Scientific Communication:
A Student Guide to Scientific Writing at NYU Shanghai

上海纽约大学
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About this Guide

This guide was developed as part of a collaboration between the sciences faculty and the writing faculty to help guide students as they work to acquire scientific literacy and communication skills throughout their careers at NYU Shanghai. This guide is supplemented by other resources, such as annotated sample papers, enhanced training for global academic fellows (GAFs) in the Academic Resource Center (ARC), and support documents for recitation instructor training. Portions of this guide have been modified from "Scientific Writing: An Introduction to Communicating with the Reader" by Joshua Dy Borja. Questions or comments regarding this guide should be sent to Dr. Joshua M. Paiz at jmp22@nyu.edu.

Purpose of This Guide

This guide has been designed to help students of all backgrounds as they work to acquire scientific literacy and communication skills. Writing is a primary mode of scientific expression, knowledge construction, and information sharing and this document focuses on scientific writing as a professional communicative act. It begins by orienting the reader to scientific writing as a form of negotiated, standards-driven communication that is consumed by specialists and non-specialists. It then discusses conventions of scientific writing, before moving on to discuss common issues in student scientific writing and ways of remediating these problems. This guide also includes a section on unique challenges faced by second language (L2) writers. It concludes with brief overviews of common genres of scientific writing that students at NYU Shanghai may encounter.

About the Authors

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A Brief Orientation to Scientific Writing

> Scientist use language strictly and narrowly as a communication tool. This distinguishing intention of communication shapes the professional culture and compositional style of scientists as writers (Goldbort, 2006, p. 2)

Scientists write, and they write regularly. They write to share research findings through publications in academic journals, to apply for grant money to fund their labs, to record stages of experiments and their results, to justify lab expenditures on new equipment, to learn about the latest advancements in their fields, etc. Simply put, one of the most regularly used tools in the practicing scientist's toolkit is language—even their knowledge of their discipline, whether that's physics, chemistry, biology, etc., is mediated through the lens of language. This means that acquiring scientific literacy skills is an important part of the professionalization of students in the sciences.

Your initial response may be that college-level sciences students are already highly literate—and this is true. However, *scientific literacy* requires students to refigure their existing literacy skills to meet the highly formalized and negotiated expectations of communicating in a variety of sciences disciplines That is, these the rules of communication that govern scientific writing have been established, maintained, and updated by the various scientific professional communities and are often codified in formal style manuals like that of the American Chemical Society, the American Medical Association, and the Council of Science Editor's *Scientific Style and Format.*. These expectations require becoming familiar with new genres of writing, new rhetorical expectations, new stylistic requirements, and new expectations for expression.

At the core of scientific communication is what is commonly referred to as *scientifically plain English* (Greene, 2013). Scientifically plain English (SPE) is predicated on the notion that good reporting in the sciences should be objective, straightforward, and grounded in the real-world. This means that good scientific writing should read itself. That is, is should craft a narrative that guides the reader through the text. It should not require the reader to constantly step outside of the text and actively engage with other materials to come to an understanding of the text's intended meaning. As Goldbort (2013) puts it, "Scientifically plain writing is objective, simple, concrete, direct, and unadorned, with straightforward constructions and the minimum number of words needed to deliver the document's material things to the reader (p. 8)." It's helpful here, to keep in mind who consumes this kind of writing—busy teachers, busy researchers, busy managers, busy grant award committees—busy people.

Scientifically plain style can be challenging for new scientific writers, because they often view scientific writing embedded in the larger context of the university and other academic writing contexts they've encountered. The new scientific writer will often deploy rhetorical tools that may be appropriate in the composition or literature classroom—creative metaphor, simile, complex idiomatic expressions, eschewing passive constructions—in their scientific writing assignments. These moves, while often acceptable and valued in other forms of academic writing, do not fit the expectations of good scientific writing.

To help students acquire and refine their scientific literacy skills, this guide will discuss some of the major concerns with student writing in the sciences at NYU Shanghai. Where necessary, it will point to external resources to aid the new science writers as they work on building these important literacy skills. Remember that acquiring this literacy is an important part of being able to work as a practicing scientist and to gain access to the professional community of the sciences.

Scientific Writing Conventions

Scientific writing is a highly-regulated style of writing, one that is governed by the conventions of scientific plain English. This style of English contributes to writing that is clear, concise, concrete, precise, and objective. In short, it facilitates communication between busy specialists and non-specialists. In this section, the guide shifts to focus on common scientific writing conventions. Examples will be provided to help solidify your understanding of these conventions. Please note: conventions are not hard and fast rules. Your professor may require modifications to these conventions to meet the needs of the course. Alternatively, you may decide to avoid some of these conventions for rhetorical or stylistic purposes.

Scientific Plain English

Goldbort (2013) ties the notions of scientific plain English to the thinking of Sir Francis Bacon, who stated that scientists must always consider "how effectively the words serve the readers in delivering their 'real' knowledge with clarity and exactness (p. 7)." These two principles—clarity and exactness—would later come to drive the scientific plain English movement in 1970s and 1980s, with a strong focus on material reality. Scientific plain English seeks to provide scientists with a linguistic toolkit that is focused on straightforward writing that makes minimal use of flowery metaphor or inaccessible idiomatic expressions. Being tied to material reality means that scientific plain English is "clear, direct, and simple" (Goldbort, 2013, p. 9). Central to this stylistic preference is remembering that your findings don't speak for themselves. It is your job as the author of a scientific text to make findings, assumptions, hypotheses, interpretations, and conclusions accessible to the reader, linking each of these to the readers' previous experiences and to the real-world. This means that, at the sentence-level, good scientific writing has a clearly defined idea and an unambiguous interpretation.

