" what they *will show* in the paper or what they did/do (e.g., "*we study*", "*we propose*"). ***Verb tense:*** present simple (most common tense in mathematics, computer science and other sciences). ***Words:*** 145	***Definition:*** The abstract states key results, so it does go into much more detail. Despite the inclusion of other moves (e.g., research aims, implications), results take up a significant portion of the abstract. ***Verb tense:*** present simple ***Words:*** 471

Thesis abstract: parts and verb tenses

Below is an example abstract from an MA thesis by Vergara (2021). It comes immediately after the cover page. Moves, their verb tenses, and extra notes are signaled in bold.

[One of the main challenges of the mining industry from an environmental prospect is the growing increase in energy consumption. Over the next ten years, energy demand is expected to increase by 41% since mines are getting older and deeper, a change in the copper production structure and the increase in seawater consumption. Within the energy demand of a mining process, final energy consumption and electricity generation are the primary sources of greenhouse gas (GHG) emissions. Thus, decreasing energy consumption and studying new energy sources with a lower environmental impact becomes necessary. In this context, the use of hybrid renewable energy systems has proven to be an attractive option regarding costs, operability, and environmental impact. Besides, they are more resilient than single energy systems.

[Aims 1 and 2 of the research – present simple] The interest of this research is **[aim 1]** to design a hybrid renewable energy system to supply the electrical demand of a mining process and **[aim 2]** evaluate the possible trade-offs that may exist. **[Methodology – present perfect and present simple]** For this purpose, a multi-objective optimization problem has been formulated considering two objectives: minimizing annual costs and minimizing GHG emissions. The calculation of GHG emissions includes direct emissions associated with fuel combustion and indirect emissions associated with electricity purchase. The proposed energy system considers solar energy and biogas generated from organic waste as primary energy sources, two energy storage systems (lithium-ion batteries and hydrogen storage), and a connection to the electrical grid. The approach is applied to a case study that considers a typical mine located in the North of Chile.

[Methodology continued – present perfect, gives a sense of "achievement", although past simple could also be used to just state facts] The model has been implemented in the computational program Julia and solved using Gurobi. In the first instance, the problem has been solved considering each objective function separately, and then the multi-objective problem has been solved using the ε constraint method. Finally, a sensitivity analysis has been performed, considering the variation in energy demand, biogas availability, costs, and grid emissions factor. **[Stating results – present simple, and past simple only to highlight specific methodological decision and its corresponding result]** The results show that biogas and solar energy are attractive options to reduce costs and emissions in the mining industry. However, the biogas does not have the potential to cover the demand as it is limited by the biomass available. Regarding the system configuration, all the proposed technologies were selected in the simulations. The energy was primarily stored in batteries; nonetheless, **[*present simple ("there is, increases, are needed") implies a general assertion derived from a result rather than a specific result]** there is no preference between storage systems considering GHG emissions. The use of energy storage systems increases the costs. However, these systems are needed to use more renewable energy and reduce emissions. A trade-off between costs and emissions **[specific result –past simple]** was observed. **[Practical implications in the form of prediction– future with "will"]** Therefore, the prioritization of one criterion will significantly impact the other. **[Recommendations – present simple passive to emphasize the suggestion itself]** Lastly, a second environmental criterion is suggested to evaluate the impact of renewable energy and energy storage systems such as abiotic depletion or the use of land.

Words: 445

Verb tense note: the switch between present and past simple may not be a good idea because it can confuse readers. Before switching from one tense to another, ask yourself *why* you need the change. Are you still in the same move or you want to do or imply something else? If you change move, change tense. If not, keep using the same verb tense.

Questions from FCFM's students and their answers

Q1. How long should the abstract be?

This varies according to the journal you are submitting your work to, so check the guidelines for authors in the journal's website. If possible, take time to browse some article published in the same journal, so you notice if a particular abstract type is more common than others. If so, you may have to adapt yours.

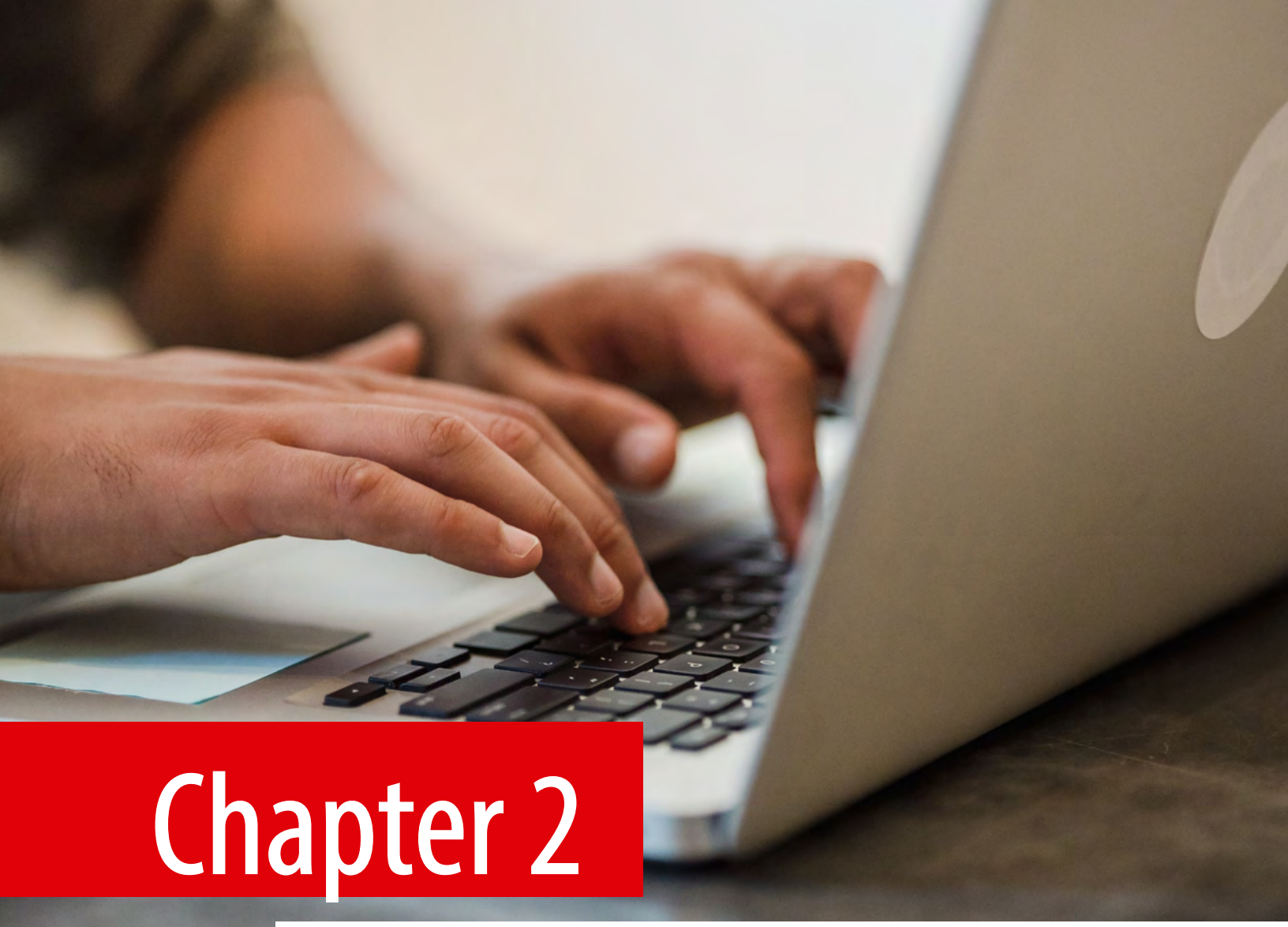
Abstract Suggestions from FCFM's scholars

Creo que [una de] las partes más importantes para el lector es el resumen…es, probablemente, la sección más leída.

