Technical Writing @ SLCC

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SLCC ENGLISH DEPARTMENT

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Foreword

This textbook is for use in the English 2100 Technical Writing courses at Salt Lake Community College. It contains reading materials that the Technical Writing Committee of the English department have deemed important for students of ENGL 2100 to learn.

It is also prepared for use by the tutors of the Student Writing and Reading Center at SLCC.

Finally we also present this book to everyone at SLCC and the general public as a resource for technical writing.

Introduction to Technical Writing @ SLCC

What is technical writing? You can think of it as writing about specialized topics or you could also think of it as using technology to communicate your ideas.[1] A science lab report, a specification, a change order for building construction, or patient education materials–just to name a few–are all considered technical writing. Similarly if you design a webpage or a brochure this can also be considered technical writing.

Academic writing, the writing you do for school, generally is informative or persuasive writing and usually only comes in a few different genres. In technical writing, on the other hand, one is often documenting what was done (such as a science experiment or auto repair invoice). Therefore the format of the writing is often as important as the content. This leads to an emphasis on usability and accessibility for your documents.

Finally, although citing your sources is important in all writing, you will find that in some fields of technical writing, such as the sciences and engineering, it is one of the more important considerations of your writing.

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1. Society for Technical Communication. 2019. *Defining Technical Communication*. [accessed 2019 Nov. 14]. https://www.stc.org/about-stc/defining-technical-communication.

Engl 2100 Learning Outcomes

The ENGL 2100 Technical Writing course at Salt Lake Community College is designed to help students prepare for writing in STEM and related fields. It is *not* a course designed to prepare students for a career in technical writing.

These learning outcomes describe the goals for the course, ENGL 2100 Technical Writing.

- Students will be able to describe aspects of rhetorical situations including purpose, audience, and context.
- Students will be able to identify and explain rhetorical strategies across different written, digital, and visual documents.
- Students will be able to evaluate the rhetorical effectiveness of written, digital, and visual documents.
- Students will effectively incorporate written, digital, and visual documents into their own writing.
- Students will use multiple composing processes (e.g. planning or preparation [includes audience analysis, genre and medium determination], research, organizing, drafting and/or designing, revision or editing, proofreading) to complete writing tasks.
- Students will produce a variety of written, digital, and/or visual documents for different purposes, audiences, and contexts.
- Students will reflect on themselves as writers.

Tips for Writing Tutors

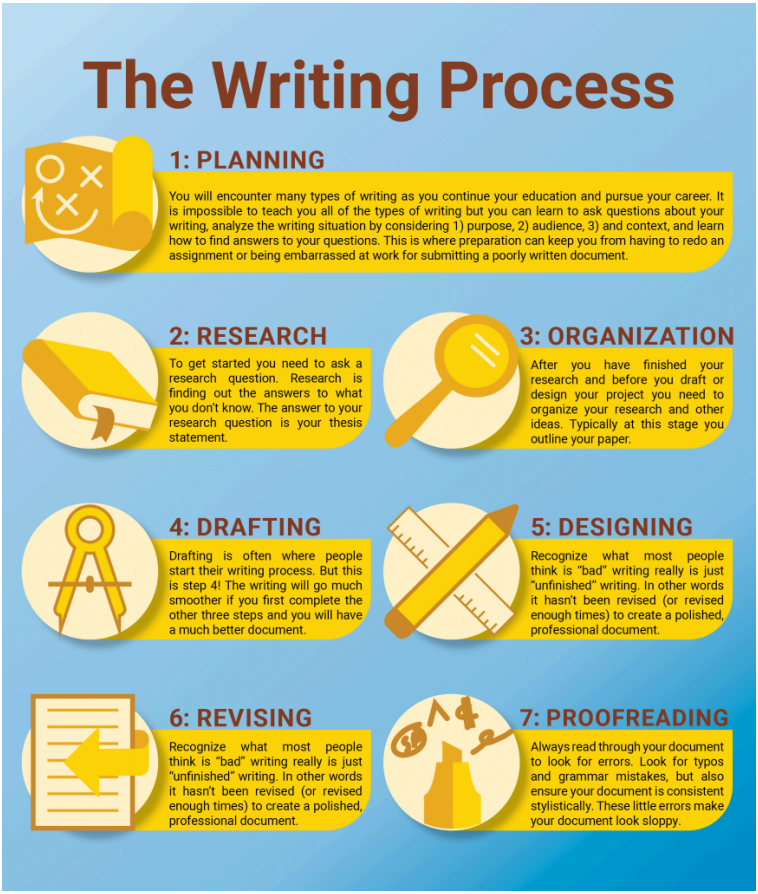
This textbook is designed to to address certain writing topics that are covered in ENGL 2100 Technical Writing. Each chapter, however, also includes a short section titled, “Tips for Writing Tutors,” that gives suggestions to the tutors on how to help students with the material in that chapter. These tips will point out what is considered the most important for that chapter and problems that students may struggle with.

PART I

THE WRITING PROCESS

One does not have to be born with great writing talent to write a good paper. Rather, good writing comes from good habits. Poor habits, on the other hand, result in poorly written papers. Some poor habits include 1) writing your paper just before the deadline resulting in a rushed paper or 2) skipping one or more of the steps of writing.

Like any other habit it takes time and practice to become a good writer. This chapter introduces six steps of writing and helps you learn how to be a better writer. This chapter is meant to accompany your writing project, but you can follow these steps whenever you need to write whether at school or in the workplace.


The Writing Process
1: PLANNING
You will encounter many types of writing as you continue your education and pursue your career. It is impossible to teach you all of the types of writing but you can learn to ask questions about your writing, analyze the writing situation by considering 1) purpose, 2) audience, 3) and context, and learn how to find answers to your questions. This is where preparation can keep you from having to redo an assignment or being embarrassed at work for submitting a poorly written document.
2: RESEARCH
To get started you need to ask a research question. Research is finding out the answers to what you don't know. The answer to your research question is your thesis statement.
3: ORGANIZATION
After you have finished your research and before you draft or design your project you need to organize your research and other ideas. Typically at this stage you outline your paper.
4: DRAFTING
Drafting is often where people start their writing process. But this is step 4! The writing will go much smoother if you first complete the other three steps and you will have a much better document.
5: DESIGNING
Recognize what most people think is "bad" writing really is just "unfinished" writing. In other words it hasn't been revised (or revised enough times) to create a polished, professional document.
6: REVISING
Recognize what most people think is "bad" writing really is just "unfinished" writing. In other words it hasn't been revised (or revised enough times) to create a polished, professional document.
7: PROOFREADING
Always read through your document to look for errors. Look for typos and grammar mistakes, but also ensure your document is consistent stylistically. These little errors make your document look sloppy.

Step 1: Preparation

Ever had the “blank screen” syndrome? That is you didn’t know what to write or how to get started? That is where the step of preparation comes in.

Unfortunately many students skip this part. They rush into research, or if the paper does not require research they skip straight to drafting. Yet spending just a few minutes preparing to write not only helps make a better paper, it saves time in later steps as well.

Write for 5

Here are two ways to start thinking about a topic to write about.

The first is called *freewriting*. Write for a few minutes *without stopping* on whatever comes to mind about a topic. You could set a timer to force yourself to write without stopping. After the time is up reread what you have written and look for the most important idea, richest or most intriguing detail, etc. Then freewrite on this idea or detail you have chosen. This is called *looping* as you keep writing without stopping on each successive idea until you have a good topic for your paper

The second way to start thinking about a topic is simply by making lists. You write down your topic then list ten or so things about that topic; again don’t stop

writing while you make your list. Then look over the list and see if you have a good idea for your paper. If not, pick the one that appeals to you most and make a new list. Keep going until you have an idea for your paper.

There are many other ways to start thinking about how to write besides the two listed in the above Write for 5. For example there are the journalists' questions that you could ask about your topic: who, what, why, where, when, how? Or going back to Aristotle you can define (what is it?), compare (what is it like or not like?), understand relationships (what caused it?), understand circumstances (what is possible or impossible about it?), or even seek testimony about it (what have others said about it?).

You will encounter many types of writing as you continue your education and pursue your career. It is impossible to teach you all of the types of writing but you can learn to ask questions about your writing, analyze the writing situation by considering 1) purpose, 2) audience, 3) and context, and knowing how to find answers to your questions. This is where preparation can keep you from having to redo an assignment or being embarrassed at work for submitting a poorly written document. The next three pages teach you about using preparation to plan your purpose, audience, and context.

Step 1 Continued: Planning with Purpose

What is the purpose of your document? Is it already defined by the assignment or by needs of your workplace or client? Often the purpose is already known–a professor will give you the assignment and explain the not only the purpose but the requirements for the assignment. Or perhaps you need to create advertising to attract clients.

If the purpose is not already defined then you need to determine the purpose yourself. To do this you need to understand your audience and the context for the document.

Step 1 Continued: Planning based on your Audience

Who is your audience? Answering this question determines much of what you write, why you write, and how you write it. For example if you audience is already an expert in the subject you don't need to include background information or define special technical terms like you would with a general audience.

Write for 5

Think about your audience. Are they experts in the subject or are they beginners. Are you writing for an executive, co-worker, or client? Is your audience adult or teens or children? What language do they speak? Write down as many characteristics as you can think of to describe your audience.

Step 1 Continued: Planning based on Context

Context can refer to several different things. First, how will your audience use your technical document? Does it need to be printed, or an e-document? Should it even be a document or would a video or audio recording be better?

Another way to think of context is to consider what will influence your audience as they read your document. Are there political, cultural, or even environmental considerations that you need to think about. For example, if you look at a Japanese map of a city a swastika marks the location of a Buddhist temple. But it would be considered offensive to use a swastika in a document meant for a Jewish audience.