One way that scientific plan English is achieved through writing that is *precise* and *objective*. There are a variety of linguistic strategies that help writers achieve these two goals. First is making sure that all pronouns in the text have clear referents. That is, if you decided to replace a noun with a pronoun, it must be immediately clear to the reader to what the pronoun is referring. Remember, the reader will often recall the most recently mentioned noun (see below). If they have to go hunting through your prose to find the pronoun referent, the precision of your text will be compromised. Objectivity is often achieved through passive wording, where the focus is more on the thing being done or thing being acted on, as opposed to the human agent carrying out the action (see below). Other ways to achieve objectivity in your writing include: precision in verb tense throughout a section, using concrete wording, and using carefully crafted numerical expressions where appropriate.

- **Example – Ambiguous Referent:**
  - <u>Incorrect:</u> We then observed cell division in the sample. It was observed to be unusual.
  - <u>Revised:</u> We then observed cell division in the sample. The division was observed to be unusual.
- **Example – Passive Construction:**
  - <u>Active Construction:</u> We observed cell division processes in the sample.
  - <u>Passive Constuction:</u> Cell division processes in the sample were observed.

Another pair of hallmarks in good scientific plain English are *clarity* and *coherence.* Here, clarity refers to avoiding ambiguity in wording, logic, and organization. The maintenance of a narrative focus also aids in clear writing (see page 10). Coherence, on the other hand, refers to how well you connect the ideas in your text in a sort of logical chain. Both clarity and coherence can be helped by using what's called *Given/New Logical Chaining*. In this form of writing, you start with a statement (e.g., I like chemistry), and in the next sentence this becomes your *given* that you extend with some new statement (e.g., I like chemistry because I find it intellectually stimulating.). In the next sentence, what was previously new becomes your given and so on.

Finally, scientific plain style is also realized through writing that is *simple* and *concise.* Simplicity in writing can be achieved through keeping any redundancy or repetition in phrasing to a minimum. While repetition is a common strategy in spoken communication, it adds too much noise to written communication. Concision in writing can be tricky. Many new writers confuse concision with using the least amount of words humanly possible to express an idea. However, this isn't the case. Concision is really the art of using exactly the right number of words to express a given idea. Actively attempting to reduce meta-language, circumlocution, and clusters of nouns and adjectives is a good first step in concise writing.

- **Example – Simplicity:**
  - Needlessly complex: We then observed cell division in the sample. The cell division in the sample was observed to be unusual.
  - Simplified: We then observed cell division in the sample. The division was observed to be unusual.
- **Example – Concision:**
  - Wordy: We, the members of the lab group, observed cell division processes in the sample that was provided to use by the teacher, who has a doctorate in Chemistry.
  - More concise: We observed cell division in the provided sample

Style Manuals in Scientific Writing

When student-writers think of style manuals and guides, they often think about getting marked down for misplaced commas, or improperly italicized titles that come about from not properly following densely worded guides on how to cite things. Certainly, style manuals govern how we cite information. However, they also cover the formatting of the document, the presentation of tables, figures, and charts, and even linguistic expectations. Following a style manual may seem like a minor part of good scientific writing. However, the ability to properly deploy all aspects of a style sheet—from citation, to page layout, to captioning figures—marks the student-writer as a member of the professional community. This is because style manuals have been created over time by the various organizations and conferences that facilitate the dissemination of the information across and between scientific communities.

In table 1 below, you will find a list of common style manuals and the disciplines in which they are commonly used. Links to style guides are provided in Appendix B, at the end of this document. Please note that this list is being provided for your own reference, and not as a definitive guide. Student-writers should always follow any specific style guide instructions set by their professors, who may prefer one style guide over another, or may modify a style guide to fit the demands of the classroom.

Table 1. Style Manuals in Scientific Writing

Style Manual	Dominant Field(s)
American Chemical Society (ACS) Style	(In-)Organic Chemistry, Biochemistry, Physical Chemistry, Analytic Chemistry
American Medical Association (AMA) Style	Medicine, Pharmacology, Biomedical Engineering
American Institute of Physics (AIP) Style	Physics, Astronomy
American Psychological Association (APA) Style	General College-level Science, Psychology,
Council of Biology Editors	Biology, Life Sciences, Medicine,

	Biomedical/Biomechanical Engineering
Council of Scientific Editors (CSE) Style	All fields
Harvard Style	All fields
National Library of Medicine (NLM) Style	Medicine, Biomedical Engineering
Vancouver Style	All Fields

IMRaD Organizational Pattern

The most common organizational pattern for scientific reports is the IMRaD pattern, an acronym formed from the first letter of each major section of the report. These sections are typically labeled as *Introduction, Methods and Materials, Results*, and *Discussion.* In the following subsections, we will discuss each of these parts in turn. The discussion of these sections will focus on common rhetorical and informational moves, as well as common challenges in writing these sections.

Introduction

The introduction serves as a preview of and roadmap to the rest of your paper. It serves to orient the reader to the paper and to any guiding theoretical framework that served to guide the experiment or the interpretation of results. It also helps to situate the focus of your research within the wider disciplinary conversation on the topic.