Felipe Diaz Alvarado

ABSTRACT ONLINE RESOURCES

- Australian National University. (n.d.). *Writing an abstract.* https://www.anu.edu.au/students/academic-skills/research-writing/journal-article-writing/writing-an-abstract
- The University of Melbourne (n.d.). *Writing an abstract: Understanding and developing abstracts.* https://services.unimelb.edu.au/__data/assets/pdf_file/0007/471274/Writing_an_Abstract_Update_051112.pdf
- Waker, M. (2016). *Rhetorical moves: Understand how writing works.* https://onlineacademiccommunity.uvic.ca/gradwriters/academic-writing-tips-tricks-and-exercises/



Chapter 2

Academic Writing Foundations

Unit Overview:

Unit 1: Paragraphs
Unit 2: Sentences and Connecting Words
Unit 3: Verb tenses and the use of the passive
Unit 4: Cohesive devices
Unit 5: Clarity and conciseness
Unit 6: Developing an academic style
Unit 7: Modal verbs
Unit 8: Evaluating work through Hedging and Boosting
Unit 9: Punctuation rules summary

Chapter 2

Unit

Paragraphs

At the end of this unit, you will be able to

- Identify the characteristics of a good paragraph
- Plan and write a complete paragraph

To begin, read the following excerpt:

"[Una de las debilidades detectadas en la escritura de algunos estudiantes es la] "falta de claridad de las ideas, falta de organización (texto con muchas "distracciones", que cuesta ver adónde apunta)."

Xavier Emery - Profesor de Ingeniería Civil de Minas y programas de postgrado de Ingeniería de Minas

The quote above was shared by one of the FCFM's professors surveyed, and it illustrates a common problem in students' writing. Have you ever read someone's work and thought "what is this person trying to say? or "I'm lost…where is this going?" This means that the writer (for whatever reasons) has not considered the audience, or the readers of their work. You, the writer, may understand your ideas, but readers do not know what is going on in your mind. It is then YOUR job as a writer to spend enough time planning your paragraphs (determine the topic of your paragraph, *how* it will be developed, and how you will order ideas), drafting, revising, and editing them. To start this process, let's see what makes a good paragraph.

Characteristics of a good paragraph

In academic writing, a good paragraph has 3 characteristics:

1) **Format**: It is **indented and separated** with a space from other paragraphs.
2) **Content:** It is a complete, *well-developed* paragraph: it **sufficiently** explains **a single idea** through a *topic sentence, supporting sentences,* and *concluding sentence.*
3) **Organization:** It presents ideas in an **organized and logical** manner (connectors and other cohesive devices) after careful planning.

In terms of **content**, a paragraph needs to have a clear and complete structure consisting of 3 parts: **topic sentence, supporting sentences, and concluding sentence.**

Let's see two examples:

Example 1 (A short segment of the paragraph was omitted for length with ellipsis marks)

[Topic sentence: It is a general idea and states what the paragraph will be (and will not be) about. It is usually the first sentence of the paragraph] The capacity for interplate/megathrust earthquakes to induce large numbers of landslides and mobilise large volumes of sediment is highlighted by the 1960 Valdivia (Duke, 1960) and the 2010 Maule (Serey et al. 2019) earthquakes. **[Supporting sentences: There are as many as needed; they help understand the topic sentence: *definitions, examples, explanations*; they are organized by the topic sentence and transition words.]** During the Valdivia earthquake, extensive landsliding occurred (Wright and Mella, 1963); however, three large landslides on the San Pedro River attracted particular attention due to the formation of landslide dams and the threat to the city of Valdivia c. 80 km form the slides (Davis and Karzulovic, 1963). The San Pedro River landslides removed c. 30 Mm 3 of poorly consolidated sediments, the intermediate transported 6 Mm 3 and, finally, the smallest involved the removal of 2 Mm 3 (Davis and Karzulovic, 1963)…The events are unevenly distributed in the study area; the majority of landslides are located in the Principal Andean Cordillera and in a very constrained region near the coast on the Arauco Peninsula (Serey et al., 2019).

Example 2 HEADING: Energy Storage Systems

[Topic sentence: definition and description of uses of energy storage systems]: Energy storage systems (ESS) are devices that capture the energy produced at one time and release it later when it is needed. **[Supporting sentences]** They are essential for energy systems' operation as they ensure the continuity of energy supply and improve the system's reliability [49]. Besides, they can be used as an alternative to backup generators such as diesel-based systems, reducing contaminating gas emissions.

In terms of **organization**, a paragraph needs to present ideas in an organized and logical manner to be easily understood. You can do that through connectors and other cohesive devices. The example paragraph shows its structure (in square brackets) and also connectors or other cohesive devices, as pronouns, which replace a word or phrase mentioned in a previous sentence (underlined).

EXAMPLE PARAGRAPH	COHESIVE DEVICES USED
SECTION TITLE: 2.1.2. Configuration **[Topic sentence: configuration classification of HRES]:** The configuration of a HRES can be classified in different ways. **[Supporting sentences]** The most common ones are based on the grid connection and its components' integration method [52]. In the first categorization, HRES are distinguished according to their stand-alone or grid connected operation. When a system is connected to the grid, it is called *on-grid system*. This configuration ensures that the demand is provided in energy deficit situations and increases the system's performance by taking advantage of the energy excess. In contrast, when a system is isolated from the grid, it is called *isolated system*. This configuration has problems related to reliability and performance since there are limited resources available, and it has to discharge the energy excess. **[Concluding sentence]** For these reasons, isolated systems are generally used when the connection to the grid is impossible or very expensive.	***Ones:*** replaces "HRES configuration types" ***In the first categorizarion:*** it refers to "based on the grid connection and its components´integration method" ***This configuration:*** refers to "on-grid system" ***In contrast:*** connector shows that the next sentence discusses a differtent configuration type. ***This configuration:*** refers to "isolated system" - "it" ***For these reasons:*** refers to "This configuration has problems related to reliability and performance since there are limited resources avalaible, and it has to discharge the energy excess."

Exercise: Read this paragraph from a paper's conclusion section. Identify the topic sentence: what is the paragraph about? How many supporting sentences does it have? Does it have a concluding sentence? Evaluate its organization by circling the connectors and other cohesive devices that link ideas throughout the paragraph.

These results may have implications for chondrule formation processes. First, type IA chondrules or fragments of reduced chondrules may very likely be the main precursor material involved in the formation of type IIA chondrules. Second, type IIA chondrule formation may be the result of processes generating crystal growth by chemical disequilibrium at high temperature, i.e. dC/dt as in our isothermal open system behavior experiments, rather than processes generating crystallization only by cooling rates as it is assumed now in the literature, i.e. dT/dt as in dynamical cooling rate experiments. This questions the reliability of cooling rate values hitherto inferred for producing porphyritic textures. Third, type A chondrule formation is a very fast process. After high temperature events of almost isothermal heating at slow cooling (>50 K/h) as short as several tens of minutes and no longer than few hundreds of minutes (at 1500–1800 _C), type A chondrule formation is terminated by a fast cooling (>>103–104 K/h). Such inferred thermal history being at odds with nebular shock models. We thus advocate that impacts on planetesimals causing rapid melting and vaporization may provide the very high density and highly volatile enriched environments required to form chondrules.

Practice: Use what you learnt in the unit to plan and write a paragraph you can add to your paper or thesis.

PARAGRAPH WRITING RESOURCES

- Bailey, S. (2011). Organising paragraphs. In *Academic Writing: A Handbook for International Students* (3rd Ed.) 77-82.
- The University of Adelaide (2014). Paragraph Writing - *Writing Centre Learning Guide.* [PDF]. https://www.adelaide.edu.au/writingcentre/ua/media/16/learningguide-paragraphwriting.pdf

Chapter 2

Unit 2 Sentences and Connecting Words

At the end of this unit, you will be able to

- Identify 4 sentence types: simple, compound, complex, and compound-complex.
- Identify the 3 variations of complex sentences (with adverb clause, adjective clauses, noun clauses).
- Identify connecting words: their meaning, their use in a sentence, and their punctuation rules in context.