Write for 5

Think about your audience and the context that they will use your document. How does this influence your decision of what type of document to create? What else do you need to consider for context?

After you have planned out your purpose, audience, and context, then you need to plan your project calendar.

Step 1 Continued: Planning with a Project Calendar

One of the most important parts of planning to write a document is creating a project calendar. The calendar helps you move through each of the six steps of writing in a timely manner.

Begin by using backward planning. In other words you start with the date that the project (document) is due. Then you build in due dates for each of the steps of writing by going backwards: proofreading, revising, drafting, organizing, researching, etc.

For larger projects you may wish to use a Gantt chart to see how multiple deadlines interact with each other.

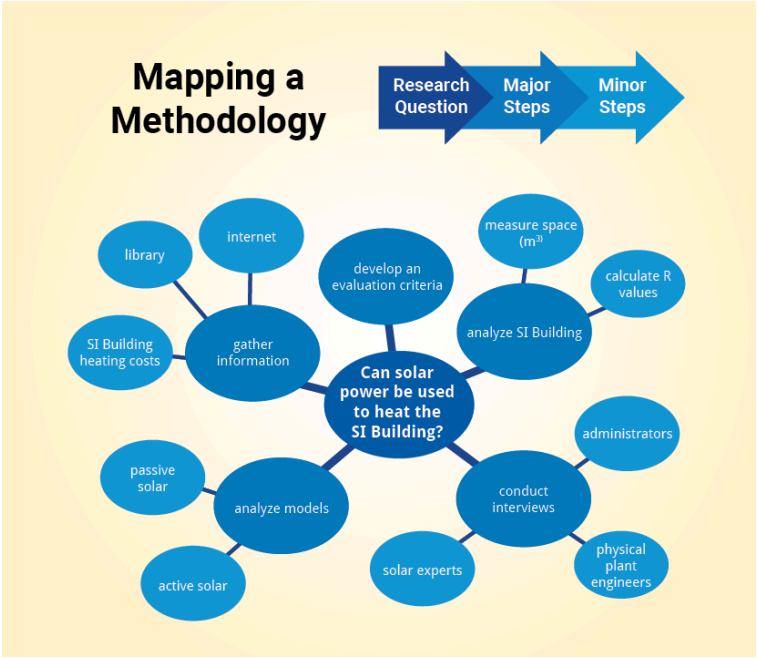
If it is a group project then you can use project management software such Asana, Microsoft Project, Clarizen, Wrike, DaPulse, and a host of others to help keep your project on time.

For more information see the chapter on Project Planning.

Step 2: Research

To get started you need to ask a research question. Research is finding out the answers to what you don't know. The answer to your research question is your thesis statement for your research paper. Start by finding your focus: what is it you are looking for or what questions are you trying to answer? Then consider how your purpose will affect your research. Are you trying to persuade your audience or to inform them?

After you have determined your question and before you begin your research think abut what kinds of research do you need to do. One way to do this is by using a mind-map such as the one below:



In this mind map the person wants to know whether or not solar power can be used to heat the Science and Industry Building. The major steps indicate ways to determine if it is feasible. The minor steps are things to be researched to answer the question. Thinking about your research methodology even before you start your research will help you do better research and better present the information once the research is finished.

1. Step 2 Research Continued

It may seem that research is the easy part: type in a few keywords in to a search engine and the internet returns more than enough information to create your document. But really that is the *problem*–there is too much information and much of it is unreliable.

Part of doing research is finding *credible* sources that you can use for your writing. How do you know it is credible. There are two important steps to determining the credibility of a source: 1) you must be able to evaluation the information you find and 2) you must be able to evaluate your own research process.

Evaluating Information

Ask yourself what source would be credible? If you want to study civil engineering Facebook is not a good source. But if you are studying social interactions of people, maybe Facebook is a good source of information. Given the large amount of information available to research you must manage the information you have with purpose and intent.

- Ask about the author's credibility. If it is an website gives information on cold fusion, is the information written by a physics professor or from someone who is being sued for fraud?
- Check for objectivity. If a university publishes a study about a pharmaceutical drug touting how great it is but at the same time the drug company that produced the drug

studied is giving a large grant to that university, then you could question the universities objectivity.

Evaluating your own research process

In order to be both *credible* and *ethical* you need to have multiple sources, and often multiple types of sources. Always write down quotations exactly and note the bibliographic information of the source. Review *Technical Writing* chapter 4 "Information Literacy" for more information.

Types of research

- Look-up searching: find immediate information to answer a question such as when you use Google maps, or are looking at one source such as Wikipedia to answer a question.
- Exploratory searching: finding multiple sources, multiple types of sources, or researching multiple viewpoints.
- Primary source: original information such as eyewitness account, data from experiments, novels, diaries, etc.
- Secondary source: sources that provide synthesis or analysis of the information of primary sources.
- Field research: interviews, surveys, etc. Please note if you are conducting field research then certain guidelines apply:
    - Typically, IRB (Institutional Review Board) approval is not required when data collection and analysis is solely for use in the classroom. There are some exceptions to this guideline: IRB approval is needed 1) if a student wishes to publish or present their findings to a wider audience, 2) if the survey/interview deals

with sensitive information, or poses more than minimal risk to participants or 3) if the participants are members of a protected group (like minors).

- In the absence of the IRB, the instructor should take on the responsibility of ensuring the research is conducted ethically, and educating student about protecting human subjects.

Step 3: Organizing

After you have finished your research and before you draft or design your project you need to organize your research and other ideas. Typically at this stage you outline your paper.

First review *Technical Writing* chapter 7 "Outlines." Then begin to organize your research and other ideas. As you learned in chapter 7 begin with the big ideas and then work towards making a more detailed outline. We recommend that you write a detailed enough outline that you list the topic of every paragraph you plan on writing in your paper. Any quotations or sources that you plan on using should also included in your outline to make it easier to draft your document.

If you are unsure what structure your outline should take, then think about what format your paper should be in. You could look at *Technical Writing* chapter 10 "Technical Reports" to see the basic format. Or if you are writing in the sciences you can look through the chapter, "Introduction to writing in the sciences" included in this textbook to learn the IMRaD format.

If you are designing a document such as a website or a video an outline still is useful. If you have a website you will want to make a preliminary sketch of the layout and consider where you will place the content. If you are making a video then you will want to sketch out a storyboard showing the sequence of shots, accompanying dialogue, etc. so that you are prepared to make the video. Organizing your information and planning out your document is an important and time-saving step in writing or designing.

For further information on outlines see Purdue OWL "How to Outline." Also explore the topics related to outlining on the left hand menu of Purdue OWL>

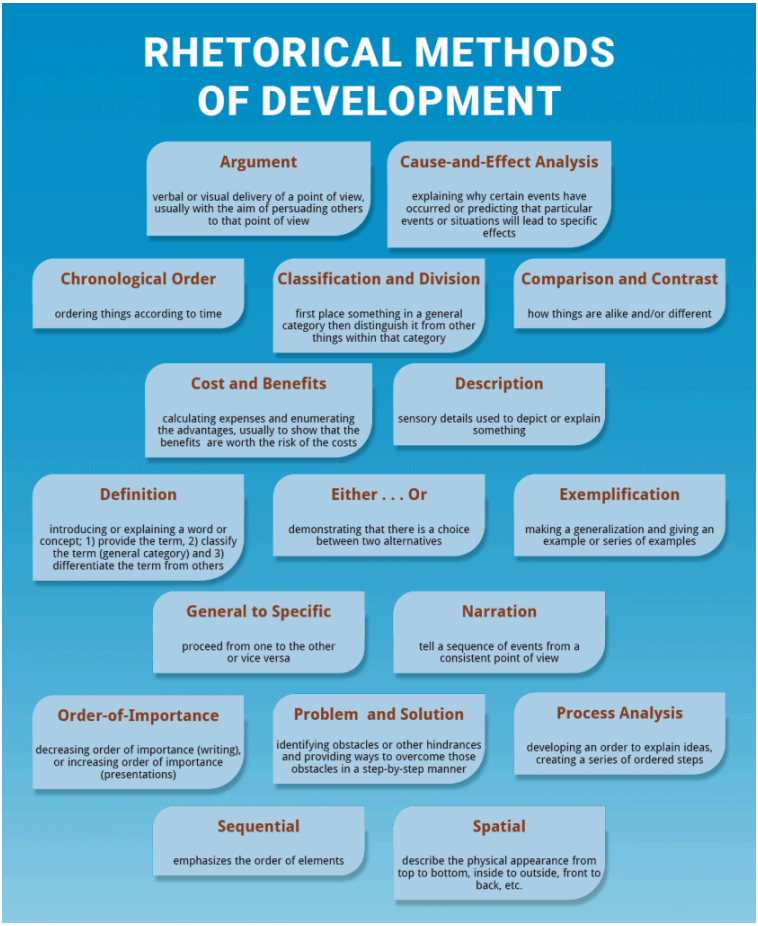
Step 4: Drafting or Designing

Drafting is often where people start their writing process. But this is step 4! The writing will go much smoother if you first complete the other three steps and you will have a much better document.

Once you have completed steps 1-3 then you are finally ready to begin drafting (or designing). Follow the outline you have made. If your outline matches the structure of the document you are drafting then it will be even easier.

In writing paragraphs it is recommended that you follow the old-new method (sometimes called the known-new method).

There are certain rhetorical strategies we use in drafting technical writing documents. These are called Rhetorical Methods of Development, which is a fancy way of saying these are common patterns of organization that you can use to present information.