After introducing the reader to the general topic of your research, you will begin by discussing the previous research—commonly known as a *literature review*. This review may be relatively narrow, in the case of a short lab report, or it may be relatively broad, as in the case of the full research report. In the review, you will begin by discussing current disciplinary knowledge about the topic that you're researching before you begin to narrow down the discussion to something that is missing from current knowledge, also known as *the gap*.

The word *gap* is meant to evoke an absence, or an empty space, which you will fill with new information. So, when you want to identify a gap in the research, you can describe a phenomenon or situation that has not yet been fully described by previous research. Or, you can propose a possible improvement to how previous experimenters collected their data. Remember, this section of the introduction is setting up the paper and orienting the reader to it. So, be sure that you are providing the necessary background information to help the reader understand the rest of the document.

Once the gap has been identified, you may move on to stating your hypothesis. In doing so, you will seek to address the following question for the reader: what is your prediction or goal for your experiment?

So, your *hypothesis statement* is the prediction or goal that motivates your entire paper. Your hypothesis is the reason that you have designed an experimental setup and collected and analyzed data. Because the hypothesis motivates your entire paper, it is the touchstone that your readers will use to connect the different sections of the paper. In order to make these connections, your writing should continually connect back to this hypothesis. This helps to creative a narrative that links the different parts of the paper together.

Next, you will discuss the experimental approach taken in your paper. The *experimental approach* is how you will set up your experiment to test your hypothesis. For example: if your goal is to demonstrate Newton's First Law, briefly describe how you use materials to demonstrate it. This part of your introduction will help you to transition to the next section, methods and materials (Hoffman, 2013).

Methods & Materials

The methods and materials section outlines the actions carried out during the course of your experiment—the methods—and the items used during the experiment—the materials. The methods and materials section is a vital to the paper as it contributes to the replicability of your research. Replication studies are a vital tool for scientist to confirm initial findings from early experiments. In the case of environmental and other location-specific experiments be sure to specify locations, times, and time intervals as part of your methods. Please note that the methods and materials section should not serve as a user manual; this section should be kept as concise as possible, often around one-page long for medium-length papers (5-10 pages).

Results

The next section is the results section. In this section you report the outcomes of any experiments and begin to analyze that data and draw conclusions. It is important in this section to tie this presentation back to the controlling thesis of the report and to your hypothesis. The results section is where you show your reader the new knowledge that you have created by filling the gap that you identified in the introduction. This means that the results section receives a great deal of attention and scrutiny.

Results section reporting requires you to provide both findings—raw data—and your interpretation of those findings—analysis. *Raw data* consists of the measurements that you make in the laboratory. Then, when you *analyze* that raw data, you perform calculations or you fit the data to a particular quantitative model. These calculations allow you to make interpretations or conclusions from the raw data. Depending on how the raw data helps to support your hypothesis, you may decide to summarize the data, as opposed to presenting it in detail. If it's central to supporting your hypothesis—and to convincing the reader that the hypothesis was valid—you may provide the data in greater detail or in its entirety (often as an appendix for larger datasets). In making your interpretations, you're seeking to show the reader how the data can be interpreted in such a way as to support your hypothesis and the claims that you may be making about it. You will return to parts your interpretation of the data to draw conclusions in your discussion section, as you continue crafting the narrative of your report.

In presenting results, the reader needs to know how reliable your measurements are. No matter how precise your instruments are every measurement has a nonzero uncertainty. This is another way of saying that each measurement has some error—the error may be very small, but it is there.

So when you report your raw data, each measurement should be accompanied by a quantitative uncertainty, which gives a range of doubt for your measurement. The ± symbol is a concise way to pair your measurement with its uncertainty, for example: 1.54 ± 0.01 m. This uncertainty in your raw data guarantees that there is uncertainty in your calculation; that is, uncertainty propagates from raw to analyzed data.

Discussion

The discussion section is the final move in the IMRaD organizational pattern. In it, you will work to conclude your paper in a logical way that connects your experimental findings to your hypothesis, previous research, and to possible implications. The discussion section is a pivotal part of concluding the narrative of the scientific report.

In the *quantitative conclusion* part of the discussion, you will clearly state whether or not your results confirm your hypothesis. Because the hypothesis motivated your entire experiment, the reader now wants to know—at the very first sentence of your Discussion—whether your results confirmed or refuted your hypothesis.

Next, you will move on to discussing any *limitations* that may have influenced your experiment and therefore your results. Since you are a human agent, working with imperfect tools in an imperfect world, there will always be limitations to report. These limitations will often affect the degree of confidence that you can have in your confirmation or refutation of your hypothesis. Limitations can often be difficult to write, because you may see it as decreasing the credibility of your findings. However, all researchers acknowledge their limitations in order to provide transparency and to suggest improvements for future studies. Below, you will find some examples of common discussion points for the limitations section:

- Uncertainty analysis and error analysis
- Systematic uncertainty and statistical (random) uncertainty
- Capabilities of your scientific instruments: least count (resolution)
- Precision versus accuracy of your measurements
- Difficulties that you encountered while conducting your experiment
- Applicability of your results—that is, how generalizable are your conclusions; are your conclusions valid only when you assume certain conditions?

In the *implications and directions for future research* portion of the discussion you focus on what your results might mean for industry/you discipline by outlining avenues for future projects. This information is included because science is a collaborative effort. This means that the research of one person is very much influenced inspired, and motivated by the work of others. This is often done by considering one, simple question: Given your conclusion and the limitations of your experiment, what is the next step toward a better understanding of the phenomenon under investigation? In answering this question, you might discuss whether the next step includes improved materials and technology, more rigorous data collection, a different environment, or a different experimental approach.

