

# *Writing about Physics (and other Sciences)*

Written by Kenneth Meiklejohn, Institute for the History and Philosophy of Science and Technology, and Margaret Procter, Writing Support, The University of Toronto

<http://www.writing.utoronto.ca/advice/specific-types-of-writing/physics>

## **Advice and Explanation of Checklist**

### **1. Know where you're aiming**

When you're being marked on your writing, it's only wise to read your assignment sheet carefully. Assignments in your physics courses may surprise you. Notice what kind of reasoning they ask you to exercise (description, analysis, argument, speculation?), what reading and listening you're expected to do (from *Newsweek* or from *Physical Review*?), and what readers you're writing for (your fellow-students in or outside the class, non-specialists interested in science, experts who know more than you do about their specific area?). You can also ask your course TAs to check your interpretations. See this webfile on [Understanding your Essay Topic](#) for further advice.

### **2. Getting started: have a point and make it clear**

Think of your writing as a way of asking and answering questions about your course topic -- or at least exploring them, since few questions in such fields as quantum physics or evolutionary biology have clear black-and-white answers. Start by considering what question underlies the given (or chosen) topic. Write it out to guide your own thinking. Change the wording if necessary to clarify your thinking. Then try out various ways of answering that question, doing as much reading, calculation, and thinking as you can for each type of piece.

Now write up an account of your thinking. Start by defining the question you've chosen to look at. Then indicate the best way you found to answer it. Both those things make up the point of your piece (not just the question, not just the answer). You will probably have a hypothesis (a tentative answer, needing to be tested and argued) rather than a thesis (a point to be proved). See this web file on when and how to use a [thesis statement](#).

Use your title to capture the essence of your ideas. It can be interesting as well as precise, even for an academic piece. A title may be a phrase (e.g., "Deepening the Quantum Mysteries," "Three Proposed Quantum Erasers") or a full sentence—often a question. It may include an explanatory subtitle (e.g., "When Can Light Go Faster Than Light? The Single-Photon Tunneling Time and its Measurement via Quantum Interference").

### **3. Create a logical structure**

Structure the piece to outline a clear path for the reader to follow in exploring the question with you—you don't have to tell us about all the wrong turns you took. Know what your objective is: do you simply want to communicate some claim, or are you trying to convince your reader of a particular position? Avoid simple formulas (e.g. the five-paragraph essay) that may not do justice to the intricacies of your explanation or argument; allow the logic of your objective to dictate structure.

You can use some creativity to find the best order for your ideas. Just make sure that your readers know where you're going and that they can follow you along. You may find a point-form outline useful for planning. Creating one from an existing draft (listing one point per paragraph) is a good way to check whether your ideas flow logically from one another and form a coherent whole. Then you can look back at your prose and see whether each successive idea follows smoothly and directly from the preceding one. Check also that the introduction and conclusion match each other and what you said in the body of the piece. (See of this guide for suggestions on paragraph development.)

#### 4. Explain your ideas

Some of your assignments may ask you to write for your fellow-students or for a popular readership; others may ask you to write for professors and experts in the field. Be sure you know where you're aiming. Don't write just to display your knowledge—work at sharing it. Consider these issues:

- What facts or evidence are essential to make my point? How can I work these into the explanations without weighing down the piece for my intended audience?
- How much does the reader know, and what should I explain? (c.g. terminology, mathematical formulas, historical references)
- Have I been balanced and fair? Have I acknowledged the strengths of opposing positions, and yet confidently and firmly presented my own?
- Am I satisfied with my presentation, and have I drawn confidently on my own insights? Has this writing exercise helped me to think clearly about the issues?

#### 5. Read, listen, and write critically

To do justice to your complex subject, don't just borrow ideas from sources and stitch them together. Of course, like any scientist, you will build in what other people have thought. But show that you are doing your own thinking—seek out opportunities to comment on your sources. (Read about further strategies for critical reading and writing.)

- Read your sources with attention to context, looking for the author's intentions and type of argument. Make notes that reflect your analysis, not just the content of the piece.
- Tell your reader *why* you are convinced by an argument, and show why you may resist some aspects or implications.
- Compare any one reading to other ideas on the same topic, and show how they are related to each other as sources, extensions, or disagreements.