RHETORICAL METHODS OF DEVELOPMENT
Argument
verbal or visual delivery of a point of view, usually with the aim of persuading others to that point of view
Cause-and-Effect Analysis
explaining why certain events have occurred or predicting that particular events or situations will lead to specific effects
Chronological Order
ordering things according to time
Classification and Division
first place something in a general category then distinguish it from other things within that category
Comparison and Contrast
how things are alike and/or different
Cost and Benefits
calculating expenses and enumerating the advantages, usually to show that the benefits are worth the risk of the costs
Description
sensory details used to depict or explain something
Definition
introducing or explaining a word or concept; 1) provide the term, 2) classify the term (general category) and 3) differentiate the term from others
Either . . . Or
demonstrating that there is a choice between two alternatives
Exemplification
making a generalization and giving an example or series of examples
General to Specific
proceed from one to the other or vice versa
Narration
tell a sequence of events from a consistent point of view
Order-of-Importance
decreasing order of importance (writing), or increasing order of importance (presentations)
Problem and Solution
identifying obstacles or other hindrances and providing ways to overcome those obstacles in a step-by-step manner
Process Analysis
developing an order to explain ideas, creating a series of ordered steps
Sequential
emphasizes the order of elements
Spatial
describe the physical appearance from top to bottom, inside to outside, front to back, etc.

Step 5: Revising (or Editing)

> *"They have accepted the grim reality that nine-tenths of all writing is rewriting. . ."* [1].

Recognize what most people think is "bad" writing really is just "unfinished" writing. In other words it hasn't been revised (or revised enough times) to create a polished, professional document.

Although the words revising and editing are often used to refer to the same thing, rewriting your first and subsequent drafts, in the publishing world revising is what the writer does and editing is, well what an editor does. The writer revises until they are satisfied and sends it to the editor (there are multiple kinds of editors, here we will simplify it to just the editor) who "edits" by checking for structure, style, grammar, spelling, and other problems. The editor may work closely with the writer or they may work separately sending each draft back and forth until both are satisfied.

If it is not a formal publication then really it doesn't matter what you call it, revising or editing, so long as you go through the various tasks of rewriting your work.

Here are some things to check for when revising:

- checking the main ideas
    - does the organization of those ideas make sense?
    - is there enough information to explain/ support the ideas?
    - is there too much or irrelevant information that should be cut out?
- does the introduction:
    - clearly explain the Purpose of document
    - Clearly identify the subject?
    - Clear thesis, claim or hypothesis?
- Body
    - Sentences: subject easy to locate and use of action verbs
    - Does each paragraph have a clear topic (claim) sentence and enough support?
    - Check for transitions between paragraphs
    - Good paragraph organization (given/new)
    - Overall flow of presentation of information or argument
    - check for fallacies–illogical, irrelevant, or unsupported statements
- Conclusion:
    - Restate main point?
    - Emphasize the importance of subject?
    - Look to future?
- Design

- It the document layout simple and easy to navigate?
- Titles, headings, subheadings to help guide the reader?
- Graphics support text and clarify difficult points?
- Check all quotations, paraphrases properly framed and correctly cited
- Fact-check

- Style conform to the standards of your major?
  - consistent use of formal writing
  - concise and clear writing
- Make sure bibliography is properly formatted

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[1] Trimble, John R. 2000. *Writing with Style: Conversations on the Art of Writing*. 2nd ed. Prentice Hall. P. 9.

Step 6: Proofreading

In publishing after an author is finished revising and all the edits by the publisher have been made, a set of proofs is created. The proofs show how the document will look when printed. At this point someone reads the proofs to catch any missed errors–hence the term proofreading.

You should be in the habit of proofreading all your professional documents, whether emails, memos, proposals, reports, websites, videos, etc. Always read through or look over (or listen or watch) your document to look for those missed errors. Often a simply typo or a mistake in grammar, but sometimes a stylistic error such as missing page numbers or a change in font partway through the document these little errors make your document look sloppy.

Taking the time to proofread is simply being professional in the way you approach your work, including communication.

Tips for Writing Tutors

It is easy while helping students to focus just on one aspect of their document. However, helping them understand writing is a process rather than an event and that good writing requires revision is important.

PART II

INTRODUCTION TO WRITING IN THE SCIENCES

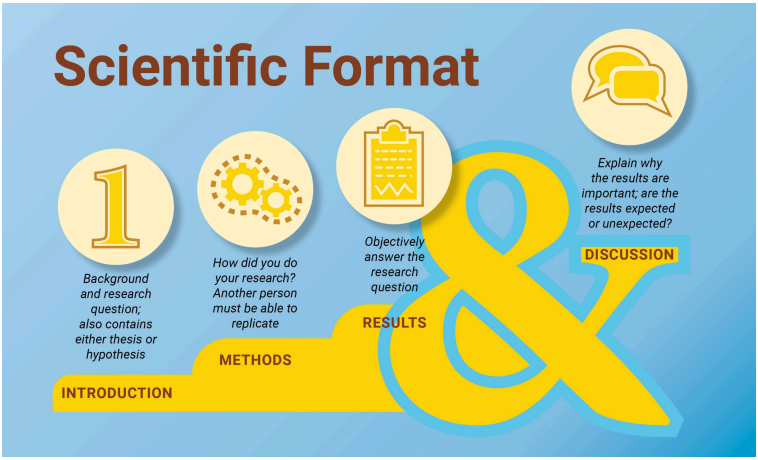
Prepared for ENGL 2100 Technical Writing at Salt Lake Community College by Daniel D. Baird (English Department faculty) and Stella G. Mosher (coordinator for DUMKE STEM Center and adjunct faculty in the Geoscience Department). Reviewed by Benjamin Solomon (English Department faculty).

1 Overview

What is writing in the sciences and how does it differ from other types of writing? The simplest answer is that it is writing done in the various branches of science such as astronomy, biology, chemistry, geology, oceanography, physics, health sciences, etc. More specifically within the sciences, *scientific writing* is contrasted with *science writing*. *Scientific writing* is writing that conveys information about one's own research to other scientists. In contrast, *science writing* is writing about science for the general public or for popular media (Sheffield 2011). Regardless of whether you are writing for other scientists or the general public, there are a few key ways in which writing in the sciences differs from writing in the humanities or any other discipline. Writing in the sciences includes concision. Concision refers to eliminating unnecessary words without omitting important information. Writing in the sciences also means that you adhere to a methodology: a systematic and reproducible approach to conducting research. Finally it focuses on the sharing of research. This document is to help you learn a little about the rhetoric of science—what to expect when you are reading scientific articles and how to use these rhetorical strategies in your own writing.

The structure of a scientific article will usually be "some variation on the IMRAD form along with a references section. . ." (CSE 2014, 4). IMRAD stands for Introduction, Methodology, Research, and Discussion (of research). This is a very different structure of writing compared to that typically used outside of science and you may be unfamiliar with it. With a little practice, however, you will soon be able to confidently use this structure. "This so-called 'IMRAD' structure is not an arbitrary publication format but rather a direct reflection of the process of scientific discovery. Long articles may need subheadings within some

sections (especially Results and Discussion) to clarify their content" (Intl. Committee of Medical Journal Editors 2010). In order to help you understand this important format the majority of the following chapters are spent introducing you to this structure.



In addition to the overview of the scientific structure, you will be introduced to the literature review. Whether a stand-alone document or as part of a larger document the literature review is an important genre in the sciences.

Throughout this chapter we have used a published scientific paper for examples of the ideas you are learning. The language of the paper may seem difficult but pay attention to the concepts pointed out in each example so that you can learn to recognize and eventually learn how to use these concepts in your own writing.

There is also a section on references. This is not meant to be a comprehensive guide to the correct way to cite your sources in the sciences, but rather a brief overview since what you learned previously may not be the way it is done in the sciences.

Finally this document is meant to be an introduction only.

Your instructor's or a publisher's requirements always supersede what is written in this document.

Writing tip: The headings, heading numbers, and other formatting used in this document follow the recommended style for a scientific paper based on *Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers* created by the Council of Science Editors (8th edition), referred to as CSE in this chapter.

2 Front Matter

Front matter is all the information that is placed at the beginning of the document. It includes the title of the document, name of the author(s), and date of publication. See Fig. 1 below for an example of front matter.

2.1 Title

Titles are to be concise as possible yet still convey the information to the reader as to the topic of the document. In science titles are straightforward and simply describe the focus of the research or experiment; avoid the poetic or clever. Also avoid acronyms or shortening of scientific terms. Finally avoid roman numerals as they are confusing in searches.

2.2 Author(s)

The *byline* lists the authors of the article. Sometimes it is an organization, rather than individuals that are listed as responsible for a publication. Often journals also have an author statement located in the back matter that credits the role of each author such as who participated in research, writing, revising, etc.

2.3 Author Affiliation

A document usually also includes institutional affiliation of the author(s) allowing one to contact the author(s).

Writing tip: for your document use your instructor's name and class. For example: Professor Smith, Biology 1030.

2.4 Date

The date will not always be listed on the article title page as it may have already been listed on the title page of the journal. Sometimes it is found in either the header or footer of the pages in the journal.

Writing tip: for your document always place the date on your title page and it should be the date you submitted your paper.

2.5 Abstract

It is common for all scientific publications to have an abstract. "[A]n abstract should be published with every journal article, essay, and discussion. An abstract helps readers to decide whether the article is of interest; as such, its content must reflect the content of the article as closely as possible, within the length available" (CSE 2014, 4). The abstract helps one make a decision as to whether or not the article is relevant to one's research, or even one's general interest. Abstracts generally run between 100 and 250 words although journals may require shorter or longer abstracts. Abstracts generally include purpose, methods, important or key results, and main conclusions.

