

TRAITS OF SCIENTIFIC WRITING

Being able to write well is a real challenge, in part, because it is hard to explain exactly what “good” writing is. Good writing of any sort has some general characteristics, or traits, that make it good;

- it has a clear theme,
- there is background information defining the context of the theme, and
- there are illustrative examples supporting the theme and any conclusions.

Good *scientific* writing, however, often has another important trait.

- Scientific writing uses *quantitative data* and *graphics* to illustrate and support the paper’s theme.

Incorporating quantitative data in a paper is not easy because it requires very precise descriptions that are difficult to craft. Like anything else in life, however, you can become a better writer with practice, both by the act of writing itself and by reading examples of good writing.

The Traits of Good Writing

Part of the process in learning how to write is to understand and recognize the qualities or traits of a well written document. I have found that the traits described below have helped me to better articulate what constitutes good writing. I encourage you to begin using this type of language when analyzing material you read and write in order to train yourself to recognize good writing when you see it. Each trait is accompanied by a question that I use to guide me in evaluating the trait.

Focus: Are the main themes of the paper easily identified, well defined, and supported with evidence?

Focus is the main message in the paper. In other words, if someone asked you specifically what a paper was about, could you tell them what specific points were addressed? Although **Focus** is about the content or theme, it also includes the details that enrich and develop that message. For science writing, these details are often identified as being facts or data. The **Focus** of a paper is strongly supported when you explicitly connect data and information to the overall theme. This data and information can take the form of quantitative data, references to tables or graphs, or previously known facts (with proper citations). These details are used to support your **Focus**. This will require that you work on developing a precise language and clear explanations, because distracting or vague statements make your **Focus** hard to identify. As a student, the **Focus** of a paper is usually assigned to you (i.e. what the paper is supposed to be about). Therefore, a paper’s **Focus** must be in agreement with the writing assignment, which means that you must take the time to understand what is expected and seek clarification if you are uncertain what you are supposed to write about.

Organization: Is the evidence (that supports the focus) presented on an “as needed” basis and within the appropriate sections of the paper?

Organization is the flow of ideas that develop the overall focus of a paper. Scientific writing is persuasive writing based on logical conclusions drawn from evaluating information or data. As a result, it is necessary to present information in a logical progression, pausing along the way to point out the important points that convince your reader that your conclusions are accurate. A well organized paper begins with a clear introduction placing the work in a general context (or explaining why you are writing about a particular topic) and the supporting information is unveiled logically and at the right times so that the reader doesn’t lose interest. Transitions between informational points are based on their *conceptual* relationships. The piece closes with a sense of resolution, usually by summarizing the important points. **Organization** is weak when information is arbitrarily presented without it having a purpose or supporting the central idea (i.e. **Focus**). Don’t just tack on a graph at the end of the paper or load data into a table without discussing its importance or

relevance in the text. If the **Organization** is strong and the transitions are smooth, it feels like you know what the author is going to say before they say it.

There are several ways to organize your writing (comparison-contrast, deductive logic, point-by-point analysis, or chronological history), but the most conventional and easiest strategy in scientific writing is to start a paragraph with a single conceptual point and then support or illustrate that point using available information or data. It is possible to save the main point until the end of the paragraph, but this requires a great deal of skill to ensure smooth transitions between paragraphs and very complete development of the logic supporting the paragraph's main theme. If you feel overwhelmed by the task of organizing, try making an outline that shows the logical progression of information or create your figures and tables first and use them to organize your points that will develop the paper's **Focus**.

Voice: **Is the paper written fluently so it doesn't feel tedious to read?**

Voice is your style of writing. Usually **Voice** provides a sense of who you are and that you care about your message. When you are engaged personally with the topic, you impart an unmistakably personal tone to your work. A strong voice uses a variety of sentence structures to develop a fluent style that is free of awkward word patterns that slow the reader's progress. Sentences vary in length and style, and are so well crafted that the writer moves through the piece with ease. Fluent writing has cadence and rhythm to it that becomes very apparent when the work is read aloud.

Unfortunately, scientific writing tends to strip the personal voice out of the writing due to the use of very precise language or jargon. We justify this in part on the idea that scientific experiments demonstrate facts that are not supposed to depend on the observer, therefore, many writers believe that the personal voice should not be included in the writing. Nevertheless, there is a certain **Voice** to scientific writing, one that tends to be very precise and to the point.

A strong **Voice** in your scientific writing will use concise, declarative sentences. Compare, for example, the two sentences below and decide for yourself which has more power behind it.

Weak **Next, the copper solution was prepared by weighing out 0.1821 g of copper nitrate and dissolving it in 10mL of tap water.**

Strong **Then, 0.1821 g of copper nitrate was dissolved in 10mL of tap water.**

It is obvious from the second sentence that a copper solution is being prepared, so the extra phrases in the first sentence are not necessary. Do not underestimate the power of simple declarative sentences.

Strong **Voice** also depends on word choice. Good word choice clarifies and expands ideas with precise language moving the reader to a new understanding or point of view. Good word choice is not flowery language, technical jargon, or unexplained terms used to impress the reader. It is simply using everyday words precisely and appropriately. Here are two sentences that contrast the use of word choice.