In the sciences, you should quote very seldom, but it's still worthwhile to mention names and give your reader the sense of being part of the conversation with leaders in the field. (See the U of T file on How Not to Plagiarize on ways to integrate your sources into your own prose.) In formal academic pieces such as research articles or reports, use a standard and consistent method for acknowledging your sources. (See another U of T webfile on Standard Documentation Formats for ways of handling that.) For less formal pieces, you may not need to be so precise about giving details like page numbers, though you'll still gain by name-dropping. Ask your instructor or TA if you need to give formal references for the short assignments in this course.

#### 6. Be focussed and coherent

Any written piece earns readers' respect and attention by maintaining focus on a central point, stating it clearly and then offering explanations and support. In science writing, there's a special satisfaction in being able to follow through a sequence of reasoning where all the ideas, sentences, and details fit together clearly.

To make that possible in your work for this course, divide even the short assignments into paragraphs that lead your readers through your ideas step by step. Use each to show where you are in exploring your question. It's advisable to start most paragraphs in the body of the paper with a topic sentence relating back to your overall point. These sentences serve as guideposts along the path. For more advice, see the web file Developing Coherent Paragraphs.

To create the kind of coherence and "flow" you need, follow these maxims:

- Stick to your message, topic, or idea consistently throughout the piece; don't waste space with irrelevancies

- Make every paragraph count: pace and sequence your information or argument to guide the reader right through to the end
- Develop smooth transitions within and between paragraphs
- Maintain a writing style and voice that is appropriate for your audience. (See the section, below, on Differences Between Formal and Informal Style.)

## 7. Be clear

Since the subject matter in science courses is often complex, make your style as simple as possible so as not to create further challenges for yourself and your reader. Here are some basic principles for clear scientific style.

### a. Use the simplest words that will carry your meaning

Fight the tendency to impress your readers with your vocabulary. The subject is already impressive enough. Keep your words simple and ordinary for the sake of communication—and also to keep your own head clear. Of course you will use technical or mathematical terms as shortcuts when writing to people at the same or higher level of expertise. But if there's any chance your readers won't know such terms, offer a definition nearby. There are many ways to work definitions into sentences:

- The step height  $W$  is called the *work function* of the metal and is typically a few electron-volts.
- The photoelectric effect (the ejection of electrons from a clean metal surface when light falls on it) provides strong evidence for the existence of photons.
- Probabilities are the odds that something is going to happen, or that it is not going to happen.

Remember that scientists (including the busy instructors and TAs who will be grading your pieces) have no patience for unnecessary words. Use analogies and colourful phrases to express your own interest in the subject, but don't rely on them to cover up weak reasoning. Clichés (overused metaphorical phrases) are especially annoying when you're asking the reader to work hard at a difficult subject. You will need some qualifiers such as "in this case" or "for the most part," but overuse makes you seem nervous. Avoid passive voice when possible too: it's often wordy and roundabout. The following pairs of examples (one from a scholarly abstract, the other from a magazine article) show the benefits of clear concise style. (For a review of ways to achieve conciseness, see the U of T webfile Wordiness: Ways to Avoid It).

- **NO** It is our desire at the present moment to construct an experimental process, with all the means at our disposal considering the complexity of the wild and wonderful world of atoms, that will demonstrate to the world at large (upon its conclusion in due time) some of the very fascinating ways that certain atoms manage to tunnel themselves through what might be considered a barrier.
- **YES** We are in the process of building an experiment to study the tunneling of laser-cooled Rubidium atoms through an optical barrier.
- **NO** A number of tests have been carried out by the various people collaborating in this project, all of which have dealt with some of the more puzzling, arcane, and paradoxical predictions made by quantum theory. Among the more dramatic ones is the one that is called, in a rather amusing phrase, the "quantum eraser."
- **YES** The team has carried out several tests of the stranger predictions of quantum theory. The most dramatic is what they call the "quantum eraser."

### b. Use short complete sentences

Keep your focus on one idea at a time, and make sure each point is complete and clear. Then you can choose to link your ideas logically, not by accident. You and your readers will be

grateful to read more short sentences than long ones: that goes for both your popular writing and your more formal pieces. Note how often your readings use short emphatic sentences, even for complex and open-ended ideas.