An article may also request a graphical abstract. It generally consists of a single image and like the written abstract gives the reader a quick overview of the contents of the article. The image may be a diagram or an infographic.

Writing tip: here are some things to consider when writing your abstract:

Do:

- State research objectives
- Explain the "what" and the "why" of the research
- Briefly describe methods
- Summarize important results
- State main conclusions and significance

Don't:

- Use quotations, references, or figure citations
- Present information not included in the report
- Get bogged down by the details

2.6 Keywords

Often a short list of words is included after the abstract to help readers search for the document. These keywords are

descriptors of the main ideas of the document. Generally these are not the same as those used in the title.

quaternary

MDPI

Article

Revisiting the Foraging Ecology and Extinction History of Two Endemic Vertebrates from Tenerife, Canary Islands

Title

Brooke Erin Crowley [1,*], Yurena Yanes [2], Stella Grace Mosher [3] and Juan Carlos Rando [4]

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Date

Abstract: We used carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes to examine the foraging ecology of Tenerife giant rats (*Canariomys bravoi*) and lizards (*Gallotia goliath*) in northwestern Tenerife, which until recently, were the island's largest terrestrial vertebrates. We combined new isotope data for 28 *C. bravoi* and 14 *G. goliath* with published regional data for both species and then compared these with data for co-occurring extant taxa and modern C_3 plants. Isotope data suggest both extinct species relied primarily on C_3 resources and were trophic omnivores. However, the two species appear to have partitioned their resources when living in sympatry. Isotopic overlap between *C. bravoi* and *Rattus* spp., and between *G. goliath*, extant *Gallotia galloti*, and introduced rabbits (*Oryctolagus cuniculus*) suggests reliance on similar foods. We radiocarbon dated four *C. bravoi* and two *G. goliath* with the most extreme isotope values. These new dates do not settle the question of what triggered the demise of either species. Nevertheless, the data are most consistent with anthropogenically-induced extinction. Temporal isotopic trends contradict expectations if regional climate were responsible, and confidence intervals for radiocarbon dates suggest it is highly likely that both species were present when humans first settled the island.

Abstract

Keywords: Canary Islands; *Canariomys bravoi*; *Gallotia goliath*; carbon isotopes; nitrogen isotopes; bone collagen; radiocarbon date; Cueva del Viento; Icod; Buenavista del Norte

Keywords

1. Introduction

Our planet has been undergoing a major extinction event since the late Pleistocene [1]. This is of global concern as biological diversity is critical for maintaining stable ecosystems [2,3]. Determining the ecological roles that now-extinct species played within the ecosystems they inhabited provides critical context for management and conservation of remaining biota, e.g., [4–10].

Island vertebrates have been particularly vulnerable to recent, anthropogenically-driven species loss due to their low genetic diversity and evolution in relative isolation from diseases, parasites, competitors, and predators [11–16]. Like most archipelagos, The Canary Islands, which are part of the Mediterranean biodiversity hotspot [17], have experienced multiple Late Holocene vertebrate extinctions [18–23], and a large number of extant native species are currently threatened [24].

Here we use carbon ($\delta^{13}C$), and nitrogen ($\delta^{15}N$) isotope values in bone collagen combined with radiocarbon (^{14}C) dates to investigate the diet and extinction chronology for two extinct taxa, the Tenerife giant rat (*Canariomys bravoi*) and the Tenerife giant lizard (*Gallotia goliath*). *Canariomys bravoi*

Notice how the text of the document starts immediately after the front matter.

Fig. 1. Front matter of an article. Source: Crowley et al. 2019. CC: BY 4.0.

3 Writing an Introduction

An introduction gives the reader the "why" the document was written. It provides readers important context for understanding your writing. For example, what was the research question or experiment that led to the creation of the written document? In general it will contain a statement of purpose, a hypothesis or thesis, and define the scope of the document—what it is or is not about. Of course there will be background information, but how much or how little will depend on the audience. A specialist in your field will need less background information than a general audience.

In science documents, the introduction often follows what is known as the Creating a Research Space (CARS) rhetorical pattern (Swales 2012). There are three sections or moves in a CARS: 1) Establishing a Territory, 2) Establishing a Niche, and finally 3) Occupying the Niche.

3.1 Establishing a territory

Establishing your territory is like announcing your topic to your readers. You also want to explain to the readers that your paper is important. To do this first you need to do more than just announce the topic, you need to give some context to your topic. Put your research or experiment into a wider context either by giving a general overview of the of the topic or by reviewing previous research. Reviewing previous research is called a literature review and is very important in writing in the sciences. See section 9 for more information on the literature review. See Fig. 2 for an example of establishing your territory.

tablishing a territory. Source: Crowley et

Fig. 2. Introduction: Establishing a territory. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

3.2 Establishing a Niche

A niche is the specific research question or topic that your document addresses. In the example paper by Crowley et. al. (2019), the general topic is the extinction of vertebrate animals living on islands (Fig. 3). The niche, or specific topic, is the extinction history of a particular giant rat and a giant lizard in the Canary Islands.

When establishing your niche ask what is missing from previous research. Is there a gap or something that needs more research or verification? Also include briefly what methods of analysis are used for testing, validation, etc.

Writing tip: make a clear argument for the value of your particular research; e.g., what are the gaps in research that your study addresses?

Fig. 3. Introduction: Literature Review, establishing a niche, and occupying a niche. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

3.3 Occupying the Niche

Here you announce how your study will contribute new knowledge or verify previous knowledge. You also state your hypothesis or thesis in this part of the introduction. Make clear the links between problem and solution, question asked and research design, prior research and your experiment.

Finally describe the organizational structure of the paper. (See Fig. 3.)

Writing tip: here are some ways to occupy your niche (notice all of these prompts are in present tense):

- The aim of this paper is
- My main purpose is
- My primary objective is
- This paper reports on the results of
- This paper primarily focuses on

When occupying your niche you can state either your thesis

or hypothesis. A thesis is a statement or claim that you make about a subject and tells the reader your viewpoint. A hypothesis, on the other hand, is a tentative answer to a question, one that must be tested through experimentation.

4 Writing the Materials and Methods (Methodology) Section

The Materials and Methods section briefly describes how you did your research. In other words, what did you do to answer your research question? If there were materials used for the research or materials experimented on you list them in this section. You also describe how you did the research or experiment. The key to a methodology is that another person must be able to replicate your research—follow the steps you take. For example if you used the internet to do a search it is not enough to say you "searched the internet." A reader would need to know which search engine and what key words you used.

Open this section by describing the overall approach you took or the materials used. Then describe to the readers step-by-step the methods you used including any data analysis performed. See Fig. 4 below for an example of materials and methods section.

Writing tips:

Do:

- Explain procedures, materials, and equipment used
- Provide enough detail for replication!
    - Example: "We used an x-ray fluorescence spectrometer to analyze major and trace elements in the mystery mineral samples."
- Order events chronologically, perhaps with subheadings (Field work, Lab Analysis, Statistical Models)
- Use past tense (you did X, Y, Z)

- Quantify measurements

Don't:

- Include results in the methods! It's easy to make this mistake!
- List unnecessary details; i.e., if someone could look up how to operate an instrument, you do not need to explain how to use that instrument.
    - Example: "We turned on the machine and loaded in our samples, then calibrated the instrument and pushed the start button and waited one hour. . . ."

Fig. 4. Methods including a subheading. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

5 Writing the Results Section

5.1 The Results Section

This section explains what you found; i.e., the answer to your research question. The Results and the Discussion (of the results) sections are the two most often mixed up sections by those who are new to this structure of writing. Just remember that Results is where you objectively summarize and present the data.

Generally, this section will begin with a brief overview of the results, then cover each of the main results from the data. Objectively point out the main ideas and use tables, figures, and other graphics as necessary to present the data. This section also discusses any limitations of the study. Fig. 5 shows an example of the Results section.

Writing tips:

If you are writing a purely research paper you can present your findings using verbs of attribution: words that point out that these are someone else's ideas. For example, you could write:

- The author stated
- This article points out
- We found
- The results of the PCR analysis showed that
- Model results can be seen in Table X

Just remember not to interpret the information. For writing an experimental report here are some tips:

Do:

- Report results and show supporting data
- Order results from most to least complex
- Describe results in past tense
- Be concise: Examining patterns for 38,646 measurements of foliar $\delta^{15}N$ from non-N^2-fixing species, mean foliar $\delta^{15}N$ was 0.4‰ (Table 1).

Don't:

- Interpret results
- Repeat all the data from the table, instead select important results to report
- Be verbose: Table 1 indicates that after examining patterns for 38,646 measurements of foliar $\delta^{15}N$ from non-N^2-fixing species the mean foliar $\delta^{15}N$ was 0.4‰.

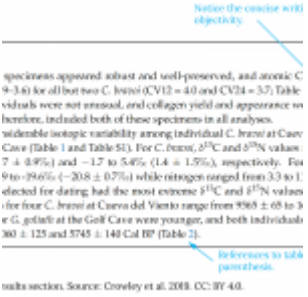

Fig. 5. Example of Results section. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

5.2 Figures and Tables

The word figure is used to describe any graphic in the document that is not a table. It can refer to photographs, drawings, diagrams, maps, and other type of illustrations. Fig. 6 shows a table and Fig. 7 shows results with a figure.

Writing Tips:

Be consistent in formatting for all figures and tables. Figure numbers and titles are listed in the caption below the figure. Table numbers and titles are listed above the table. Notes or source information are placed in the caption below the table. Figures and tables should be placed in the text where they are referred to and the reference to the figure or table should be in parenthetical text. Captions should be concise yet contain enough information for the reader to understand what the figure is about. Graphs should have clearly labeled legends.