The IMRaD pattern is the dominant organizational method of writing scientific reports. It should be noted that this approach can be modified as necessary to fit the demands of your specific rhetorical situation. Always defer to your professors' specific instructions. Now, we will close by briefly covering issues of integrity and originality in scientific communication.

Integrity & Originality

> The advancement of scientific inquiry, the very process of experimental research itself, depends on a trusting collaboration among its practitioners. Thoroughness and honesty in citing the scientific literature is an integral part of the professional collaboration (Goldbort, 2006, p. 152).

In your courses, you are expected to do your own work. You may not merely copy the work of others—classmates, students from other courses with similar assignments, or professionals. Nor are you permitted to purchase papers written by someone else. These acts are commonly known as *plagiarism* and are classed as violations of the NYU Shanghai code of academic integrity. Violations can carry hefty penalties (NYU Shanghai, 2016). Likewise, you may not reuse work from one assignment in another (for the same or for a different class) without the express permission of the professor. To do so is to engage in *self-plagiarism*, which is also a violation of the academic integrity code. In the case of *collaborative writing projects*, each member of the team is expected to meaningfully contribute to the composition of the text. This contribution may be negotiated by the team and that each professor may have different expectations for what full participation in collaborative writing might look like.

All of this means that your work must be original work. However, science does not happen in a vacuum. Rather, it is a highly-situated endeavor, one where each new advancement or innovation is built upon previous work. Likewise, your writing will build on theories, methods, and findings from other scientists' work. This means that you must be sure to cite their work by following the procedures outlined by one of the style sheets (Table 1, above). Properly citing others' work helps you to build your credibility and authorial voice in a way that is recognized by others.

Writing on the role of citation in the sciences, Montgomery (2003) discussed citation as a key act in building and maintaining a professional identity in scientific writing. That is, the act of citing is one of the core pillars of professionalism in the scientific disciplines. He supported this claim by outlining four major roles for citing:

1. Accountability – Proper and complete citations show the reader that you're familiar with current and core literature in your discipline.
2. Collegium – Citations in your writing show that you belong to a group of researchers and practitioners that share common theoretical leanings.
3. Agreement & Disagreement – The strategic deployment of citations and the linguistic choices leading up to the citation can signal your orientation to the work of other researchers.
4. Originality – Deploying citations to highlight the gap may allow you to make a claim of originality regarding your own work.

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Common Issues in Student Scientific Writing

Narrative: Scientific writing often contains a form of narrative that begins with your hypothesis, carries through your results, and terminates with your discussion. To help achieve this narrative, be sure to state why your results are relevant to your hypothesis. Even though an experiment usually comes with many preliminary steps, each step is relevant in some way to the purpose defined in the hypothesis. In the discussion section, make sure that you draw final connections back to your hypothesis and how your work, as reported in the paper, fills the gap that you identified in the introduction.

Notation: When your paper uses many technical terms, it can bog down the reader, reducing the efficacy of the communication. So, make sure that terms and variables are clearly defined and that notation is clear to the reader.

- **Example**: For water between 0°C and 370°C, **viscosity μ** decreases with increasing **Kelvin temperature T** [8]:

  $$\mu(T) = (2.414\text{x}10^{-5})\ 10^{247.8/(T-140)}\ .$$

Hedging: Hedging is a common tool of scientific and academic writers that allows them to make a claim while not overreaching in making it. In scientific writing, this often occurs in the discussion section while outlining the implications of your findings. Hedging is commonly carried out through using medium certainty in your writing. *Medium certainty* requires the use of certain discourse markers to make sure that their statements are neither too strong, nor too weak.

- **Example (High Certainty):** Adopting the methods reported here **will** lead to a replication of our findings.
- **Example (Low Certainty):** Adopting the methods reported here **might** lead to a replication of our findings.
- **Example (Medium Certainty):** Adopting the methods reported here **will likely** lead to a replication of our findings.

Table 2, below, shows selected discoursal markers that help you create different degrees of certainty (Halliday & Matthiessen, 2014).

Table 2: Samples of Discoursal Markers of Certainty

Low Certainty	**Medium Certainty (Hedges)**	**High Certainty**
Might	Probably	Is
Could	Likely	Must
Possibly	Should	Always
May	Usually	Certainly
Would	Typically	Definitely

Subject and Verb: Your choice of subject and verb should give strong signals about the function of your sentence. If you want a sentence to communicate what has been found in previous experiments, you can make this clear by directly pairing the scientist with an action verb.

- **Example:** During an unscientific visit to a cat café, **Li and Ginsberg observed** a positive correlation between joy and number of cats present [17].

Subject–verb Distance: In scientific plain English, it is recommended that you maintain a short distance between subjects and verbs in a sentence, which makes the information clearer for the reader. In the following examples, subjects are in blue and verbs are in red.

- **Example:** According to a dynamic analysis of the fluid system, **back-and-forth fluid motion and arm motion (pitching)** **excite** this mode ω_{nat}, whereas **lateral motion and vertical motion** **produce** negligible excitations [1].

Passive voice: When scientists describe their experiment's materials and methods in scientific papers, they rarely refer to themselves—that is, they rarely use the words I or we. Instead, they most often use the passive voice to shift focus from the human agent to the procedure. This is because knowing the actions of the experiment is more important than knowing who completed the actions.