- Quantum Physics is the most successful theory for answering these questions. It has no competition.
- In other words, electrical charge is "quantized." It comes in chunks. In the case of electrical charge, all of the chunks are of the same size. Why this is so is one of THE unanswered questions in physics.

c. **Match subject and verb**

The core of your sentence consists of a definite subject and a distinct verb. One thing to watch for in proofreading your work is that the subjects and verbs match (both singular or both plural). Keeping them close together helps.

- [*wrong*] The **time** they spent during the past ten years of experiments with lasers **were** wasted.
- [*right*] The **time** they spent during the past ten years of experiments with lasers **was** wasted.
- [*right, more concise*] **Ten years** of experimentation with lasers **were** wasted.

**NOTE:** *Data* is officially a plural noun (the singular is *datum*, but nobody ever uses it). You'll keep out of trouble with the grammar police if you say "the data are," not "the data is." By the way, the plural of *quantum* is *quanta*.

**NOTE:** If English isn't your first language, you may find that you have trouble putting the final s in the right places. Check through your work for that detail so your reader doesn't have to keep filling it in. In short pieces, you may be able to go rapidly through each sentence looking at the subject-verb match. For longer pieces, check at least the first and final paragraphs. Try reading your piece out loud: if you hear yourself saying a final -s, check that it's written down.

- [*errors*] In real system the potential energy is always a measure of the interaction between particle.
- [*no errors*] In real systems the potential energy is always a measure of the interaction between particles.

d. **Structure long sentences carefully**

Of course you will often need longer sentences to reflect the complexity of your material. Set them up so readers can see where you're taking them. To avoid seeming lost in your own sentences, avoid the dread "**run-on sentence**" (sometimes called "comma splice"), where ideas are jammed together without any logical link. Another giveaway of confused thinking is the **sentence fragment** or incomplete sentence. It's not length but structure that causes these typical problems:

- [*run-on / comma splice*] Quantum mechanics does not predict specific events, it does predict probabilities.
- [*run-on / comma splice*] With this algorithm we need only five steps to obtain the desired result, with the other one, we need at least twenty.
- [*fragment*] Quantum mechanics, for all its ability to get into the world of the atom and beyond the overly-rigid rules of classical physics, which are no longer adequate for the wonderful world of today.

Here are some ways to structure your sentences to show different logical relationships and emphasis. Note how the specific punctuation confirms the intended logic:

- iv. Separate sentences with a *period* (to sound decisive), *adash* (energetic), or a *semicolon* (balanced, formal).
  - Quantum mechanics does not predict specific events. **It** does predict probabilities.
  - Quantum mechanics does not predict specific events -- it does predict probabilities.
  - Quantum mechanics does not predict specific events; **it** does predict probabilities.
- v. Join sentences with the simple conjunctions *and*, *but*, and *or* to show strong basic relationships, usually with a comma between (or occasionally a period for a dramatic effect).
  - The Great Machine runs **blindly on**, **and** all things in it are mere cogs.
  - Choose the method with five steps, **or** be ready to spend three more hours doing the problem.
  - We need to provide a mathematical proof in each instance. **But** what is a proof?
  - Absolute time, wrote Newton, "flows equably . . .," **but** he was wrong.
  - Quantum mechanics does not predict specific events, **but** it does predict probabilities.
- vi. You can occasionally insert one of the weaker linking words (such as *however*, *thus*, *therefore*, *on the other hand*, and *accordingly*) for a subtle effect of contrast or qualification. These cannot join sentences by themselves. A period, dash, or semicolon is still needed. Note the different positions available for the linking word.
  - Quantum mechanics does not predict specific events. **However**, it does predict probabilities.
  - Quantum mechanics does not predict specific events; **however**, it does predict probabilities.
  - Quantum mechanics does not predict specific events. It does, **however**, predict probabilities.
- vii. Join sentences with a subordinating conjunction (such as *when*, *where*, *because*, *if*, and *whether*) to signal a specific logical relationship. Usually the conjunction comes at the start of the first sentence.
  - **Because** the second algorithm requires twenty steps, we chose to use the other one.
  - **If** we picture a moving particle, it is very difficult to imagine not being able to measure both its position and momentum.
  - **Since** we cannot determine both the position and momentum of subatomic particles, we cannot predict much about them.
  - **Although** quantum mechanics does not predict specific events, it does predict probabilities.