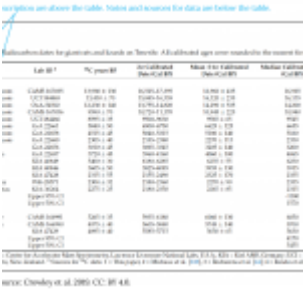

Fig. 6: Example of a Table. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

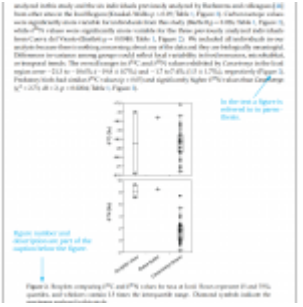

Fig. 7. A page in the Results section showing a figure with caption. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

6 Writing the Discussion and Conclusion Sections

6.1 Discussion

This section discusses your results, presenting the "so what," or "why should the reader care" about your research. This is where you explain what you think the results show. Tell the reader the significance of your document by discussing how the results fit with what is already known as you discussed in your introduction, how the results compare with what is expected, or why are there unexpected results. Here are some words to get you thinking about this section: evaluate, interpret, examine, qualify, etc.

Start by either summarizing the the information in this section or by stating the validity of the hypothesis. This allows readers to see upfront your interpretation of the data. End the discussion by summarizing why the results matter.

Writing tips:

Do:

- Summarize the most important findings at the beginning (1-3 sentences)
- Describe patterns and relationships shown in your results
- Explain how results relate to expectations and literature cited in Introduction
- Explain contradictions and exceptions
- Describe need for future research (if no Conclusion section)

Don't:

- Overgeneralize, use specific supported statements
- Ignore unexpected results or deviations from your data
- Speculate conclusions that cannot be tested in the foreseeable future.

Fig. 8. Beginning of Discussion showing how the authors summarize the main points and then move on the interpret data. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

6.2 Conclusion

The Discussion usually serves as the conclusion. If there is a separate conclusion section then it should be brief, only one or two paragraphs. In the conclusion typically authors offer either recommendations or future perspectives for the research. Figs. 8 and 9 show the Discussion and Conclusion sections from the sample paper.

FIg. 9. End of Discussion and the Conclusion. The Discussion calls for further research while the Conclusion summaries the overall paper. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

7 Back Matter and References

Back matter refers to everything that comes after the main text of the document. (See Fig. 10 for an example.)

7.1 Addendum, Acknowledgments, etc.

At the end of the document but before the end reference list there may be several items included. For example you could include a list of supplementary materials, either unpublished or available online. Acknowledgments usually identify funding and the contributions of those who are not listed as authors. It has also become common to include an author statement that credits the role of each author such as who participated in research, writing, revising, etc.

7.2 References

Citing or documenting your sources are crucial both to avoid plagiarism and for credibility. The Crowley et al. (2019) document that has been used as a sample for you to look over only has 18 pages of text but 120 references!

You probably learned Modern Language Association (MLA) citation style either in high school or your first English class at college. This style, however, is not used in the sciences. You also may have learned APA style citations. This refers to the to the American Psychological Association's style guide. APA is used in the social sciences and in some other disciplines. In the physical and natural sciences many of the journals will use what is called Scientific Style and Format from the book of the same name prepared by the Council of Science Editors (CSE). If you learned APA (or what is commonly called the author-date) citation system then you are in luck as this style is similar to the CSE name-year citation system. Many science journals, however, use the alternate CSE style known as citation-

sequence. You should become familiar with both the name-year and citation-sequence systems but place special emphasis on learning whichever system your major uses.

For example, biology typically uses CSE name-year system, physics uses the CSE citation-sequence system, but chemistry uses the American Chemical Society (ACS) system (which is very similar to CSE citation-sequence system.) Thus it is important to learn what is the commonly accepted way of citing references in your major.

Once you have discovered the citation system your major uses, the next step is to learn how to do both in-text references and end references. In-text references occur in the text where the information is written and usually only contain just enough information to redirect the reader to the end references. The end references contain all the information a reader needs to find the source of the information. See the chapter on "Citation & Copyright" for more information. Please consult *Scientific Style and Format* or the style guide for your career field for a more detailed overview of references.

Writing tip: When writing in the sciences using quotations is generally discouraged. Instead it is expected that one will summarize or synthesize the findings or main points and then cite the source.

7.3 Appendixes

After the references if necessary one can include appendixes (sometimes spelled appendices). They should be numbered with an Arabic numeral and have a title. Appendixes could include supplementary materials such as calculations, figures, or tables that are too long to fit in the Results or other sections without interrupting the flow of the text, glossary of terms, or sample documents.

Fig. 10. Showing the end of the Conclusion and Back Matter including the beginning of the References list. Click on thumbnail to see larger picture. Source: Crowley et al. 2019. CC: BY 4.0

8 Writing a Literature Review

The literature review is a common genre in the sciences. You will encounter it in your readings and you will probably be required to write one in your science classes. Certainly if you go on to major in the sciences you will need to be able to write this common type of document. Part of doing science is background research and the literature review demonstrates that you have done that. Literature reviews often are found in the introduction of a larger document, such as a research paper, but also can function as a stand-alone document.

The literature review is not an annotated bibliography. The annotated bibliography simply asks you to summarize each source you read. The literature review goes beyond the annotated bibliography—you should critically analyze each source you read and put the authors into conversation with each other—synthesize the information. The key to your literature review is to organize it around themes, trends, topics, or methods. A good literature review 1) sets up the context: where do each of the articles fit within the broader scholarly conversation; 2) shows your credibility: you are familiar with important ideas and even debates on this topic; 3) and if it is part of a research article: shows what gaps are there in the research that your document will address (Global Communications Center).

If your literature review is not part of a larger document then it should be structured as follows:

- Title page with author and date
- Abstract (optional, check with your instructor)
- Introduction (what is overall topic and your purpose to this

document?)
- Body
- Conclusion (summarize main ideas, put in context of larger area of study such as discipline, etc.)

Writing tip: you might ask yourself, "What would the author of article A say to the author of article B about the same subject? Does author A add to author B's research? Does author A critique author B's research?"

Here are some do's and don'ts from the Global Communications Center handout.

Do:

- Describe overall theme
- Connect multiple studies
- Situate individual authors within a trend
- Summarize research ideas and show which ones are the most important
- Show limitations of previous research or weakness in methods

Don't:

- Summarize only one text
- Give too many details on one single author
- Fail to connect to overall theme
- Simply present a lot of data without explanation

9 Final Thoughts

Many students are surprised to find how much reading and writing they do in the sciences. In a 2015 survey conducted of transfer students at the University of Utah, when asked how many were surprised at how much reading was assigned around 7% were very surprised, 16% were fairly surprised, 35% were somewhat surprised, about 33% were not very surprised, with only a 9% not at all surprised (Toth 2015). That means of the 275 students surveyed, more than half of the students were surprised to some level at the amount of reading. For writing the survey results were a bit better with only about 35% of the students expressing some level of surprise at the amount of writing (Toth 2015). But reading and writing does not end with school. As stated in the beginning of this document one of the most important part of being a scientist is sharing one's research.

As you move forward in pursuing your education and on into your career in the sciences there are some sources that may proves useful. There are several writing centers that keep resources online such as the Global Communication Center at Carnegie Mellon University or the Online Writing Center at Purdue University. At some point as your writing becomes more complex you may need to purchase the style guide for your specific field whether it be the CSE style guide or another one. Of course the best resource will always be your instructor.

10 Acknowledgements

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Tips For Writing Tutors

When faced with a text written by a student for a science course how should you approach the text? What help should you offer the student for improving their text? What should you prioritize?

1. **Documenting sources**. The most important concept for students to learn in writing in the sciences is the need to document sources. This is important to demonstrate that 1) students clearly separate what are their own ideas and what are ideas taken from elsewhere and 2) that they have situated their ideas in the larger context of research. Quotations in student's work are acceptable but are rare in the sciences. It is ideal instead for students to work towards learning to paraphrase or summarize their sources. Generally published science papers do not have quotations. Make sure students have documented their sources both in the text and in the bibliography. In terms of documenting sources APA is generally accepted although an instructor may require something different.

    - Often students do not document the source of figures, pictures, graphs, tables, and charts that are not their own so please pay attention to these. Worse, students often cut and paste copyrighted material from the internet. Please explain that they cannot use copyrighted materials without

written permission from author/creator (for pictures, etc.). You may wish to guide them to copyright free or other license types that they can use. For more about fair use see Chapter II Copyright and Fair (Educational) Use in this textbook.

2. **Formatting**. Students struggle with the scientific format (IMRaD) so having a basic understanding of this format is important to help them. Students also struggle with many of the basics of formatting such as where to put a figure number or how to caption a figure or a table. This information can be reviewed under Section 5 Writing the Results Section.
3. **Writing Style:**

    - Writing in the sciences is characterized by concision. Concision refers to eliminating unnecessary words without omitting important information.
    - Although active voice in general is preferred, passive voice will occur when emphasizing the research process, experimentation, etc. such as is found in the materials and methods section of a report (CSE 2014, 116).
    - Typically the writing is to be objective or bias-free. This does include avoiding the use of "I" although some instructors will allow it.
    - Students often are not aware that they cannot use people's first name or given name when referencing a person in a text. Generally use of surname is preferred

for all situations in formal writing.

Finally *Scientific Style and Format* (CSE 2014, 8th edition) can be referenced, if needed, for other questions such as special scientific conventions. This manual is based on the *Chicago Manual of Style*.

> Remember that the student's instructors are the content experts. You as a tutor do not need to be familiar with the content in order to help them have better writing.