Recall that, when a sentence is in the passive voice, the subject does not perform the action of the verb; instead someone else performs the action on the subject.

- **Examples:**

  The sandwich was eaten.

  The test tube was spun in a centrifuge.

  Over several trials, pendulums of varying weights were set in motion.

  The speeds were recorded with a Pasco CI-6742A ultrasonic motion sensor.

Past tense: The materials and methods section is also often written in the past tense, indicating that the experimental procedures have already been completed.

- **Example:** Trials were sorted into one of two discrete temperature groups: Tlow = 22.5 ± 0.5°C and Thigh =138.0 ± 0.5°C. The latter is achieved with a Waring Professional Extra Burner and a glass beaker. The temperatures were confirmed by a mercury thermometer with least count 1°C.

Commonly misused words: Take active steps to properly deploy commonly misused words in scientific writing. The list below is from Golbort (2013).

- Affect/Effect (v.)
  - Affect = influence or change
  - Effect = bring about something, to cause something
- After/Following
  - After = later
  - Following = means *immediately* after the previous thing
- Among/Between
  - Among = many things
  - Between = two things
- Can/May
  - Can = ability
  - May = possibility or potential
- Compare/Contrast
  - Compare = examination of similarities
  - Contrast = examination of differences

- Complementary/Complimentary
    - Complementary = addition to equal a whole
    - Complimentary = approval or praise
- Compose/Constitute/Comprise
    - Compose & Constitute = to make up something
    - Comprise = to contain something
- Constant/Continual/Continuous
    - Constant = something that holds true always without variation
    - Continual = an event that repeats
    - Continuous = something that happens one after the next without ceasing
- Farther/Further
    - Farther = distance
    - Further = more
- Fewer than/Less than
    - Fewer than = countable objects/events
    - Less than = quantities and qualities
- Imply/Infer
    - Imply = to suggest
    - Infer = to conclude
- Its/It's
    - Its = possessive
    - It's = contraction of it + is
- Many/Much
    - Many = reference to numbers
    - Much = reference to quantity or degree
- Principle (n.)/Principal (adj.)
    - Principle = a basic rule/truth
    - Principal = key or important fact/issue/matter
- That/Which
    - That = restrictive
    - Which = non-restrictive
- Various/Varying
    - Various = different things
    - Varying = changing

Collaborative Writing: Some of the reports that you write at NYU Shanghai will require you to engage in collaborative writing. Even for professionals, this can be a difficult experience. This difficulty largely stems from the feeling of being left out of the drafting and revision process (being overlooked), or from the feeling that you have had to "carry the team" (being exploited). However, collaborative writing doesn't have to feel this way.

Collaborative writing is a potentially powerful writing strategy because it allows for the construction of a polyvocal document that taps into the perspectives, experiences, and knowledges of the co-authors. To help make collaborative writing maximally effective, we recommend you take the following steps before you even put the first word on the page (See Spring, 1997).

1. Negotiate domains of responsibility for each member.
    a. Who's writing what sections?
    b. Who's responsible for proof-reading and editing?
    c. Who's responsible for executing revisions?

2. Outline deliverables for each stage of the project.
3. Negotiate deadlines that allow time for revision.
4. Seek input from team mates on each stage of revisions and editing.
5. Negotiate remediation for team mates that “drop off the radar.”
6. Document all team interactions related to the project.
7. Hold all team mates equally accountable for deliverables and project completion.

Making teams work is a task that requires leadership and that is predicated on good planning. To help with this, we echo the Johnson-Sheehan (2011) in advising you to begin with backward planning (p. 40). In *Backward planning*, you being with a deadline, for example, 11 May 20xx. Then you ask, “What are the sub-parts of this project that need done? Does one sub-part need to be done before work on another can begin? How long will each step take? From there, you fill out your calendar from the deadline, working in reverse, and slotting in the various sub-parts at the dates that you and your team have agreed upon.

Figures, tables, graphs: Much of the data in scientific writing is best presented visually in the form of a figure, table, or a graph. If you’re having trouble thinking of how to start your paper, it may be fruitful to begin by populating your document with any necessary visual information. This can help to ease some of the stress of starting to write because you can begin with what you already have.

Keep in mind that a brief caption must accompany each visualization. In the caption, number your figure and state what is being shown to the reader. To ensure that the reader understands the relationships shown in a graph: label the axes, make the units clear to the reader, and state the most significant result that comes from analyzing the figure.

Figures, tables, and graphs don’t speak for themselves. That is, you must help the reader make sense of them by explaining them to the reader in your text.