To create a sentence, there are 4 possibilities: **a simple, compound, complex, and a compound-complex sentence**. In turn, each sentence type is made up of clauses (clause: subject + verb phrase), which can be *independent* and *dependent*. This knowledge is crucial in order to identify and write grammatically and stylistically correct sentences.

SENTENCE TYPES	INTERNAL STRUCTURE
Simple Sentence Sentence = Independent clause	[Freshwater boils at 100 degrees Celsius at sea level.] [Freshwater boils at 100 degrees and freezes at 0 degrees Celsius.] [Freshwater and salt water do not boil and do not freeze at the same time.]
Compound Sentence (Two Independent clauses)	[Salt water boils at a higher temperature than freshwater], so [food cooks faster in salt water.]
Complex Sentence (Independent and dependent clause combination)	*[Because* salt water boils at a higher temperature than freshwater], [food cooks faster in salt water.]
Compound Complex Sentence (At least one independent clause and one or more dependent clauses)	The cook wanted to cook faster, so he used salt water, which makes food cook more quickly.

Source: Oshima A. and Hogue A. (2006). *Writing Academic English*. (4th ed.). Pearson Longman.

Sentence types and their structure

For **simple sentences**, there is one independent clause. In other words, there is one subject combined with one or more verbs. In contrast, a **compound sentence** is made up of two independent clauses, which can be joined in three ways:

1. With a coordinator **(for, and, nor, but, or, yet, so = "FANBOYS")**: Salt water boils at a higher temperature than freshwater, ***so*** food cooks faster in salt water.
2. With a sentence connector **(therefore, hence, then, thus, etc.)**: Salt water boils at a higher temperature than freshwater; ***therefore***, food cooks faster in salt water.
3. With a semicolon **(;)**: Salt water boils at a higher temperature than freshwater; food cooks faster in salt water.

A **complex sentence** contains one independent clause and one (or more) dependent clause(s). In a complex sentence, **one idea is generally more important than the other**. We place the more important idea in the independent clause and the less important idea in the dependent clause. There are three kinds of dependent clauses: *adverb, adjective, and noun clause*.

1. Adverb clause:

An adverb clause acts like an adverb; that is, it tells where, when, why, and how. An adverb clause begins with a subordinator, such as when, while, because, although, if, so, or that. It can come before or after an independent clause.

[Dependent clause with subordinator "although" + independent clause):

(DC) Although several papers deal with detecting defects during welding, (IC) a thorough consolidation of in situ defect detection methods has not been reported yet.

2. Adjective clause:

An adjective clause acts like an adjective; that is, it describes a noun or pronoun. An adjective clause begins with a relative pronoun, such as who, whom, which, whose, or that, or with a relative adverb, such as where or when. It follows the noun or pronoun it describes.

Example 1

The methods covered in this manuscript make use of different input signals that include audio, welding current and voltage, and optical signals.

Example 2

ANNs were also used by Pernambuco et al. [39], who proposed a non-intrusive methodology to identify the discontinuities during the metal inert gas (MIG)/metal active gas (MAG) welding process using the electric arc's sound signals.

3. Noun clause:

A noun clause begins with a wh-question word, that, whether, and sometimes if. A noun clause acts as a noun; it can be either the subject or an object of the independent clause.

Example

Their findings also indicated that weld sound was a reliable indicator of defects.

Compound-complex sentences should contain at least two independent clauses and one or more dependent clauses (or, as the name suggests, one compound and one complex sentence). However, in academic writing, a sentence should be ideally made up of no more than 4 (relatively short) clauses to ensure clarity and conciseness.

Example

[INDEPENDENT CLAUSE] This valuable subsample contains well-sampled light curves for 9,258 spectroscopically confirmed quasars [DEPENDENT CLAUSE] whose variability properties are analyzed in Mac10, and [INDEPENDENT CLAUSE] it can be used to verify some of the results inferred from the analysis of two repeated observations.

Exercise: Select a paragraph from a paper you have read or your own writing. Analyze each sentence and say which type they are. What is the most frequent type you see? Ideally, you should use a variety of sentences.

Sentence types and their structure

When using a connecting word, you should take into account these 3 considerations: Meaning, type of connecting word, grammar + punctuation. These 3 aspects are present in the chart below. To use it, first think about the logical idea (meaning) you want to express; then the type of sentence you want to use it in; finally, the correct grammar and punctuation.

Example

Initial sentences with no connector: I left home late at 6. I missed the bus.

Meaning needed: Introduce a result or consequence.

Sentence where it will appear: A simple sentence ("I missed the bus"), which requires then a sentence connector type at the beginning.

Grammar and Punctuation: A sentence connector follows a previous sentence and has a comma after it.

Possible connectors in the chart that meet my requirements: 7

Final version with a connecting word: I left home late at 6. *As a result*, I missed the bus.

Note: Types of connecting words are *coordinators, subordinators, and sentence connectors*, which have been already presented above.

CONNECTING WORDS CHART*				
Meaning / Function	**Sentence connectors** *Beginning of independent clause - comma after*		**Subordinators** *Start of dependent clause + comma + independent clause*	**Coordinators: FANBOYS** *Only in compound sentence – comma before*
To introduce an additional idea	In addition futhermore moreover	besides additionally	In addition to...	and
To introduce an opposite idea or contrast	on the one hand on the other hand in contrast on the contrary however	nevertheless instead still nonetheless In spite of this/ Despite this	although even though though while whereas Although/ Even though Unlike...	but yes
To introduce a choice or alternative	Otherwise		if unless	or
To introduce a reason or cause	One reason is... Another reason why...		because since as	Due to... Owing to...	for
To introduce a result or consequence	accordingly as a result as a consequence therefore	consequently hence thus	As a result of So that In order to	so
Sequence	First Then Eventually Soon			-
Express similarity	Similarly Likewise In the same way		Like... Similar to	-
Emphasis	Certainly Clearly Indeed	In fact Most importanly Surely	-	-

*This chart was adapted by the author and is a much shorter version of Oshima and Hogue (2006). For a more comprehensive chart see Oshima and Hogue (2006) in the References.

SENTENCE WRITING RESOURCES

- The University of Adelaide (2014). Sentence Structure Guide- Writing Centre Learning Guide. [PDF]. https://www.adelaide.edu.au/writingcentre/ua/media/18/sentence-structure-guide.pdf

Chapter 2

Unit 3 Verb tenses and the use of the passive

In this unit, you will be able to

- Recognize the most common verb tenses in English
- Apply verb tenses correctly in a thesis/paper section
- Identify and use the passive correctly

Overview of verb tenses in English

There are many verb tenses in English, but this unit focuses only on the ones which are most common in research paper sections, including abstracts. Keep in mind that these are generalizations and that sometimes you may find a different or more frequent verb tense in papers of your discipline. What follows is a short glossary with key grammatical terms.

Verb tense: This refers to WHEN something happens (present, past, future).

Infinitive: This is a verb in its base form, with nothing attached to it. In verb tables, it's usually the first column.

Passive voice: While a sentence in active voice follows the subject + verb phrase + direct object pattern (because the emphasis is on who/what *does* the action), sentences in passive voice change the pattern to object + verb phrase + by whom (the last element is optional because the emphasis is on the action, not the doer). For more details on passive voice, see Ch.2, Unit 3).

Modal verb: A type of auxiliary verb that can express necessity, certainty, possibility, etc. (for details on modal verbs, see Ch.2, Unit 7).