PART III

INTRODUCTION TO WRITING IN ENGINEERING

Prepared for the ENGL 2100 Technical Writing course at Salt Lake Community College by Daniel D. Baird (faculty in the English, Linguistics, and Writing Studies Department) and Korin Holden (adjunct faculty in the Engineering Department). Reviewed by Aimee Birdsall (faculty in Engineering Department).

Overview

This chapter will introduce you to some basics of writing in engineering. Many journal articles for engineering use what is called the scientific format. This chapter does not intend to cover in detail the differences between writing in the sciences and engineering but instead point out some specifics that are unique to engineering writing as opposed to scientific writing when using the scientific format.

> It is assumed that you are already familiar with the scientific format, also known as IMRaD (Introduction, Methods, Results, and Discussion). If not you can review the chapter, "Introduction to Writing in the Sciences" in this textbook.

Throughout this chapter we have used a published engineering paper for examples of the ideas you are learning. The language of the paper may seem difficult, but pay attention to the concepts pointed out in each example so that you can learn to recognize and eventually learn how to use these concepts in your own writing.

Please use this chapter to learn both how to read engineering articles and how to format and write your own papers in your engineering classes.

Finally, this document is meant to be an introduction only. Your instructor's or a publisher's requirements always supersede what is written in this document.

Writing an Abstract and Introduction

Abstract

The goal of an engineering abstract is to efficiently and concisely express the purpose and results of your paper. Readers look at the abstract because they are in search of answers, and the abstract allows them to know if your paper is of use to them or not. If the research problem is addressed but the study (the answer) isn't explained in the abstract, the reader will not read the article and will search elsewhere. By including the overall results in the abstract, the reader gets a feel for the article and if it is worth reading.

> At least in engineering, one may read the abstract for free. If the abstract demonstrates that the article is what the reader is searching for, the reader can buy the article for a fee. For this reason, the abstract needs to be a faithful representation of the article. Nobody wants to waste money on something that is misrepresented.

An abstract typically follows a format used to summarize your paper. First, there should be an introductory sentence on the research that is needed in a specific area or a problem that needs to be examined. It should introduce the study; that is, the plan to address the problem. Next, the study should also include a sentence on data such as tests, samplings, survey

results, etc. Following the method of study, a two to three sentence discussion that includes key data points of the study would be helpful to the reader. The abstract should not include mathematics or citations (remember–it is a summary, not a detailed explanation). The conclusion of the abstract should share the overall results from the study. An abstract should stand on its own, i.e. the reader should be able to understand the content of the paper just from reading the abstract.

For an example of how to write an abstract, see the sample document below (Fig. 1). Notice the length and placement of the abstract. Also notice that at the end of the abstract are a list of keywords that would be used in a search engine to find the article.

Journal of Civil & Environmental Engineering

Evaluation of Indoor Air Pollution in Urban Homes: A Case Study from Isfahan, Iran

Abstract

Keywords

Introduction

Introduction

The introduction could be very lengthy or quite short depending on how long the research is and how involved it is. At times, an introduction could include an abbreviated literature review or history of the project. If the research is a part of a bigger endeavor, the entire study could be briefly discussed and referenced.

Fig. 1. This shows the beginning of the article including the abstract, introduction, and beginning of the methods section. Click on thumbnail to see larger picture. Source: Loghmani et al. 2019. Open Access Journal.

Writing the Methods Section

The Methods section (also called Materials and Methods) allows the reader to see how the study was carried out (Fig. 1 and Fig. 2). This section can be enlightening because it connects the dots from the introduction (telling the reader what the problem is) and the results (showing data on "solutions" to the problem). There is more than one way to go about solving a problem. By explaining the approach used, it gives the reader time to process some thoughts about how the research progressed from step to step.

The results are a product of the methods used, so they should be carefully analyzed before beginning your testing. Questions to consider might be: Could it be done a different way that would be easier, more feasible, take less time and yield "better" results? Was the method in line with the scientific method and followed all necessary steps? Was it ethical?

The methods section can also describe the technical theory involved in the study. If the research called for special equipment or software, it could be mentioned in the section.

Finally, stating the method and how the study was carried out in turn allows others to repeat the study, thus lending credibility to your article by showing that the results can be reproduced using the methods described. Different branches of engineering have specific testing procedures that make studies easy to duplicate by listing which procedure and standard you used in your methodology. An example of these standards would be those set by the American Society for Testing and Materials (ASTM).

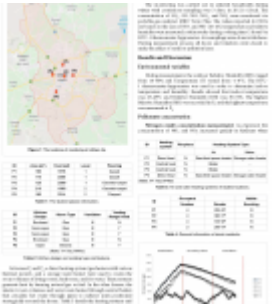

Fig. 2. Materials and Methods continued from Fig. 1. Also first part of Results and Discussion. Click on thumbnail to see larger picture. Source: Loghmani et al. 2019. Open Access Journal.

In Figure 2 observe how figures and tables are used to present data for the materials and methods section. Each figure or table is referred to and explained in the text.

Writing the Results and Discussion Section

Results

The Results section is where you insert the data (Fig.3). The data in the charts needs to be meaningful. You do this by formatting charts with appropriate axis labels, legends and units. The title or caption of the chart or figure must capture the meaning of the data. Choose the data carefully and make it count–it is a communication of the entire paper. Charts, graphs, tables, and plots are called "descriptive data," meaning they need to do the bulk of describing the data for you. Make sure they are well labeled!

Writing Tip: The chart or figure should communication the ideas of the paper as a whole so that a reader could discern what 90% of the paper is about just by looking at the visual aids.

As the researcher and author, it is important to be ethical and not skew the data (meaning not to distort the data to how you would like it). Most data is not perfect but it is still important to show the imperfections. Data needs to be inclusive and unbiased.

Writing Tip: Don't forget to create a caption for the figure or table. Also don't forget to cite your source for any referenced information. The title for a figure goes below, the title for a table above, and the caption for a figure or table appears below the information (see Fig. 3). It is easy to accidentally get this wrong.

Data could be placed in the back of your paper as an appendix, but most data is referenced in the text and it is nice to see the sentence and its corresponding chart side by side.

Fig. 3. Continuation of Results and Discussion from Fig. 2. Click on thumbnail to see larger picture. Source: Loghmani et al. 2019. Open Access Journal.

Discussion

The Discussion section is the place to explain the results section. If the research went as planned, there is no need for an in-depth discussion–results and discussion can be covered side-by-side in the same section as in the sample paper used for this chapter (Fig. 2, Fig. 3). Notice that both the presentation of data in charts and the discussion of data in the combined Results and Discussion are represented in Figure 3.

On the other hand, if the methods or the data do need to be explained, a separate discussion section provides a place to

explain the study: what worked and what didn't. Here you may choose to talk about the outliers in the data, why there is some "noise," or what had to be adjusted after the research began.

Writing Conclusions

The Conclusion section gives a good wrap-up of the paper (Fig. 4) and answers the question “What was discovered while doing the research?” This section could touch on how the study was set up, if it went as planned, and did the data support the outcomes of the study.

The conclusion could also share the overall result of the study. If it was groundbreaking, the conclusion could include a plan for future research exploring an offshoot of the current study or new research in a different direction all together. Lastly, suggestions should be made to implement the findings of the study into practice. A plan of implementation could be included, but is not a requirement.

Fig. 4. The Conclusion of the article and the beginning of the References section. Click on thumbnail to see larger picture. Source: Loghmani et al. 2019. Open Access Journal.

Importance of Citations

In this world where cats seemingly play the piano on the internet, one has to ask themselves what is actually fact. Just because someone posted something doesn't mean there is any substance to it. Citations are crucial for the credibility of a paper.

As the author, one should be researching reputable papers to find factual information. Good information can be found on websites, but the best information usually comes from journals that contain similar research and have published the results.

As the reader, if there is a list of citations that are well documented and, even better, from journal sources backed by national societies that are respected, the paper can be a trusted source to re-reference. People want to see facts.

> The sample journal article used in this chapter employs citation-sequence (also called numbered) citations. This chapter on writing in engineering uses the author-date system. Both are used in engineering journals; it is up to you to be aware of which citation style is used by the journal or publisher you are submitting to. If you are writing your paper for a class, ask your instructor.

Fig 5. List of references in numbered or citation-sequence system. Click on thumbnail to see larger picture. Source: Loghmani et al. 2019. Open Access Journal.

Differences Based on Type of Engineering

This chapter has focused on writing in the scientific format. The ideas in this chapter are meant to give you a brief introduction only. Be aware, however, that chemical, civil, computer, electrical, mechanical engineering, and computer science each have their own journals, websites, organizations, etc. They also have their own requirements when it comes to writing. As you progress in your major you will encounter more individualized and varied styles than discussed in this chapter.

Each of the websites below includes guides and templates for authors wishing to write in these fields. You may wish to consult these websites and their resources as you go forward in your schooling:

- American Institute of Chemical Engineers (AIChE)
- American Society of Civil Engineers (ASCE)
- The Institute of Electrical and Electronic Engineers (IEEE) for electrical engineering and computer science (and computer engineering)
- American Society of Mechanical Engineers (ASME)

For a more in-depth discussion of writing and engineering see the Fundamentals of Engineering Technical Communications textbook by Ohio State University.

Writing tip: For the specific format of your paper please follow your instructor's guidelines. In ENGL

2100 you are expected to follow the format of the template provide for your specific field listed above. (See the instructions for the Writing Project.)

References

References

Loghmani F, Jones C, Hertel O (2019) Evaluation of indoor air pollution in urban homes: A case study from Isfahan, Iran. Journal of Civil & Environmental Engineering 9: 337. An Open Access journal.