## 8. Check your work for mechanical flaws

Readers who come looking for interesting ideas have little tolerance for distracting detail errors that you could have fixed with a bit more care. Develop a system for checking through your work for correctness and consistency.

- Print it out at least once so you see it on paper.
- Don't trust your grammar-checker, except for amusement. The only thing it might help you with is recognizing passive voice: it gets that one right about two-thirds of the time, but it still can't tell you how to mend the problem.
- Do use your spell-checker, though, as the final step before printing. But you have to be the one to decide whether to accept its suggestions. Don't let your key words get changed just because the spell checker hasn't taken Quantum Physics.
- Flaws in punctuation may be a little more forgivable, but not when they interfere with the reader's understanding or spoil the emphasis you've carefully built up with sentence structure.

Seek out advice on punctuation from a handbook or website, and use it to become familiar with the standard patterns.

Here are some **pitfalls** to avoid in any writing, especially when you're trying to play the role of guide or expert:

- confusion of *it's* (contraction for *it is*) and *its* (belonging to it), *they're* (contraction for *they are*) and *their* (belonging to them), *you're* (contraction for *you are*) and *your* (belonging to you)
- use of *you* to mean "people in general" ("You shouldn't trust classical physics.")
- random use of semicolons (see above on their structural function)
- overuse of exclamation marks, font style, bold, italics, capitals, etc. in an attempt to achieve emphasis

Stay out of trouble too by following the standard format for any manuscript:

- 12-point font, 1-inch margins, double spacing
- numbered pages after the first
- *either* indentation of the first line of paragraphs *or* extra spacing between paragraphs.

### **A Note on the Differences between Formal and Informal Style**

You'll use both types of style in this course for different assignments, and you'll certainly use both types of writing in the future. Here's a review of specific differences. Use it to keep your style consistent in any one piece, and to make even your academic writing as interesting as possible without losing too much dignity.

**ACADEMIC:** Spell out words, use technical terms as needed, offering at least a running definition when you introduce them

**POPULAR:** Use contractions like "don't," keep technical terms to a minimum and make a production of explaining them on first use

**ACADEMIC:** Avoid using "I," but use "we" in explaining technical matters; rarely mention any specific people by name except famous experts

**POPULAR:** use any pronoun except "you" to indicate "people in general"; refer to many specific people by name, including current scientists working on your topic

**ACADEMIC:** Emphasize abstractions such as theories, concepts, and mathematical formulations; label any diagrams or charts

**POPULAR:** Give plenty of examples; use simplified diagrams

**ACADEMIC:** Use passive voice ("it has been demonstrated") when you need to indicate that any scientist could achieve the same experimental results and any thinker could follow the same reasoning pattern; but also use active voice frequently to make your account more dynamic and personal ("Steinberg used optical barriers to show that...")

**POPULAR:** Avoid passive voice and focus on people and what they did; use narrative form to explain scientific experimentation

**ACADEMIC:** State your points succinctly and confidently; make clear assertions and argue them cogently, offering firm support and rebutting opposing points

**POPULAR:** Acknowledge the difficulty of the subject, show empathy with the reader's likely confusion; give plenty of explanations and examples; note controversies and suggest that they're exciting.

## ACADEMIC VOCABULARY

### 1. Neutral vs academic

In writing, academics use rather formal expressions uncommon in everyday language.