Weak **Several things are discernible by these results.**

Strong **Several concepts are shown by these results.**

Substituting "concepts" for "things" clarifies what the subject of the sentence is. Words and phrases such as "thing", "a little", "easy", and "very accurately" have no definite meaning and have little use in scientific writing. Furthermore, even though the word "discernible" is a perfectly good word, is not one that is used much and looks like you whipped out the thesaurus to make the sentence sound more academic. Both of these sentences are weak, however, because they both use what is called "passive voice".

Passive voice is a sentence structure where the subject who performs the action is ambiguous; the purpose being to enhancing objectivity by taking the actor (i.e., the researcher) out of the action (i.e., the research). Unfortunately, the passive voice can also lead to awkward and confusing sentence structures and is generally more boring to read than the active voice. Passive voice is easy to spot; look for a form of "to be" (*is, are, am,*

was, were, has been, have been, had been, will be, will have been, being) usually followed by a verb ending in "-ed." Some exceptions to the "-ed" rule are words like "paid" and "driven." Here is the equation for identifying the passive voice:

form of "to be" + past participle = passive voice

A strong **Voice** avoids excessive use of the passive voice. Notice the difference in our last example if it is rewritten in the active voice.

Weak Several concepts are shown by these results.

Strong These results illustrate several concepts.

You can probably tell from the lengthy explanation regarding **Voice**, that it will probably be what you struggle with the most. It is a subtle and difficult thing to master. Keep in mind, however, that there is no one "best way" to write. Nevertheless, you need to develop your **Voice** to be an effective scientific writer, one that is precise and eloquently conveys the intricate relationships among the information presented.¹

Convention: Are the terms and ideas presented appropriately in a way that is easily understood and free of distracting grammar and spelling errors?

I use the term **Convention** to address two main issues in scientific writing—the use of scientific concepts and language, and the physical presentation of your work. The latter issue, physical presentation, is important because even if your ideas are revolutionary, they will not be read and accepted unless you can get people to read them. As we are all well aware of, packaging makes all the difference in consumer choices, and no one will read your work unless it is packaged (i.e. presented) well. This includes those pesky mechanical details that have been drummed into you since grade school—spelling, grammar, paragraphing, and punctuation. Punctuation is especially important for it helps to alter or fine tune the meaning of sentences. In my writing, I have found Strunk and White's *The Elements of Style* to be a very important reference book. It is a great resource for resolving common mechanics issues. It is well written, and it is very short.

Physical presentation of your work also includes the accepted formatting for presenting scientific information. This means that graphs, maps, and visual information need to be presented in a way that is accessible to your reader. Some points to keep in mind are...

- Figures, graphs, and tables must be titled and their features clearly labeled.
- Figures, graphs, and tables must be inserted in the same order they are presented in the text.
- Abbreviations or acronyms must be explained the first time they are used.
- Heading should be used to provide structure to your paper (if necessary).
- References must be cited and formatted consistently within a bibliography.

The other issue of **Convention** deals with the use of scientific terms or concepts. Science is as much vocabulary as it is conceptual, and to effectively communicate concepts, you must be able to use the vocabulary correctly. In some ways, this trait could be thought of as part of **Voice** (word choice); however, I am distinguishing between **Voice** and **Conventions** on the basis of the words being either "scientific" or used in everyday language. Below is an example.

¹ There is a very helpful website that discusses writing issues including characteristics that help develop Voice; <http://www.unc.edu/depts/wcweb/handouts/sciences.html> (accessed May'07).

Weak **When mixed in water, NaCl is broken up into its individual atoms.**

Strong **When dissolved in water, NaCl dissociates, or separates, into its individual ions.**

The revision of the first sentence corrects for the improper use of the term *atoms* (*ions* are charged atoms and exist as dissolved particles in solution). This is a *Convention*. The substitution of “*dissolved*” for “*mixed*” is more about *Voice* for it more of an issue about word choice to precisely describe what is happening. Also note that the second sentence defines “*dissociates*” as a separation providing clarity to the sentence.

Practice, Practice, Practice!

As with any skill, you don’t get good at writing unless you practice. This means, of course, that you have to go out and do more writing, but reading is also a form of writing practice. I was a bit surprised when I realized this, but I suppose I shouldn’t be since we learn how to speak by listening and how to behave by watching. So I encourage you to read a lot and train yourself to recognize the traits of good writing. As you begin to see these in other people’s work, it will become easier for you to see them in your own work and revise when needed.

I have included some student examples for you to examine in another document (Evaluating for the Traits) When you read these examples or any other piece of writing, take a couple of minutes and reflect on how the traits of good writing are used (or not used). I have found these traits have helped me to become more aware of writing and that is the first step toward improvement. Here is a summary of the traits and the corresponding questions to help define them.

Focus: **Are the main themes of the paper easily identified, well defined, and supported with evidence?**

Organization: **Is the evidence (that supports the focus) presented on an “as needed” basis and within the appropriate sections of the paper?**

Voice: **Is the paper written fluently so it doesn’t feel tedious to read?**

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