Verb tense	Grammar rules	Example sentence
Present simple	be (is /are) any other verb (+): add "s" "es" any other verb (-): add *do/does* + not + verb	Geology **is** an interesting field. The student **submits** the paper. He **does not know** how to solve the problem.
Past simple	be (was/were) any other verb (+): regular verb: add "-ed" or "d" to the infinitive irregular verb: find the past form in an irregular verb list any other verb (-): add *did* not + verb	The paper **was** groundbreaking. His findings **were** well-received. The student **submitted** the paper. They **chose** the best sample. He **did not know** how to solve the problem.

Present perfect	be: has/have been ("ha/han sido-estado") have/has (not) + past participle *past participle for regular verbs is the same as past simple – e.g., *yielded* – while for irregular verbs, it's usually the third column of the irregular verb lists — e.g., *shown, found*	This issue **has been** insufficiently **studied**. Studies **have found** the solution to this. Research **has shown** inconclusive results. Experiments **have yielded** promising results.
Simple future with "will"	active: be and any other verb: be + infinitive passive: will be + past participle	Active: Its position relative to a sample **will allow** a more precise estimation. Passive: Interpretation **will be discussed** in part 5.3.
***Modal verbs: these verbs do not indicate tense, but they are common in papers.**	active: {should, need to, have/has to, may, might, can, could} + (not) infinitive passive: {should, need to, have/has to, may, might, can, could} + be (not) + past participle	Active: Their parameters (e.g., pressure, water) **may play** a role. Passive: Further measurements **should be performed**.

The passive voice

The passive voice (be + past participle) is very common in theses and research articles. Let's look at some examples from a research article, indicated in **bold.** What can you conclude?

1. This paper **is focused** on the characterization of the thermal history of…
2. The scale **was** later **extended** to several groups, including the CV (e.g., Guimon et al.,1995; Bonal et al., 2006), CO carbonaceous chondrites…
3. Experimental and analytical conditions applied to the type 3 chondrites from the Antarctic meteorites collection **are described** in the following sections.
4. The widths, positions and relative intensity of the D and G bands **are reported** in Tables 2–4.
5. The width of the G band (FWHMG) **has been proposed** as a suitable tracer of metamorphic trend of the IOM of types 1, 2 and 3 chondrites (Busemann et al., 2007), but this result **is not supported** by other studies (Quirico et al., 2003, 2009, 2011).
6. Interpretation **will be discussed** in part 5.3.
7. These samples **are characterized by** raw Raman spectra exhibiting not only the D1-band but also the D2-band…
8. The carbon thermometer of Busemann et al. (2007) **was** thus **calibrated** based on poorly accurate temperatures.

These are some important conclusions to remember in your own writing:

1. In passive sentences, the subject (what is first, before the verb) is *always* a thing (abstract or concrete), and *never* a person (e.g., "We", "Researchers", "Quirico et al.").
2. Passive voice can be used in any verb tense (present simple, past simple, present perfect, future with "will").
3. Passive voice can occur in introductions (1,6), methodology (2,3,8), results (4,7), discussion (5), and other sections.

Clarifying passive voice questions by Spanish speakers

1. What is the translation of a passive structure in Spanish?

Example sentence: This paper is **focused** on the characterization of the thermal history of…

Possible translations:

a) Este artículo se enfoca en la caracterización de la historia termal de…

b) Este artículo está enfocado en la caracterización de la historia termal de…

As you can see in example A, the passive is the exact translation of the impersonal SE in Spanish.

2. Should I replace every "we" with passive voice?

Not really. As discussed in the methodology unit, both "we" and passive voice are used in that section. Using only passive voice will make your writing too dense and hard to understand. See how the writer uses both "we" and passive in a real article: "The raw Raman spectra **are** indeed **characterized** by a slight fluorescence background and by D- and G-bands broader (Figs. 4 and 6) than they typically are for type 3 chondrites. **We do not necessarily mean** to propose that MIL 07687 is the first CO2 chondrite…" (excerpt from Bonal et al., 2016).

Paper section	Examples from papers and the associated move
Introduction and Literature Review	**1) Present simple:** - Welding **plays** a pivotal role in several industries including automobile, aerospace, oil, gas, and space exploration. (Importance of the topic). - In this study, we **examine** the hypothesis that… (Study purpose). - In Section 5, we **discuss** the implications our results have on transient identification. (Paper outline). **2) Past simple:** - Cudina et al. [34] studied the correlation between the arc sound and arc behavior. (Specific past research). - Luo et al. [38] used wavelet analysis and ANNs to identify laser welding defects. (Specific past research). **3) Present perfect:** **Both examples report general findings (1) or research gap (2) with present perfect in passive voice:** (1) Increased earthquake activity in the subducting plate **has been** previously **reported** from around fracture zones in different subduction zones (e.g., Kirby et al., 1996; Lange et al., 2010; Dzierma et al., 2012). (2) The metamorphic history of the CO chondrites considered here **has not** yet **been assessed.**
Methodology	**1) Past simple: The most common tense in many disciplines** - Passive (to highlight procedure; the most common form): Detection and characterization of bending-related faults **was conducted** by means of shipborne bathymetric data. - Active (to highlight authors' decisions): In the case of northern Chile, we **used** the compilation provided by Geersen et al. (2018a). **2) Present simple:** **In some disciplines' abstracts:** To quantify the impact of oceanic-plate structure and faulting on slab hydration and intermediate-depth seismicity…, **we correlate** high-resolution earthquake catalogs and seafloor maps…
Results	**1) Past simple is used in some disciplines, but present simple seems to be more common in disciplines such as physics, geology, mathematics, and astronomy:** Examples of present simple have been found in some disciplines when describingNthe development and result of an equation (Mathematics); what steps are followed (Computer Science); what data is obtained from observations/measurements (Geology), as in this example: "A linear chain of large seamounts…**is** also **observed** at the southwestern corner of the Japan Trench subduction zone."

Discussion	**1) Present perfect:** it is used for summarizing article aims. - We **have assembled, organized and publicly released** a dataset… **2) Past simple:** used to refer to a specific study result. - Voevodkin (2011) **found** that a broken power-law provides a good fit to the S82 ensemble SF… **3) Present simple:** it states how your study result compares with the result of other studies / it explains a result. - This behavior **extrapolates** well to the UV results of Welsh, Wheatley & Neil (2011) (…) - 2-epoch SDSS data **are** consistent with the shallower slope of 0.33, but our data **do not support** the conclusion of a much steeper SF(Δt) for small Δt found by Voevodkin (2011). - While we **cannot rule out** a broken power-law dependence with the available data, the observed SF is fully consistent with the form expected for a DRW (Eq. 5).
Conclusion	**1) Present simple for summary of results:** - Concerning the question of non-interactive versus interactive, the insights obtained from k-means clustering **are** as follows. The non-interactive EUGkM **has** a clear advantage. **2) Present perfect to state paper contributions:** - We **have introduced** a noninteractive method for differentially private k-means clustering and **improved** one interactive method... **3) Simple future with "will":** - However, future improvements in the resolution of local seismicity catalogues **will allow** further quantification of…
Definitions/Figure/ Table/Graph Descriptions	**1) Present simple:** - *Definition:* We **define** a quasar as any object listed in the SDSS catalog of … - *Figure features description*: Curved black lines **are** slab-surface isolines at 40, 80, and 120 km depth. Panel A **shows** the color-coded depth to the seafloor, whereas panel B **shows** a line drawing of oceanic-plate faults…

ADDITIONAL VERB TENSES RESOURCES

- Portland State University (PSU) and others (2015). Civil Engineering Project: Materials for Courses & Independent Study.
  http://www.cewriting.org/courses-and-independent-study
- ISU Writing Center (2016). *Verb tenses*.
  https://www.isu.edu/media/libraries/student-success/tutoring/handouts-writing/editing-and-mechanics/verb-tenses.pdf

Chapter 2

Unit 4

Cohesive devices

At the end of this unit, you will be able to

- Know what cohesion is and how to achieve it through 3 different cohesive devices
- Identify possible issues when using cohesive devices
- Identify 3 cohesive devices in an excerpt and in your own texts

To create a sentence, there are 4 possibilities: **a simple, compound, complex, and a compound-complex sentence**. In turn, each sentence type is made up of clauses (clause: subject + verb phrase), which can be *independent* and *dependent*. This knowledge is crucial in order to identify and write grammatically and stylistically correct sentences.

