Notes on Writing a Paper:

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Clarity in Scientific Writing: (reprinted from "Writing Analytically" by D. Rosenwasser, J. Stephen and D. Babington, Thomson Nelson Publisher, 2006.)

Well-crafted scientific writing should be like an arrow, accelerating towards a target. The introduction should launch the arrow, and all the arguments should add momentum in the direction of the path. Clear objectives are essential to guide the course. As tempting as it is to make side remarks, your final work will achieve its goal more succinctly if you can keep to this vector picture.

Of course, all writing can benefit from a goal and a planned trajectory. However, scientific writing can differ from other forms in at least two structural ways.

Short paragraphs, each laying out one thought, are acceptable.

Secondly, the precision of scientific terms should be respected. Sometimes this will mean that the same terms must be used repeatedly to maintain the exact meaning. A thesaurus is rarely helpful in diversifying correct scientific terminology.

A logical plan for your arguments, combined with lean, precise language, can provide clarity in scientific writing.

- *Mary Anne White*

Further Comments

The following are some general comments concerning papers, not in any particular order.

Follow the directions given to you.

Organize Your Thoughts:

- It's useful to write an outline prior to writing, using headings and subheadings to organize your thoughts.
- Use subheadings if the format allows.
- Express one thought per paragraph.

Level of Treatment:

- Should be appropriate to the course level.

Figures:

- If you use figures re-drawn from a source, identify the source. (And you must re-draw figures yourself or have else have the copyright holder's permission. [In the former case, indicate, for example: "Styled after ref. 2". In the latter case, indicate, for example, "From ref. 2 with permission.")

Symbols:

- Define every symbol used in every equation (except those was previously defined in your text). Equations should be punctuated as prose. An example follows:

  The force, F, is given by:

  $$F = m\,a$$

  where m is the mass and a is the acceleration.

- Take care of the symbols in your equations, and use them consistently. For example, some sources use κ for thermal conductivity, while others use λ. If there is more than one

common symbol used for something you wish to describe, decide which you are going to use and then use that consistently.

Format:

- A paper should not use the first person, *i.e.,* there should be no sentences that begin, "In surveying the literature, I found...". Scientific writing is more impersonal, *e.g.,* the above could be phrased, "A survey of the literature revealed that...".

- Indent paragraphs. (It makes it easier to read.)

- Be consistent in your format – e.g. if subsection titles are in capitals, then that should be the case for all subsection titles.

- If you refer to work by J. Smith, and then you later with to refer back to it with "He showed...", be sure that you know that J. Smith is a "he"! (Either look up the first name of J. Smith, or else re-phrase it to gender-neutral language.)

- Know the correct use of "its" and "it's". "Its" refers to possession by "it"; it is the exception to the rule of putting an apostrophe to show possession. "It's" is a contraction for "it is". Here is a sentence with correct usage: *"It's soon going to show its age."*

- When you use Latin words or Latin abbreviations, such as *N.B., vs., e.g., i.e., etc.,* these should either be *italicized* or <u>underlined</u>.

- In formal scientific writing, such as this paper, one should not use contractions. That is, use "cannot", not "can't", *etc.*

- In formal writing, whole numbers less than ten are written out as words, and numbers ten and over are expressed in numeric form. Data are an exception; data numbers are always expressed numerically: for example, "Mary had three little lambs and they grazed on 27 different fields, eating an average of 2.5 kg of grass each, per day."

- When a noun has a compound adjective, that compound adjective should be hyphenated, unless the modifying part ends in "ly" in, which case the modifier is itself an adverb, and there is no hyphen. For example use the term "low-temperature thermometer" but there is no hyphen in "strongly coupled conductor". The reason for the hyphen is to clarify the meaning. For example, consider the following sign in a candy store window, and the possible meanings shown by different hyphenations:

As it read: dietetic sugar free candy

Does this mean: dietetic-sugar free candy (*i.e.,* candy with dietetic sugar, and free of cost), OR

dietetic sugar-free candy (*i.e.,* candy that is free of sugar, useful for dietetic purposes)?

Without any hyphens the sign is ambiguous (although in this case the meaning is probably obvious).

- The font for a quantity must be the same in the text and in the equation, *e.g.* when you have the equation:

$$d\varepsilon/dt = A \qquad (1)$$

then use ε and not ϵ in the text.

- The paper should be in sentence form throughout. Point form is not acceptable in formal scientific writing.

- One of the most common grammatical errors is mismatch of plurality of subject and verb. Check carefully to make sure that they are both singular, or both plural. One thing to watch is that the word "data" is plural, as in, "The data show good correlation." The singular word is "datum", but it is rarely used.

- All units must be SI. If you acquire data in British units (which are very common in American general literature, and also in engineering sources), convert them to SI units.

- Standard typing practise is to leave one or two spaces after a period or colon, none before a comma or semicolon, none after "(" or before ")", and one after a comma or semicolon. There should always be a space between a number and its units, *e.g.* 10.1 J, and between multiple parts of units, *e.g.* 32.7 J mol^{-1}.

- *i.e*. stands for "that is"; *e.g*. stands for "for example".

- Refer to each figure and table in the body (text) of your paper.

- Write very large or very small numbers using scientific notation, such as 1.3×10^{3} or $1.1477835 \times 10^{-12}$, (not 1.3E3 or 1.1477835E-12).

- Use appropriate symbols, *e.g.* π, not pi.
- Element names in a sentence should are not be capitalized (e.g. The carbon atom…).
- Keep each figure and its caption together on the same page.

References:

- Distinguish clearly between your References and your Bibliography. (References refer to specific points; bibliography [not essential] is your background reading.)
- The references should all be cited in order. For example, the first one cited in the text is [1], then [2], *etc*. In the reference section they should be listed in the same order. If you reference the same source as [1] later in the paper, use [1] to number the reference at the second (and subsequent) citations. In other words, each number of the reference list should be to a unique source. WORD can do this automatically using Endnotes and cross-referencing.
- Give all authors on all papers in the reference section (*i.e*., do not use "*et al*.")

Equations:

- Each equation in your paper, whether referred to later in the text or not, should be numbered. Although you may not refer to the equation later, a reader might. Furthermore, if you do refer to the equation later, it is very handy to be able to write something like "Differentiation of equation (4) with respect to temperature leads to ....".
- Equations, like all parts of prose, should be punctuated. Two examples follow.

(a) The best way to describe the relationship between force (F), mass (m) and acceleration (a) is given by:

$$F = m\,a. \qquad (2)$$

(b) In the case of adherence to Ohm's Law, the voltage, V, is given by:

$$V = i\,R, \qquad (3)$$

where i is current and R is resistance.

In case (a), the sentence ends with the equation, so a period is needed at the end of the equation. In case (b), the punctuation sets off the equation as part of the text.

- When an equation written as:

$$A = B/CD, \qquad (4)$$

it is ambiguous. Either write:

$$A = B/(CD)$$

OR $$A = (B/C)D,$$

depending on which one you mean.

- Define all symbols for all equations (unless they have been defined earlier in your paper); include definitions in sentence form (see examples (a) and (b) above). Do not give a list of parameters in point form; use sentences.

- If a specific equation comes from a particular source, reference it as follows:

"The relationship between wavelength, λ, and energy, E, is given by [3]:

$$E = hc/\lambda \qquad (4)$$

where h is Planck's constant and c is the speed of light."

In this example, [3] is the reference cited and (4) is the equation number.