Tips for Writing Tutors

The STEM fields including engineering requires concise, well organized, and direct writing. Unlike English writing that depends on narrative writing and quotations for support, engineering writing focuses on documenting sources and presenting data in tables, graphs, etc. When working with engineering students here are some things to check for (in order of importance):

- Check for citations (correctly used and formatted) and that information is summarized rather than quoted
- Figures (graphs, charts, etc) and tables are meaningful, have captions, and are labeled
- Abstract follows a structure of introductory sentence, a methods sentence, 2-3 sentences of key data points and a conclusion sentence on the overall result
- The results section includes a table or chart and the discussion section is meaningful and correlates with results

PART IV

CITATION & COPYRIGHT

Typically the primary content of your document should be created by you and be your own original work. However, for research purposes or other reasons you may want to incorporate text, images, video or audio from another source. If you incorporate external materials, you need to make sure that the content is credited and available for reuse. This section contains a few guidelines for how to integrate external materials appropriately. This is called citation.

Citing your sources, also called referencing your sources (and sometimes called documenting your sources) is important for multiple reasons. First it lends credibility to your own writing by showing that you have used trustworthy sources and original research in an ethical way to inform your own ideas. It also helps readers find the sources of your information–your evidence for why you argue for a certain position or why you put forth a certain hypothesis.

Citation styles are standardized. In your high school or other previous English classes you may have learned about MLA (Modern Language Association) style citations. In technical writing the default standard is APA (American Psychological Association) style; however, different career fields use different citation standards. For example, in many of the sciences the CSE (Council of Science Editors) style is used.

Finally, remember anything written down, recorded, or posted to the web is under copyright. You cannot use something that is copyrighted without *written* permission from the owner.

Using material from other sources

If you integrate text from an external source (not your own ideas but someone else's ideas) into your writing remember you must cite that source. The main goals of any citation (whether formal or informal) are to a) signal that the ideas or content are not originally yours and b) give your audience a way to find the original information. To achieve these two goals, there are several different approaches you can take to informal citation

- Integrate the citation into your sentence: America's Test Kitchen recommends that you re-season your cast iron pan after every use.
- Mention the source in parentheses after the sentence: You should re-season your cast iron pan after every use. (America's Test Kitchen).
- Link to a digital source: If you are creating a digital document, you can connect the user directly to your source with a hyperlink: America's Test Kitchen recommends that you re-season your cast iron pan after every use.

Also be sure to use quotation marks to indicate any content that you've used word for word: According to America's Test Kitchen, "The key to owning one cast-iron skillet your entire life is seasoning and maintaining it." Quoted materials should only be used sparingly.

There are standardized ways of citing ideas and materials that are not your own that you use in your document. You will learn the basics in this chapter.

Verbs of Attribution

One important aspect of letting your reader know that you have borrowed information from someone else is to use a verb of attribution. These verbs signal to the reader that the information is not yours.

For example if you wish to summarize what someone else has said on a particular subject you would state some like this:

According to the Mr. Jones, ice melts at a different rate in space then it does on earth.

The word, "according," in this example is the verb of attribution. For a more detailed explanation and a list of examples use an internet search engine to search for "verbs of attribution."

To learn more about using quotations, see

"Annoying Ways People Use Quotations" by K. D. Stedman. 2010. Writing Spaces: Readings on Writing, Volume 2. Edited by Charles Lowe and Pavel Zemliansky. Creative Commons Attribution: Noncommercial No Derivative Works 4.0 license. https://wac.colostate.edu/docs/books/writingspaces2/stedman–annoying-ways.pdf

References and Citation Styles

References (also called citations) occur in two different places in your paper. The first type are in-text references that occur in the text where the quotation or related information is written and usually only contain just enough information to redirect the reader to the end references. End references give all the information the reader needs to find the research source. Sometimes the end references are called works cited, bibliography, or just references.

Although there are many different standard reference styles, the good news is that they all fall into two categories: author-date (or name-year) and citation sequence. APA is an example of an author-date system.

Citations: Author-Date (Name-Year) Style

In-text citation

The author-date (also called name-year) system is used in many career fields. The in-text citation usually contains the author's surname and the year of the publication. I may also contain other information such as what page number the quotation was found, etc. Here are some examples of in-text citation:

Examples

Jones' (2016) findings suggest that Godzilla has not recently terrorized any islands.

Recent research suggests that Godzilla has not recently terrorized any islands (Jones 2016).

Many journals will place a comma between the author's surname and the year: (Jones, 2016). This is in keeping with APA style; however, others such as the CSE do not use the comma as in the examples given above. If it becomes necessary to add a page number, you

would add a comma after the year and then list the page number(s) for the source of the quotation: (Jones 2016, 4).

It cannot be stressed enough that you need to research what style is commonly used in your major. Also understand that different journals even in the same field may have different style requirements.

End References

Using the author's surname and date a reader then can refer to the end references and find the full citation. The full citation contains all the necessary information to look up the author's source for the quotation or reference. Here are some examples:

Examples

Jones, L. 2016. An update on Godzilla's rampage: Who is in danger? Journal of Scientific Research on Kaiju, 8 (3), 12-36.

Suzuki, I. 2017. Rampaging monsters. New York, NY: Kaiju Imprints, LTD.

Telemann, G. 2018. Crisis in Tokyo: Godzilla returns once again. Kaiju News [accessed 2019 Jan 15]. http://www.kaijunews.com. doi:10.1136/kjn.3307500.119

In the author-date system references are listed alphabetically by author's surname. Regardless of which system you use notice that, unlike MLA, titles to articles are not put in quotation marks or italicized and only the first word and proper nouns are titled. This is common in most citation styles in STEM fields.

In the case of webpages give date accessed and last edited or published if available. Don't forget to use hanging indent. Finally include the DOI if available. A DOI is a Digital Object Identifier used to permanently identify an article or document and link it to the web; you can find more info on DOI and how to use them on the internet.

Writing tip: Personal communications (email, interview, etc.) are referred to only in in-text references and not in end references. The citation would look like this:

Examples

He told me that Godzilla has not yet destroyed Hawaii (Feb. 3, 2018, email from L. Jones to author; unreferenced).

Citations: Numbered (Citation-Sequence) Style

In-text reference

In contrast to author-date systems, citation-sequence systems simply use a number for the in-text reference. This allows for many citations even in a single sentence without making the sentence difficult to read. Because of this many sciences and engineering journals prefer citation-sequence.

Traditionally citation-sequence systems used bracketed numbers, but many journals are moving in the direction of using superscript numerals instead. Again, be aware of the style used in your career field and specific publication. Here are examples of both:

Examples Superscript

Jones[1] findings suggest that Godzilla has not recently terrorized any islands.

It seems that Godzilla has not recently terrorized any islands.[1]

Examples Bracketed Numbers

Jones' [1] findings suggest that Godzilla has not recently terrorized any islands.

It seems that Godzilla has not recently terrorized any islands [1].

Notice the placement of the citation. If the author is named in the sentence the citation goes next to the name. Otherwise it goes at the end.You add numbers in numerical order unless you refer to the same source, then you use the original number. For example if you see the citation numbers 1, 2, 3, 1, 4 this means the author used source number 1 twice in the paper.

Because the in-text citations are numbered, you simply need to jump to that number in the end references to find the information for the source. Here are examples of citation-sequence end references:

Examples

1. Suzuki, I. Rampaging monsters. 2nd Ed. New York, NY: Kaiju Imprints, LTD.; 2017.

2. Jones, L. An update on Godzilla's rampage: Who is in danger? Journal of Scientific Research on Kaiju 2016;8(3):12-36.

3. Telemann, G. Crisis in Tokyo: Godzilla returns once again. Kaiju News 2018 May 3 [accessed 2019 Jan 15]. http://www.kaijunews.com. doi:10.1136/kjn.3307500.119.

Writing tip: If the author uses source number 1 multiple times in the paper, they would need to use the number 1 each time as an in-text citation. In the end references, however, the author would only need to list the source once.

Many writers find they prefer citation-sequence systems to author-date, but the choice is ultimately up to the publisher not the author. Be sure to research your career field and be wary of stylistic requirements of publishers.

Citing a Picture

APA Style Citation for Pictures

Option 1: Citation as part of caption

Fig. 1. Crocodile. Source: Everglades NPS, 2005, R. Cammauf. Retrieved on 2015, October 23 from https://www.flickr.com/

Option 2: Citation placed in References Page

Fig. 1. Crocodile.

—

References:

Crocodile [Image] (2005). Everglades NPS. R. Cammauf. Retrieved on 2015, October 23 from https://www.flickr.com/

Writing tip: If picture is used in a presentation such as a Powerpoint Slide then you can put the citation in the notes section to avoid clutter.

Copyright: Images, Audio, and Video

Most content that is written down, recorded, or posted to the web is under copyright. You cannot use something that is copyrighted without *written* permission from the owner. Many content creators, however, will upload materials to the web *copyright-free*. There are various license types associated with copyright-free content. Some examples include:

- Attribution: Must give appropriate credit to creator
- NonCommercial: Content cannot be used for commercial purposes.
- No Derivative Works: The content can be used, but only in its original form.

In addition to content that is uploaded by a creator to be copyright-free, a lot of media is in the public domain. Typically content enters the public domain when its copyright has expired. Copyright law began in 1924 so works created before then generally are in public domain.

Listed below are a variety of sources where you can search for openly licensed or public domain media. Please be sure to review licensing information on each database so you follow specific rules for use and attribution.

- Images:
  - Creative Commons
  - Pixabay
  - Pexels
  - Unsplash
- Video:

    - Coverr
    - Pexels
    - Pixabay
    - Videezy
    - Videvo
- Audio:
    - Free Stock Music
    - Videvo
    - YouTube Audio Library

Creative Commons and Wikimedia commons allow you search for a variety of freely usable media files.