What is cohesion?

Cohesion is a text characteristic that makes ideas better connected and therefore, easier to understand by readers. To illustrate this, read the two sentences below. Which one is easier to understand? Why?

1. Ann conducted a research study in the social sciences. In Dubai, she interviewed twenty people.
2. Ann conducted a research study in the social sciences. As part of her study, she interviewed twenty people in Dubai.

Source: The University of Adelaide (2014). *Writing Cohesively and Achieving Flow - Writing Centre Learning Guide.* [PDF]. https://www.adelaide.edu.au/writingcentre/ua/media/19/learningguide-cohesionandflow.pdf

To achieve cohesion, besides having a clear idea of what you want to do in a paragraph and outline (plan) your ideas, you should connect them properly. There are 4 tools to do this, called **cohesive devices**: Connecting (or transition) words; pronouns; chain of ideas: old/new info pattern; topic strings. All of these are useful, and ideally, they are **used in combination**.

1. Connecting words: these can be words or phrases that express logical connections between sentences. They can add, contrast, exemplify, compare, etc. To see these in detail, go back to Unit

> Example: **Although** they provide a straightforward way to construct numerical models, these models can appear very patchy and unstructured and often fail at representing complex geological structures (Deutsch, 2006). **Furthermore**, the contact relationships and cross dependence between domains are not explicitly controlled, yielding geologically unrealistic transitions, and the properties of the outcomes are implementation-dependent (Emery, 2004).

In this excerpt, "although" is used to state a positive feature before the negative one, which is the paragraph's focus, as corroborated in the sentence that follows. It starts with "furthermore", telling the reader that another negative feature will be discussed.

Possible issue and solution: Beware of using too many connecting words in your texts; it can be counterproductive. **Simply put: an excess of connecting words does not guarantee understanding and a positive impression from the reader, so use these in combination with other cohesive devices.**

2. Pronouns and *adjectives: These are very useful words when you use them correctly, as you can use them to refer to something you already said, with no need of repetition. A complete pronoun table is shown below. *Only demonstrative and possessive adjectives.

Subject Pronoun	Object Pronoun	Possessive Adjectives	Reflexive Pronoun	Demonstrate Pronoun (as subject)	Demonstrate Adjectives (+noun)	Possessive Adjectives
I	Me	My	Myself	*Singular:* this-that *Plural:* these-those	*Singular: this-that* *Plural: these-those*	My
You	You	Your	Yourself			Your
He	Him	His	Himself			His
She	Her	Her	Herself			Her
It	It	Its	Itself			Its (singular)
We	Us	Our	Ourselves			Our
You	You	Your	Yourselves			Your
They	Them	Their	Themselves			Their (plural)

Adapted from: https://www.grammarbank.com/pronouns-chart.html

Example 1

For lower tourmaline contents, the clasts are angular to sub-angular, while **they** become more rounded for higher tourmaline contents.

The student has used the personal pronoun "they", which refers BACK and thus avoids the repetition of "clasts" mentioned in the previous clause.

Example 2

This [second-order stationarity] is a weaker form of stationarity, as **it** only involves the first two moments (mean value and covariance function) of the random field.

The student has used the singular subject pronoun "it", which refers BACK and thus avoids the repetition of "This [second-order stationarity]" mentioned in the previous clause.

Possible issue: A possible problem is unclear reference. In the example below, is it clear what "it" refers to?

English has almost become an international language. Except for Chinese, more people speak it. Spanish is the official language of more countries in the world, but more countries have it as their official or unofficial second language. More than 70% of the world's mail is written in it. It is the primary language on the Internet. (p.23).

Solution: Replace "it" with the specific word and insert relevant connecting words to further clarify ideas.

English has almost become an international language. Except for Chinese, more people speak it than any other language. Spanish is the official language of more countries in the world, but more countries have English as their official or unofficial second language. In addition, more than 70% of the world's mail is written in English, and it is the primary language on the Internet.

3. Chain of ideas through old/new info pattern: This device means referring back to a previous word, phrase or even an entire sentence (although referring to an entire sentence is not recommended so much to avoid ambiguity).

Example 1

In this approach, **the locations** targeted for simulation are visited sequentially. The value at **each location** is obtained by applying Monte Carlo simulation to a distribution function estimated by means of indicator kriging (Journel, 1983; Journel and Isaaks, 1984; Alabert, 1987; Journel and Alabert, 1988; Journel, 1989).

This example shows the use of the old/new info pattern. The student first refers to "the locations", *[new info]* which is a word that is repeated in the sentence "each location" *[old info]*.

Example 2

Among the existing approaches for simulating geological domains, the **plurigaussian model** has become popular in the petroleum and mining industries. In **this model,** the domains are obtained by truncating one or more Gaussian random fields.

This example shows the use of cohesive device 1 + the old/new info pattern. The student has used the singular demonstrative adjective "this", followed by the noun "model", *[old info]* which is a word that has just been mentioned in the previous sentence "the plurigaussian *model" [new info]*. **The key is to repeat a word that has been mentioned in the previous sentence.**

Identify the 3 cohesive devices in an excerpt

Read the excerpt below. Identify all the cohesive devices used and determine if the text is cohesive or not. The answer key is at the end of the unit.

Excerpt: The number of iterations is quite large (200 updates per data). This choice is somehow arbitrary, and it is aimed at ensuring convergence of the Gibbs sampler to the target distribution. This will be verified experimentally in a next subsection on model validation. (Madaniesfahani, 2016).

ADDITIONAL COHESIVE DEVICES RESOURCES

- Faivre, S (2012, June 26). Part 1: Coherence, KNO. https://www.youtube.com/watch?v=vbUc2C_begw&ab_channel=SusanFaivreSusanFaivre
- The University of Auckland. (2010). *Essay Writing: Achieving Coherence*. Retrieved from https://flexiblelearning.auckland.ac.nz/essay-writing-2018/8.html#3_2

Chapter 2

Unit 5 Clarity and conciseness

At the end of this unit, you will be able to…

- Understand the importance of conciseness and preciseness
- Identify common cases of non-concise language
- Apply strategies to make your writing more concise

Definitions

Conciseness: Expressing an idea in as few words as possible.

Preciseness: Saying EXACTLY what you mean, with the most suitable word(s). Being precise using the correct technical term is particularly important in academic writing, as it shows your knowledge of your topic and makes your research more credible.

- Precise: "is related to" > *related how?* - causes, determines, influences?
- Concise: "makes a comparison" (verb + noun) – compares
- Formal: "very important issue" – key, significant

Why are conciseness and preciseness important?

The importance of these two concepts is reflected by the following opinions of FCFM's professors. They were asked, "What are your expectations for students' final written work?"

"Que se entiende lo que se quiere decir, que el lenguaje es preciso."

Patricio Felmer
Ingeniería Matemática

"Espero uso de terminología específica."

J. Cristian Salgado H.
Ingeniería Civil Química e Ingeniería Civil en Biotecnología

"…en inglés, al menos en áreas matemáticas, se prefiere mucho tener oraciones cortas y precisas, y párrafos cortos.

José Soto
Ingeniería Matemática

Common cases of non-concise (or *wordy*) language

Wordiness means using more words than necessary to express your ideas, and it can happen for several reasons. Each reason is discussed below.