- **Example:**

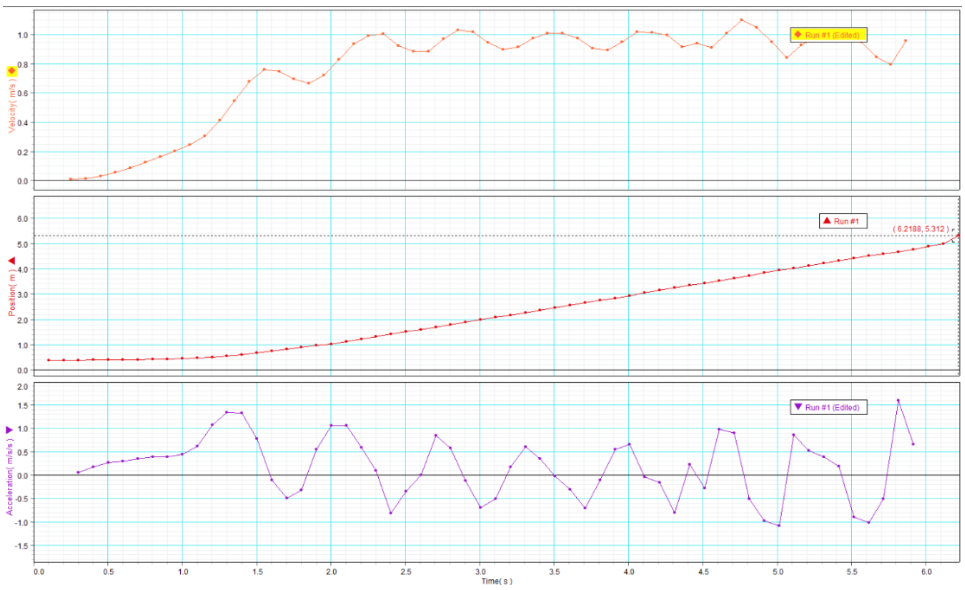

Fig. 5. Plot of velocity, position, and acceleration over time for human walking without coffee cup. Step frequency fstep ~ 1.5 Hz drives the walker’s velocity sinusoidally about an average velocity v ~ 0.95 m/s in the walking direction.

Figure Placement: When you mention a figure, you are offering a signal for the reader to consult that specific figure. In this way, your sentences, along with physical placement of the visualization, should guide the reader to the figure.

L2 Writers and Scientific Writing: Unique Challenges for Multilingual Writers

Managing Multilingual Resources

Multilingual writers bring with them an expanded array of linguistic and rhetorical tools. These tools can greatly expand ones expressive and communicative potential. However, certain challenges in managing these multilingual resources can arise when one transitions to an environment where the second language is the primary mode of communication. This means that there's the need for the multilingual writer to take active steps to ensure that an influences from the first language are conducive to facilitating communication and meaning making in the second language. Some common areas where there may be negative interference are around tone, the organization of a text, syntactic structure of sentences, and accuracy of expression. Remember, being multilingual isn't a problem; it's a benefit. However, applying those multilingual resources to new contexts—and to stressful ones at that—require additional care.

Hypercorrection

Hypercorrection is when a person "corrects" their speech or writing to match what they consider to be the normal, correct usage but in doing so they *over correct* and end up producing an error (see Fromkin, Rodman, & Hyams 2007). This often occurs when students assume that good scientific writing is like good academic writing, or that either of these are like good literary writing. This can lead to a form of stylistic hypercorrection.

Effective Paragraphing in Scientifically Plain English

Paragraphing refers to how one constructs paragraphs in writing. Through control over paragraphs, the student-writer controls the flow and organization of information. This is because paragraphs serve as logical containers that explore, investigate, trouble, or contrast a single idea. In order to ensure effective paragraphing, it's important to remember the functions of the various parts of a paragraph.

- (Optional) *Transition sentence* that links the paragraph to one that precedes it, or back to your thesis/main argument.
- *Controlling sentence* that sets the direction for the paragraph that follows it by outlining what will be discussed in it.
- *Supporting sentences* that support, explore, extend, or trouble the topic of the controlling sentence.
- *Close sentence* that finalizes the discussion of the paragraph and prepares the reader to transition to the next paragraph.
- (Optional) *Transition sentence* that links the paragraph to the next one. <u>Note</u>: Paragraphs will typically have only one transition, at the beginning or the end, unless it is a very long or complex paragraph.

Remember, a paragraph is a logical unit in an essay. If the content of the paragraph is straying from what's been identified in the controlling sentence, it's likely time for a new paragraph.

Sentence Structure

Sentence structure is one of the most common errors in writing, whether it's the native speaker or the non-speaker author. Below, you will find a brief description of the most used sentence patterns in English writing, as well as descriptions of common errors.

Sentence Patterns

- Simple sentence – comprised of, minimally, a subject and a verb, may contain a compliment. This is also called an independent clause.
    - **Example**: Scientific writing is an important mode of communication.
- Compound sentence – comprised of two independent clauses joined by a comma + conjunction or a semi-colon.
    - **Example:** Scientific writing is an important mode of communication, because it allows for the dissemination of experimental information.
- Complex sentence – comprised of an independent clause and one, or more, dependent clauses. *Depended clauses* cannot stand on their own as sentences and often serve as introductory or restrictive clauses.
    - **Example:** Despite its difficulty, scientific writing is an important mode of communication.
- Hybrid (Compound-Complex) sentences – are combinations of the compound and complex sentence patterns.
    - **Example:** Despite its difficulty, scientific writing is an important mode of communication, because it allows for the dissemination of experimental information.

Common Sentence Structure Errors

- Fragment sentence – occurs when a dependent clause is used a complete sentence, or when the idea expressed in a sentence is left incomplete.
    - **Example**: In this experiment, we mixed.
    - **Correction**: In this experiment, we mixed the reagents in an volumetric flask.
- Run-on sentence – occurs when two or more independent clauses are incorrectly fused into a single sentence.
    - **Example:** In this experiment, we mixed the reagents we waited five minutes to observe any sedimentation.
    - **Correction:** In this experiment we mixed the reagents. We then waited for five minutes to observe any sedimentation.

- Comma splice – occurs when two or more independent clauses are incorrectly connected with just a comma.
    - **Example:** In this experiment, we mixed the reagents, we waited five minutes to observe any sedimentation.
    - **Correction:** In this experiment, we mixed the reagents; then, we waited five minutes to observe any observation.