Copyright: Music

Music is tricky. Typically you cannot copy copyrighted music, even for research purposes, and insert it in your paper, video, etc. PDinfo.com says this about music: “We highly recommend that you consult an attorney or rights clearance agency before you use any music under copyright protection for anything other than your own personal use.”

Fair (Educational) Use

Fair use typically refers to educational use where you are using the quotation, graphic, table, etc. as part of a research or other type of paper for school or research purposes. Here are the guidelines for fair use:

- Do not use commercially (cannot use to make money),
- Must give credit to its creator (cite the source) and
- Generally cannot copy the whole thing. For example it is OK to quote a sentence, or a paragraph, but not whole chapters. This is why you cannot copy a whole picture or a song that is copyrighted.

Tips for Writing Tutors

- When working with students from STEM fields both in-text citations and end references should be one of the first things you help them with.
- Students often forget to cite figures and tables: be sure to help students with those; even if the figure or table is original and not taken from another source, it still needs a caption: See 5.2 Figures and Tables for more information on using proper formatting for captions.
- Often instructors will simply require APA reference style (author-date); however, be aware that many science, technology, and engineering papers use citation-sequence for the references, be sure to check what the instructor requires and be aware of the differences between the two reference styles.

PART V

CIVIC-ENGAGEMENT AND TECHNICAL WRITING

Many of the course sections for Technical Writing are offered as service-learning courses. What is service-learning? Your college experience is to help you have the means to make a living, follow a career path, and find self-fulfillment. Yet it should go beyond these self-oriented goals, it also should prepare you to be a member of society. Perhaps you need to take care of family members, such as your own spouse and children or parents. Yet being a member of society also suggests that you have a civic responsibility as well. Through your service with a non-profit organization and the reflection on that service provided by the writing assignments in class you will come to understand for yourself the reasons for and importance of civic engagement.

"I think service-learning means that community service goes hand-in-hand with getting a higher education. Just as an individual invests in a degree in order to begin or advance their careers, they should also invest in the community where they will advance in age and/or their children will be born into. I think it's especially important to set good examples of community service to younger generations so that they can continue implementing good acts and keep the cycle going." –Previous Student of ENGL 2010

The Salt Lake Community College's vision states that SLCC will be "a model for inclusive and transformative education, strengthening the communities we serve through the success of our students." The values that SLCC has defined to meet this

vision include classroom learning in an atmosphere of respect and empathy for diverse cultures and perspectives, and serving the community—especially in collaboration with community needs.

Service-learning classes seek to fulfill SLCC's vision by allowing you to have direct experience by applying what you are learning about writing to real-world settings. This includes both individual and team projects. You will also be given a chance to reflect on these assignments to consider what you have learned and how you have had an impact in your community.

Students who engage in civic engagement tend to have higher grades, are more likely to graduate, and have a more meaningful class experience. Also the idea that giving back something to the community is just as important as learning in class, and that by doing both you can be prepared to be a good citizen in your community, workplace, and in your life.

Writing for Community Change

Writing for Community Change by Elisa Stone is an OER text that discusses technical writing's relationship with service-learning and good citizenship. It includes some of her personal experiences in South Africa as part of service-learning abroad.

PART VI

PROJECT PLANNING

When considering a project, it is best to step back and get a look at all the preparation that goes into the project.

1. Define How Project Relates to Mission Statement and What are the Objectives of the Project
2. Identify Deliverable(s)
3. Define Team Member Responsibilities
4. Create a Project Calendar
5. Create a Work Plan

The next several pages will describe each of these steps. Only after you have created a work plan should you start your project.

Mission Statement and Objectives

Most people jump right in to defining the deliverable of the project–what is the final product, e.g. a document, a product, a service to be offered, etc. is. But before considering the deliverable, step back and think about the overall mission statement and objectives of your organization.

Typically an organization a mission statement that defines the purpose of the organization. Salt Lake Community College's mission statement is, as you would expect, about educating students. Even a class usually has course objectives or learning outcomes about what it hopes students will gain by taking the course that are related to SLCC's mission statement. Individual assignments also have objectives that help you meet the goals, or mission statement, of the course.

So whether it is for class or work, think a minute of how your project will fit in to the overall mission statement of the organization. Does the project fulfill a particular objective that matches the mission statement?

Identify Deliverable(s) and Outcomes

A deliverable is the actual product or service you will provide. For a class it may be a major paper or something you design like a webzine, etc. For a company it may be the product they sell or the service they provide to clients. Now that you have thought about how your project fits with the mission statement and/or objectives for the assignment, class, or company, etc., you need to think about the steps involved in creating your deliverable.

Let's imagine you need to create a pamphlet for a nonprofit organization. You would need to do some research, write the text for the pamphlet, obtain or create the graphics, and design the pamphlet itself to name just a few of the steps involved. Each of these steps can be called outcomes.

Another way to think of outcomes is that they measure progress towards the goal of completing your project. Outcomes must be specific, measurable, and meaningful to the project. Writing the text in the above example is specific, can be measured, and certainly is meaningful to the project.

So as you plan your project also plan your steps, or outcomes that need to be finished in order to complete your project.

Team Member Responsibilities

If you are working on a project by yourself then it is easy–you have all the responsibilities of the project. But when you are on a team then you need to decide who does what. Often you will divide the responsibilities by skill. For example:

- Researcher(s): library, field, and internet research.
- Writer(s): create content.
- Editor(s): organization and style of document. Also proofreading.
- Designer(s): laying out the document, collecting images, making tables, graphs, charts, etc.

You also need *good* communication between team members. Whether you communicate by email, texting, in-person, or a combination of these someone should be responsible for being the contact person. The contact person makes sure everyone receives the needed information and also can act as a liaison between the team and another organization, such as a community partner if you are doing a service-learning project.

> –"In American classrooms, we tend to prize individual accomplishment, yet in professional careers we need to work well with others." Joe Moxley from "Managing Group Projects" found at writingcommons.org

One other important person to select is the coordinator. The

coordinator maintains the project schedule. They also run meetings setting the agenda and making sure that the agenda is met.

These are just some suggested responsibilities. Your team might have other responsibilities, or if the team is small combine some of these responsibilities.

Finally you will want to agree on how to resolve conflicts before they happen. Should decisions be majority or unanimous? Who referees conflicts? And don't forget to record what is done in meetings.

More on teams and team communication can be found in chapter 7 "Managing Team Communication" in *Fundamentals of Engineering Technical Writing* .

Having Effective Meetings

The following are some tips for effective meetings:

- Plan date, time, location, who should attend
- Choose Meeting Facilitator; it can be the same person who is in charge of the project or you can choose a different facilitator each meeting
- Set an Agenda; this is done by the meeting facilitator who also asks for agenda items from the team
- Start and End Meetings Promptly (Be on time!); be courteous of other people's time
- Address Each Agenda Item Separately;
- Be Courteous and Encourage Participation
- Reach Consensus and Move On; if you cannot reach consensus or a single agenda item is taking too much time you can postpone that item to another time
- Record Decisions
    - What actions will be taken
    - Who is responsible for those actions
    - When should it be completed by

Here are two excellent Ted Talks on teamwork:

- Tom Wujec: Build a tower, build a team 7 min
- Margaret Heffernan: Forget the pecking order at work 15 min

Here are some others you may also wish to view:

- Simon Sinek: How great leaders inspire action 18 (why,

how, and what)

- Dan Pink (2009): The puzzle of motivation 18 min
- Susan Cain: The power of introverts 19 min
- Sugata Mitra: The child-driven education 17 min

More on teams and team communication can be found in chapter 7 "Managing Team Communication" in *Fundamentals of Engineering Technical Writing* .

Project Calendar

The project calendar includes not only the final date that the project must be completed by, but also a detailed list of the steps and outcomes and their due dates needed to complete the project.

For example you are writing a report. You would need due dates for all of the steps of writing, planning, research, organizing, drafting, revising, and proofreading in addition to the due date for the report.

When you plan a project calendar there are two tips that make the project itself go smoother: 1) be as detailed as possible with the project calendar and 2) use *backward planning*. Backward planning simply means you start with the due date for the project and then work backwards through the calendar from that date ensuring that you have enough time to complete each of the steps that are needed to finish the project.

To return to the report example. If it is due March 2nd, then you would plan to work proofreading from Feb. 28 through Mar 2. You would spend from Feb. 18 to Feb. 28 revising, Feb. 14 through 17th drafting, Feb 13th organizing, Feb. 7th to Feb. 12 researching and you received the assignment on Feb. 6th and spent that night planning. This is just an example but you can see how backwards planning works.

For complex projects you may want to use a Gantt chart or project management software such as Asana, Microsoft Project, Clarizen, Wrike, DaPulse, and a host of others.

Work Plan

The final step in project planning is writing out a work plan. A work plan is a summary of how you will complete the project and contains a list of personell working on the project and other necessary information. Here are some items that can be included in a work plan.

- Description of how the project will be completed.
- Identify mission and objectives.
- Create step-by-step plan showing separate tasks and activities, the outcomes that lead to deliverables.
    - Estimate effort and duration of each task
- Determine each person's responsibilities in team.
- Establish a project calendar—sequence and timing of activities.
- Estimate a project budget.
    - Money
    - Time
    - Other resources
- Summarize the deliverables (results) of the project.

Often the work plan is written as a proposal either attached to a memo (inside the company) or with a cover letter (outside the company). In this case the memo or cover letter will give a brief overview of the project, why it is necessary, etc. It would also include the completion date and contact information of the person to be contacted about the project.

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