Reason 1: Wordiness due to redundancy

Read the 2 versions of this excerpt. Which one is easier to process?

VERSION 1	VERSION 2
We should not try to anticipate in advance those great events that will completely revolutionize our society because past history tells us that it has been the ultimate outcome of little events that has unexpectedly surprised us. **Words:** 37	We should not try to anticipate those great events that will revolutionize our society because history tells us that the outcome of little events has surprised us. **Words:** 27

Explanation: Version 2 is probably much easier to read. You may have noticed redundant words such as "anticipate in advance", "completely revolutionize", "past history" "ultimate outcome", "unexpectedly surprised."

Reason 2: Wordiness due to long adverb phrase at the end of sentence (*how* something is done/happens, etc).

VERSION 1 (Long)	VERSION 2 (Short)
The holes must be aligned in an accurate manner. **Words:** 9	The holes must be accurately aligned.. **Words:** 6

Explanation: Version 2 is shorter because the adverb phrase has been shortened to 1 word. As a tip, whenever you want to say "in a/an X way", add the suffix "ly" to the adjective to shorten the phrase.

Reason 3: Wordiness due to wordy phrases at the beginning of sentence (e.g., it is possible that, it can be seen that, it is suggested that, it is necessary that, etc.).

VERSION 1 (Long)	VERSION 2 (Shorter equivalent)
a) *It is important/necessary that* (Es importante/necesario que…) b) *It is possible/probable that* (Es posible/probable que…) c) It is suggested that ("se sugiere que…") d) It can be observed that ("se puede observar que…")	*X must, should* *X may, could* *should, recommend* *Table/Figure X shows that…*

In some cases, starting a phrase with "it is … that" may be the only choice to express what you *want* and *need* to say, as in the example below, which uses "it is assumed that" (in italics):

"To make a conversion between number of buckets and hauled tonnage, *it is assumed that* the LHD in each cycle dumps a bucket of material to the ore pass with a swell factor of 0.86 for each bucket."

In this example, the phrase *it is assumed that* cannot be changed because it is referring to an assumption or what should be taken as true for the problem formulation.

Reason 4: Wordiness due to long "pompous" connectors (e.g., due to the fact that, despite the fact that, in a situation in which, provides the opportunity to).

VERSION 1 (Long)	VERSION 2 (Short)
a) Due to the fact that b) Despite the fact that c) In a situation in which d) Provides the opportunity to e) in order to	because, since, why although, even though if can to

Reason 5: Wordiness due to "verb + noun combination"

VERSION 1 (Long)	VERSION 2 (Short)
a) Making it possible to b) Make a comparison c) Presented increases	allowing compare increased

Reason 6: Wordiness due to long subjects (number of words before the main verb)

VERSION 1 (Long)	VERSION 2 (Short)
The dependencies of the number of operational ore pass in contrast with the number of active drawpoints and number of buckets are illustrated in Figure. 4.16 and the corresponding numbers are presented in Table.4.6. **Subject Words:** 21	The number of operational ore pass dependencies versus the active drawpoint and bucket numbers are illustrated in Figure. 4.16 and the corresponding numbers are presented in Table.4.6. **Subject Words:** 14

You probably agree that version 2 is much easier to process than 1. This is due to a shorter subject, which adds clarity to the idea. The sooner you get to the main verb, the better!

Apply strategies to make your writing more concise

Read the excerpts below. Identify wordiness cases (1-6) and fix it according to the strategies given. The answer key is at the end of the unit.

Excerpt 1 (adapted slightly):

It is essential to understand the mining process in order to provide a proper input for the model and analyze the outputs in a meaningful way.

Excerpt 2 (adapted slightly):

Predominantly, there exists sufficient material above each drawpoint to be extracted in each shift; however, it is not permitted that the amount of extracted material exceeding more than the suggested value by the operation.

Excerpt 3 (adapted slightly):

Considering the theoretical model as the objective function consists of two different units, the tonne for tonnage and percentage for the copper grade, it is necessary that objective function normalizes.

ADDITIONAL CONCISENESS RESOURCES

- Purdue Online Writing Lab (n.d.). *Eliminating Wordiness.* https://owl.purdue.edu/owl_exercises/sentence_style/eliminating_wordiness_test/index.html
- University of Melbourne. (April 15, 2020). *Clarity and Focus: How to write clearly.* [Video]. https://youtu.be/6c8hZVhEt5k

Answer key: (Answers may vary slightly)

Excerpt 1:

The mining process should be understood to provide a proper input for the model and analyze the outputs meaningfully.

Excerpt 2:

Predominantly, there is sufficient material above each drawpoint to be extracted in each shift; however, the amount of extracted material cannot exceed more than the operation's suggested value.

Excerpt 3:

Considering the theoretical model as the objective function consists of two different units: the tonne for tonnage and percentage for the copper grade. The objective function must/need to normalize - needs to be normalized.

Chapter 2

Unit 6 Developing an academic style

At the end of this unit, you will be able to

- Determine the characteristics of an academic writing style
- Distinguish between an informal versus academic writing style
- Check your own writing for informal features and fix it with a more academic style

What is an academic writing style?

In an effort to define "academic writing style," Bailey (2011) argues that it "should attempt to be accurate, impersonal and objective" (p.150). While this unit lists a set of academic writing rules, that are often applicable, you may find some of these rules are "broken" once in a while in the research world. Still, if you are just beginning your career as a researcher, it is best to follow all of these rules for your work to be perceived as academic in tone and language.

What is an academic writing style?

These are the most common characteristics of an academic writing style. (Slightly adapted from Bailey, 2011; Blass and Vargo, 2013):

a) Do not use idiomatic (poor Spanish translation) or colloquial (everyday) vocabulary

If you are sure the word selected is formal or informal, use a monolingual dictionary. Type the word and see if "informal" comes up. If so, select a synonym. (See list of suggested online dictionaries in the Appendix).

b) Use vocabulary accurately

There is a difference between *rule* and *law*, or *weather* and *climate,* which you are expected to know if you study these subjects.

c) Don't be vague. Be as precise as possible when dealing with facts or figures

Avoid phrases such as *about a hundred or hundreds of years ago*. If it is necessary to estimate numbers, use *approximately* rather than *about*.

d) Conclusions should use tentative language

Avoid absolute statements such as *unemployment causes crime*. Instead use cautious phrases: *unemployment* ***may*** *cause crime* or *tends to cause crime*. This "softening" of statements is called "hedging", which is discussed in more detail later in Unit 8.

e) Avoid adverbs that show your personal attitude

Do not use words such as l*uckily, remarkably, surprisingly*.

f) Do not contract verb forms

Do not use "*don't, can't.*" Use the full form: *Do not, cannot*.

g) Although academic English tends to use the passive more than standard English, it should not be overused

Both are needed. For details on the correct use of passive voice, go to Ch.2, Unit 3.

h) Do not use direct question forms; instead, use sentences

As an example, change: "This section discusses "How can we solve this?" to "This section discusses *how to solve this*.

i) When writing lists, avoid using etc. or *and so on*

Insert *and* before the last item.

j) Do not start sentences with "and, but, so"

Replace them by a sentence connector with the same meaning (refer to Connecting words table on Ch.2, Unit 2.

k) Do not use the imprecise and informal words in the table below

Replace them by a suitable formal choice:

INFORMAL	FORMAL
like for introducing examples	Use *such as* or *for instance*
thing and combinations *nothing or something*	Use *factor, issue* or topic
lots of	Use *a significant / considerable number*
little / big	Use *small / large*
'get' phrases such as *get better / worse*	Use *improve* and *deteriorate*
good / bad are simplistic	Use *positive / negative*

l) Do not "talk" to the reader

This means not using "You" in your sentences, as in: "*You* should be wondering if…", "*You* should consider the following." To fix it, focus on a "third person": this, this study, the literature, tests, etc. Example: *A remaining question* is… *The following* should be considered… In this sense, avoid the "conversational" tone you can find in book chapters, a website, or even a video. These are other genres, unlike theses and research papers, which do not have this "conversational" tone.