Effective Proof-reading and Editing

Good writing doesn't just happen. Good writing takes time and multiple passes. This means that after a draft is completed, the student-writer must review the draft looking for opportunities to improve. One of the most effective strategies for proof-reading and editing is to enlist the help of someone else. There's no better way to assess the effectiveness of your written communication than to put it in the hands of a reader. Assuming that there isn't time, below are some effective proof-reading and editing strategies.

- Give yourself time. Don't start proof-reading immediately after you finish drafting. Once you finish drafting, take an hour or two to do something else.
- Give yourself *even more* time. Allow plenty of time to make more than one read through (pass).
- Focus on one-to-two major issues each time you read through your text. For example:
    - Pass one – communication and accuracy
    - Pass two – organization and transitions
    - Pass three – sentence structure and word choice
    - Pass four – formatting and style sheet conformity
- Start from the last sentence on the last page and read backwards, when looking for grammar errors.

Typical Scientific Writing Genres at NYU Shanghai

Students in the sciences program at NYU Shanghai will encounter many different genres in their classes. A *genre* of writing is a form of writing that sets certain parameters and expectations for the communication. In the narrative genre for example, the expectation is that the author uses descriptive language to paint a vivid image for the reader; that they *show* us a story, as opposed to just *telling* us one. In argumentative genres, on the other hand, the expectation is that the writer starts from a clear premise and uses logic and tools of persuasion to convince the reader to think or act in the way that the writer desires. Scientific writing is replete with its own genres. In this section, we will discuss some of the genres that you may produce as a student here at NYU Shanghai. Your individual course or professor may have additional, or different, requirements.

Lab Reports

Lab reports represent a key genre in scientific writing, as it is through the lab report that the researcher chronicles their lab-based activities for either an employer or professor. The lab report is grounded in the laboratory notes, and are often seen as a more formalized extension of the lab notes. That is, if the lab notes can be seen as the skeleton hanging in the corner; then the lab report is the Visible Man Anatomy Model™, completely with organs and musculature.

In a lab report, you selectively par down your lab notes into a coherent narrative that is tied to a hypothesis. Lab reports are often organized in the IMRaD organization pattern to facilitate clarity and completeness in the reporting. Another way that lab reports depart from lab notes is in their conclusion. While your lab notes may just sketch out how the experiment went and its connections to the hypothesis. In lab reports, you will more fully articulate the status of the experiment and the relationship between the experimental outcomes and your hypothesis. During the conclusion of a lab report, you will also discuss limitations and possible directions for future research.

Project Proposals

Proposals are a very broad genre—they cover everything from project proposals to grant proposals. Sciences majors at NYU Shanghai, you will likely encounter the project proposal genre at some point. A project proposal is an argumentative piece of writing that seeks to establish your ability to plan and execute a research project. However, unlike an academic argument, where you use outside sources to support your argument, the research plan that you discuss in your proposal is your key piece of evidence. Below, you will find the typical moves in a proposal (Johnson-Sheehan, 2011):

- Introduction that orients the reader to the overall project and its general goals.
- Description of current knowledge and/or programmatic/department preparation to execute project.
- Description of the project plan in detail, which may include timetables, deliverables, staffing, equipment, etc.
    - Target solution.
    - Objectives of plan.
    - Methods proposed.
    - Deliverables and outcomes.
- Review of personnel qualifications and how they align to project needs.
- Discussion of costs and possible beneficial outcomes.
- Graphics that support the proposal content.
- Budget with appropriate break downs as required by proposal guidelines.

Keep in mind, that proposals are a highly flexible and localized genre. Always follow the guidelines of your institution/organization.

Abstracts

Abstracts are like the movie trailers of scientific writing. They are short—usually 1-2 paragraphs—provide an overview of the problem bring addressed in the research report, preview the methods you used in your examination, and preview findings. The abstract is the first thing that your reader will encounter, and they will often use it to decide if they want to keep reading your paper. Therefore, you should be sure that it acts as a hook to draw the reader into the paper. Always try to write the abstract last, as you should reverse engineer your paper to get to the abstract.

Annotated Bibliographies

Annotated bibliographies provide students with a highly flexible genre that allows them to organize the body of scientific literature that they are working with, as well as their initial reactions to and reflections on that material. Annotated bibliographies contain numerous entries, but each entry can be anywhere from a sentence to a page long. Most annotated bibliographies contain entries that have the following three parts, typically in this order.

- Full end-of-text references entry for the source.
- A short summary of the source's main points.
- A short response to/reflection on the source, which may be focused on how the source relates to your project or learning.

Poster Presentations

As a sciences major at NYU Shanghai, you will also likely encounter the poster presentation. This is often a tricky genre to work with. It's best to remember, first and foremost, the poster is a graphics-driven genre. Yes, it makes use of words, but at its heart it is consumed in much the way that an image is. This means that you must translate the pages of your research report into easily consumable chunks that provide enough information for the audience to understand your project, its importance, and its implications. Remember, you may be present to interact with the audience, but there may be times where you will not be able to talk with your audience. So, the poster must be able to stand alone.

If you're having trouble getting started with your poster, it may be best to begin by sketching it out. Once you have roughly laid out the different sections and graphics placements, you can begin thinking about content. In this regards, bullet points are preferable to blocks of text. Also, keep the introduction short and position it in the upper left hand corner. Place the conclusion in the lower right. This will visually frame the content of your poster, and will help guide the readers eye through the different parts of the poster at a glance.