Distinguish between an informal versus academic writing style

Read this paragraph and underline any examples of poor, non-academic writing style. Then rewrite it. The answer key is provided below the text.

How to make people work harder is a topic that lots of people have written about in the last few years. There are lots of different theories etc. and I think some of them are ok. When we think about this we should remember the old Chinese proverb, that you can lead a horse to water but you can't make it drink. So how do we increase production? It's quite a complex subject but I'll just talk about a couple of ideas. (Source: Bailey, 2011).

NON-ACADEMIC PHRASE	PROBLEM AND SOLUTION
How to make people work harder . . .	Imprecise vocabulary – use 'motivation'
. . . lots of people . . .	Vague – give names
. . . the last few years.	Vague – give dates
lots of different . . .	Avoid 'lots of'
. . . etc. . . .	Avoid using 'etc.' and 'and so on'
. . . I think . . .	Too personal
. .. are ok.	Too informal
. . . When we think about this . .	Too personal
. . . the old Chinese proverb . . .	Do not quote proverbs or similar expressions
So how do we increase production?	Avoid rhetorical questions
It's quite a . . .	Avoid contractions
. . . I'll just talk about a couple . . .	*Too personal and informal*

Rewritten paragraph: Motivation has been the subject of numerous studies during recent decades, but this essay will focus on Maslow's hierarchy of needs theory (1943) and Herzberg's two-factor theory (1966). Their contemporary relevance to the need to motivate employees effectively will be examined critically, given that this can be considered crucial to a firm's survival in the current economic climate.

Application: Check your own writing for informal features and fix it with more academic stylistic choices.

Chapter 2

Unit

Modal verbs

At the end of this unit, you will be able to

- Correctly use a variety of modal verbs in your academic writing to express (in)ability, (im)possibility, (un)certainty

Read the two versions of excerpts 1-4 (with and without a modal verb, respectively). What is each version trying to say? Which version is less certain, necessary, and possible?

	VERSION 1 (with a modal verb)	VERSION 2 (w/out a modal verb)
Excerpt 1	With a smaller privacy budget, one **should** run fewer number of rounds, to avoid the results being overwhelmed by too much noise.	With a smaller privacy budget, one **runs** fewer number of rounds, to avoid the results being overwhelmed by too much noise.
Excerpt 2	A small number of iterations **may** be insufficient for the algorithm to converge.	A small number of iterations **is** insufficient for the algorithm to converge.
Excerpt 3	In addition, these noisy counts **might** benegative, non-integer, or both.	In addition, these noisy counts **are** negative, non-integer, or both.
Excerpt 4	In the case of DPLloyd, one **could** also obtain the number of data points in each cluster.	In the case of DPLloyd, one also **obtains** the number of data points in each cluster.

What are modal verbs and what are they for?

All the "Version 1" excerpts contain a modal verb. Common **modal verbs** are *can, could, should, have to, need to, must, may*, and *might*. As you can see, modal verbs show possibility, ability, necessity, uncertainty, among others. If you see version 2 of excerpts 2 to 4, they sound much more absolute, while version 1 of those excerpts sounds much more "careful." Thus, modal verbs *hedge* (or soften) your statements and make them more precise, which is expected in academic writing. (see Chapter 2, Unit 8 for more details on hedging).

How and *where* are modal verbs used?

Modal verbs are a type of auxiliary verb, so they are used together with the main verb of a sentence. They can also be accompanied by an adverb (word ending in "–ly") to *soften* or *boost* your statements (for details, see next unit). Finally, these verbs can be used in any part of your thesis or paper, but some tend to appear more in certain sections than in others. The next section presents each modal verb and its uses along with a real paper examples (Villeneuve et al., 2015; Fernández et al., 2016).

Can: it expresses ability, possibility, or certainty. The example excerpt uses "can" to express the abilities (or characteristics) of cosmic spherules:

> "The chondrules are thus to a certain extent analogous to cosmic spherules that can record through their spinel composition the diverse redox conditions of the atmosphere crossed by an extraterrestrial object during its fall towards the Earth's surface (Toppani and Libourel, 2003)."

Could: possibility in the future or past (a little less than "can")

> "…have led several workers (e.g. Sears et al., 1996; Jones et al., 2005; Hewins et al., 2005 and Refs. therein) to suggest that type I chondrules **could have been** derived from type II chondrules by evaporation and reduction processes during heating events…"

Should:

1) Recommendation:

> "With a smaller privacy budget, one should run fewer number of rounds, to avoid the results being overwhelmed by too much noise.

2) Hypothesis:

> "Because the Ti2O3/TiO2 buffer curve is 5 log units below (more reducing than) that for Fe/FeO (IW), none to only minor Ti3+ content should be found in a phase with measurable amounts of FeO."

3) Importance:

> "It should be noted that micron and submicronsized features are also present in the FPWJ samples, as shown in Fig. 2(d)."

Must:

1) Inference or supposition:

> "Similarly, forsterite dissolution in the iron-rich melt must also be a fast process, according to the significant increase of MgO content in the melt at short oxidation times…"

2) Obligation:

> "For a given chondrule, heating duration from the peak temperature down to the closure of the system at the glass transition temperature (Tg) must vary between several tens of hours to several days."

May: some lack of certainty

> "Second, type IIA chondrule formation may be the result of processes generating crystal growth by chemical disequilibrium at high temperature (…)"

Might: much less certainty than "may"

"Dendritic olivines in the mesostasis very likely crystallized during the quench of the samples and their abundance might be correlated with the FeO content of the liquid (Fig. 7)."

Note: *May, might,* and *could* can be particularly difficult for Spanish speakers, as all of these are simply translated as "podría." Thus, writers should be careful and not rely on automatic translators; instead, writers should read each of those sentences carefully and select the modal verb that really represents what they want to express. If writers do not do that, the intended meaning (e.g., possibility or certainty level) could be lost in translation or worse, interpreted differently by the reader.

Other uses in past simple (from Glasman, 2010).

may have been **might have been** **could have been**	**+ past participle of main verb**	*Example:* The fall in pressure **may/might/could have been** caused by leakage.
may not have been **might not have been** **could not have been**	**+ past participle of main verb**	*Example:* The fall in pressure **may/might/could not have been** caused by leakage.

ADDITIONAL HEDGING AND BOOSTING RESOURCES

- The University of Manchester (n.d.). *Academic Phrasebank: Being cautious.* https://www.phrasebank.manchester.ac.uk/using-cautious-language/

Chapter 2

Unit 8 Evaluating work through Hedging and Boosting

At the end of this unit, you will be able to

- Learn how to hedge your statements
- Learn how to boost your statements

What does "hedging" and "boosting" mean?

Hedging (softening) express "uncertainty…. deference, modesty, or respect for colleagues' views" (Hyland, 2000 cited in Caplan, 2020).	**Boosting** (strengthening) refers to the use of words or phrases used to demonstrate you are confident in your claims and results.

The importance of hedging and boosting in academic writing

As discussed in the previous unit, hedging is especially important throughout thesis and paper sections:

1. In the introduction, when outlining a hypothesis that needs to be tested.
2. In the literature review, when commenting on the work of other writers.
3. In the discussion, when discussing the results of a study, which may not be conclusive.
4. In the conclusion, when making predictions or suggestions for further research.

Boosting, on the other hand, increases the confidence, certainty, and strength of your statements throughout thesis and paper sections.

How to hedge and boost your statements

The table below presents ways to hedge and boost statements, with examples.