Full Reports

Full scientific reports follow the IMRaD format and often seek to advance new methodological or theoretical approach to a topic, or they seek to confirm a hypothesis. That being said, Goldbort (2013) identifies a number of similarities between scientific reports and the kinds of academic writing that you may have done in your other classes (p. 108). They are: (1) bibliographic research as a starting point; (2) top-level organization (IMRaD); (3) modes of persuasion and exposition; (4) process- and product-oriented; (5) ethical imperative to avoid plagiarism. However, scientific reports depart from academic essays in that they must accurately and objectively report on (a) what was done during the course of the experimental intervention and (b) the results obtained from that experiment. The IMRaD section, above, provides a good introduction and overview to writing research reports.

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Appendix A: Science Writing Resources at NYU Shanghai

This appendix outlines resources available to you at NYU Shanghai that may be able to help you with your scientific writing tasks.

The ARC

The Academic Resource Center, or the ARC, is located in the fifth floor annex, room 519. The tutors in the ARC have received special training on working with scientific writing. The will not comment on the accuracy of the content, or on grammatical issues that do not impede meaning. They can and will, however, be happy to help you work on clarity of expression, adherence to genre expectations, and maintaining the proper tone for scientific writing assignments. Even if you haven't started writing, they'll be happy to work with you as you plan out your document.

NYU Shanghai Library

The NYU Shanghai Library, located on the Century Avenue side of the fourth floor, has access to resources on scientific writing. Some of these will be in the reference section, while others may be held in reserve. We encourage you to talk to a reference librarian so that they can connect you to the best resources for your individual needs.

Introduction to Scientific Writing Vidcasts

An *Introduction to Scientific Writing* vidcast series was developed as part of a partnership between the writing program and first-year science program. In this series, the presenters discuss the foundations of scientific writing by focusing on the linguistic and stylistic demands unique to this type of writing. The vidcast lectures can be access through the following URLs:

The *Introducing Scientific Writing* vidcast can be accessed here: http://bit.ly/SciWtgIntro

The *Organizing Scientific Writing* vidcast can be accessed here: http://bit.ly/OrgSciWtg

The *Scientific Writing Best Practices* vidcast can be accessed here: http://bit.ly/SciWtgBP

Annotated Sample Papers

As part of the collaboration between the writing and first-year sciences programs, two annotated sample papers have been compiled. These papers work with two major genres that you may encounter here at NYU Shanghai—the Lab Report and the Research Report. These documents have been carefully annotated to call out the major sections of each paper, relative to the IMRaD framework discussed above, and to share writing strategies for scientific writing.

The annotated lab report can be accessed through this URL:
https://drive.google.com/open?id=0Bzzk95HddlYSMEJzWGJYNVJ0Z2c

The annotated research report can be accessed through this URL:
https://drive.google.com/open?id=0Bzzk95HddlYSQkFpeEVtc3FUWmc

Appendix B: Web-based Scientific Writing Resources

Given how untamed the world-wide web is, we have decided to compile a list of vetted web-based resources that discuss scientific writing. In compiling this list, we sought sources that were reliable, well-maintained, and had a grounding in sound scientific and professional writing best-practice.

Table B1. Web Resources for Scientific Writing

Resource Name	Description	URL
Duke University Scientific Writing Resource	This web tutorial offers three mains lessons: Subjects/Actions, Cohesion/Emphasis, and Simplicity. The creator estimates that each lesson takes as little as 45 minutes	https://cgi.duke.edu/web/sciwriting/index.php
NYU Research Poster Presentation Resource	This web resource from NYU Washington Square discusses how to design an effective poster presentation. Consideration is given to the importance of visual rhetoric and design.	http://guides.nyu.edu/posters
ACS style guide	This web page includes basic instructions for how to properly format your papers to meet ACS standards.	https://www.library.wisc.edu/chemistry/research-help/write-and-cite/acs-style-guide/
AMA style guide	This web page includes basic instructions for how to properly write your papers to meet AMA standards of format and linguistic style.	https://owl.english.purdue.edu/owl/resource/1017/01/
AIP style guide	This web page includes basic instructions for how to properly write your papers to meet AIP standards of format and linguistic style.	http://web.mit.edu/me-ugoffice/communication/aip_style_4thed.pdf
APA style guide	This web page includes basic instructions for how to properly write your papers to meet APA standards of format and linguistic style.	https://owl.english.purdue.edu/owl/resource/560/01/
CBE style guide	This web page includes basic instructions for how to properly write your papers to meet CBE standards of format and linguistic style.	http://libguides.merrimack.edu/citing_sources/CBE
CSE style guide	This web page includes detailed instructions for how to properly format your papers to meet CSE standards, as well as how to make stylistic decisions to	http://www.scientificstyleandformat.org/Home.html

	facilitate ease of reading.	
Harvard style guide	This web page includes detailed instructions for how to properly format your papers to meet Harvard style standards, as well as how to make stylistic decisions to facilitate ease of reading.	http://guides.library.uwa.edu.au/friendly.php?s=harvard
NLM style guide	This web page includes detailed instructions for how to properly format your papers to meet NLM style standards, as well as how to make stylistic decisions to facilitate ease of reading.	http://guides.lib.monash.edu/c.php?g=219786&p=1453279
Vancouver style guide	This web page includes basic instructions for how to properly write your papers to meet Vancouver standards of format and linguistic style.	http://guides.lib.monash.edu/c.php?g=219786&p=1453285