Hedging language choices	Examples (hedging in bold)
Use only a modal verb (could, may, might, etc.) Use modal verb + *be likely that*	"These results **may** have implications for chondrule formation processes. First, type IA chondrules or fragments of reduced chondrules **may very likely be** the main precursor material involved in the formation of type IIA chondrules."
Use an adverb (frequency, manner, etc.)	"Type I chondrules or fragments of type I chondrules **are very likely** the main precursor material involved in the formation of most type IIchondrules."
Use a verb as "seem to", "tend to"…	"Crystal sizes **tend to** reach a maximum size in the range of 75–150 in diameter (Fig. 8a)."
Use a modifier as *quite, rather* or *fairly* before an adjective.	"It is **fairly** well established that quasar variability properties depend on physical properties..."

Boosting language choices	Examples (boosting in bold)
Use a modal verb as *will, must, can, cannot*	A simultaneous enrichment of the major siderophile elements (Fe, Cr, Co, Ni, P) in P-rich zones coating anhedral relict cores **cannot be** coincidence.
Add an adverb reflecting certainty *(indeed, certainly, undoubtedly, in fact, clearly).*	**Indeed,** the excluded 22% of the sample will mostly contribute power to the long-term rather than the short-term SF given their indeterminately long time scales.
Use a modal verb + adverb	The sudden FeO enrichment of the melt due to iron metal oxidation **can indeed explain** (i) KD's in the range of 0.15–0.30.
Use verb "be" + adverb + adjective"	"Scientists and industrialists disagree about the health hazards of dioxins, the latter stating that the risks **are clearly exaggerated."**

Chapter 2

Unit 9 Punctuation rules summary

At the end of this unit, you will be able to

- Know the basic punctuation rules of periods, commas, semicolons, and colons
- Correct the punctuation in sentences and short excerpts

Punctuation Mark	Rule(s) and examples
Period	**.**
1. At the end of a sentence and a paragraph. **2.** In a list of bullet points as long as they are complete sentences.	
Comma	**,**
1. Between main clauses with a coordinating conjunction (for, and, nor, but, or, yet, so): "Suppose ϱ0 is allocated to the count query, **and** ϱi is allocated to the sum query for the i-th dimension" **2.** Between individual items in a series or list: "… was done by running DPLloyd with **20, 80, and 200 iterations**." **3.** After sentence connectors and introductory phrases: "**Therefore**, both Var (Si) and Var (C) are equal to 2((dr+1)t)2 ϱ2." **4.** Around appositives (a word or phrase that renames or defines a preceding noun): "Compared with theMSE analysis of DPLloyd, they are comparable when ℓ ≈ N t√d, **that is**, when each block contains only a small number of data points." **5.** After an introductory dependent clause in a complex sentence: "**While** many methods for choosing the initial points have been developed [26], these methods were developed without the privacy concern and need access to the dataset." **6.** Around non-restrictive (non-essential) adjective clauses, phrases, or information: "We call the approach of applying PrivGene to k-means clustering PGkM, **which** is similar to DPLloyd in that it tries to iteratively improve the centroids." **CAREFUL:** NEVER PUT A COMMA BETWEEN SENTENCES! PUT A PERIOD INSTEAD.	
Semicolon	**;**
1. In place of a comma and a conjunction to join independent clauses: "Adhesion testing in accordance with ASTM 633-C was performed for the samples; the results are presented in Table 6 and Fig. 5." **2.** Before a sentence connector (e.g., *however, therefore, besides, etc.*): "Models predict that the gas is slightly depleted within the dead zone in comparison with the local maxima (…); **besides**, protoplanetary (…) can develop typical structures of transition discs" **3.** Between items in a list when the list items have commas: "In the two leftmost columns, red indicates reactivated spreading related faults; black, new bend faults; yellow, faults striking 100°–140°, which is oblique to the paleo-spreading fabric (…)" **4.** In APA style, semi-colon separate authors in in-text citations: "thermal history (e.g. **Desch and Connolly, 2002; Morris and Desch, 2010**)."	

Colon	**:**
1. At the end of a sentence and a paragraph. **2.** In a list of bullet points as long as they are complete sentences. **1.** Before a series or list that follows a complete sentence. It can also be after "the following", or "as follows." **2.** After a grammatically complete sentence when the first signals that the second will provide an answer, definition, or example: "NDT methods are considerably effective in detecting defects accurately; however, these methods have a common drawback: all these techniques can detect defects only in the post-processing stage." **3.** In proportions.	

Adapted from FSG (n.d.). *Punctuation for connecting words.*
http://www.fsg.rnu.tn/imgsite/cours/Summary%20of%20Punctuation%20and%20Capitalization%20Rules%20(1).pdf

Read these excerpts and use the table above to fix their punctuation. If you find any wordiness, correct it as well. Check the answer key below.

Excerpt 1:
As it is shown in Figure. 4.6, almost on any day, the mining operation was not able to meet the long-term plan targets for tonnage, however, the grade extracted by mining operation was higher than the mine plan estimation for the corresponding day in some days.

Excerpt 2:
Furthermore in each operational day amount of the material extracted from the mine is not equally distributed in a daily base operation.

Excerpt 3:
As a road-header is used for extraction in mine then the maneuver displacement for this kind of machine is difficult in production tunnel then consequently travel time for moving to another front for continue extraction is high.

Your answers:

Excerpt 1: _____
_____
_____

Excerpt 2: _____
_____
_____

Excerpt 3: _____
_____
_____

Answer key:

Excerpt 1:
As Figure. 4.6 shows, the mining operation was rarely able to meet the long-term plan targets for tonnage; however, the grade extracted by mining operation was sometimes higher than the mine plan estimation for the corresponding day.

Excerpt 2:
Furthermore, on each operational day, the amount of material extracted is not equally distributed in a daily base operation.

Excerpt 3:
As a road-header is used for extraction in mine, the maneuver displacement for this machine is difficult in the production tunnel. Consequently, travel time to move to another front and continue extraction is high.

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Appendix

Useful Dictionaries and Academic Vocabulary Resources

- **Longman Online Dictionary:** https://www.ldoceonline.com/
  It is a very user-friendly monolingual dictionary. It has been specifically designed for learners of English, so explanations are easy to read. There are synonyms, example sentences, and many other features. It provides spelling differences between British and American English.

- **Cambridge Online Dictionary:** https://dictionary.cambridge.org/
  It is another very user-friendly monolingual dictionary. It has several dictionary types, a grammar section, thesaurus (good for finding synonyms), and translation dictionaries (with Spanish included).

- **Merriam Webster Online Dictionary:** https://www.merriam-webster.com/
  This monolingual dictionary is used only for American (U.S.) English. It can be useful, but a bit harder to understand than the previous one because it is designed for native speakers of English, not learners of English. It has a section called "Word Usage & Grammar," which can be helpful and interesting.

- **Freedictionary.com:** https://www.thefreedictionary.com/
  This website is not a learner's dictionary, but it is very complete and covers many areas of expertise. If a word is not in the other 3 previous dictionaries, it will probably be in this one. It contains example sentences, long lists of antonyms and synonyms, a daily grammar lesson section, and much more.

- **wordreference.com:** https://www.wordreference.com/
  This website is strongly recommended if you are looking for a reliable translation. This is because you see the suggested words and the context or field where the word is used. A very useful feature is the forum, which contains discussion threads based on specific terms that people need to know.

- **Academic Phrasebank:** https://www.phrasebank.manchester.ac.uk/
  This website, created by John Morley and The Univeristy of Manchester, is highly recommended to improve your academic vocabulary. It provides a vast number of standard academic phrases for each thesis or paper section as well as language to describe graphs, explain causality, classify, etc. You can use it to plan each section (it shows the phrases for each rhetorical move), get inspired, or simply to look for the phrase that suits your purpose. You can use the phrase as is, or adapt it slightly.

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FACULTAD DE CIENCIAS FÍSICAS Y MATEMÁTICAS
UNIVERSIDAD DE CHILE