NEUTRAL	FORMAL	NEUTRAL	FORMAL
in short, briefly	in sum, to sum up	only	solely
basically	essentially	mainly, mostly	primarily
almost, more or less	virtually	by	attempt

### 2. Nouns referring to ideas and phenomena

(environmental) issues, (Darwin's) theory, the model of how elements relate to each other, the nature of (intelligence), the principle (of least effort), the pattern (of results), a feature (of the new SW), beyond the scope of (this essay), perspectives/views on research into (new) approach to

### 3. Verbs for structuring academic problems

discuss (a problem), investigate (attitudes), illustrate (a point), conduct (a set of experiments), consider (advantages and disadvantages), analyse (recent events), demonstrate (the ability), identify (constants and variables), support or challenge (a statement), examine (the situation), provide (statistical evidence), include (a discussion), offer (growth), develop (methods), establish (the quality of), account for (the decrease), present (data), approach (a problem), describe (the situation), explore (the relationship between), emphasize (the importance of training)

### 4. Adjectives

A-+prepositions: relative, relevant, specific, common, appropriate to, characteristic, typical of  
 A-+opposites: abstract (problem) & concrete (examples), simple (issue) & complex (circumstances), accurate (picture) & inaccurate (assessments), rough (estimate) & precise (calculations), specific (problem) & general (terms)  
 A-combinations with nouns: apparent (discrepancy), potential (problem), principal (cause), rigorous (methodology)

### 5. Adverbs

comparatively/relatively, especially/particularly, primarily, mostly/largely, directly/indirectly, somewhat/considerably, essentially, approximately-precisely, rarely-frequently, eventually (in the end, after some time), ultimately (finally), after other steps have been completed, generally-specifically, merely, hardly ever, simply (plainly, easily or absolutely, undoubtedly)

### 6. Phrasal verbs

often have one-word synonyms, which are usually of Latin origin and are more formal than their phrasal verb equivalents but both are appropriate when writing or speaking about academic subjects. Vary your language by using both.

PHRASAL VERB	SYNONYM	PHRASAL VERB	SYNONYM
put forward (a theory)	present, propose	point up	highlight
carry out (research)	conduct	set out (to do sth)	list
make up	constitute	set out	describe
be made up of	consist of	go into	discuss
point out	observe	go against	not be in agreement with

### 7. Nouns and the words they combine with

#### N, + adjectives

contact - useful, valuable, personal, constant, close, frequent, intermittent  
 debate - considerable, heated, intense, public, animated  
 elements - crucial, decisive, fundamental, conflicting, consistent  
 phenomenon - common, isolated, general, recent, universal  
 results - conflicting, inconclusive, unforeseen, preliminary, encouraging  
 role - decisive, challenging, influential, key, major  
 sample - random, representative  
 in... terms - absolute, relative, general, practical  
 way - alternative, efficient, practical, convenient, proper, acceptable

#### N, + verbs

contact - come into c. with, establish, maintain, break off, lose  
 debate - engage in, contribute to, d. surrounding an issue  
 elements - combine, differentiate, discern  
 phenomena - observe, investigate, explain  
 results - collect, question, invalidate, falsify, publish  
 role - define, strengthen, play, take on  
 sample - take, provide, analyse  
 way - discover, devise, work out, develop

### 8. Adjectives + nouns

Adjectives of importance + nouns  
 important - aspect, contribution, difference, implications, point, question, reason, element  
 significant - increase, reduction, number, proportion  
 major/minor - role, changes, problem, factor, issue, concern, difference, theme, contribution, point  
 enormous/considerable - amount, expansion, number, range, diversity, difference, variation, extent, degree, impact, power, influence, significance, interest  
 particular - interest, attention, significance, importance, concern

#### Adjectives of frequency + nouns

Frequent - belief, acceptance, support, opposition, assumption, use.  
 Common (frequent) - experience, practice, use, concern (shared) - knowledge, ground, feature, interest  
 Specific - context, information, case, type, form, purpose, characteristics, conditions, example

#### Other adjective + noun combinations

inflexible combines with words relating to results or changes - consequence, outcome, collapse, decline, conflict, effect, developments  
 explicit combines with words relating to how things are presented - reference, statements, comparison, account, mention  
 Relevant combines with words relating to evidence - data, documents, information, details, factors

### 9. Verbs + nouns + adverbs

Verb	Noun	Adverbs
to be based on	research, theory, story,	mainly, partly, loosely
to associate with	word, idea, theorem, term	generally, commonly, invariably

<i>to discuss</i>	idea, problem, issue, question, topic, theme	at length, briefly, thoroughly
<i>to establish</i>	relationship, connection	firmly, clearly, conclusively
<i>to examine</i>	facts, evidence, effects, aspects	briefly, critically, thoroughly
<i>to demonstrate</i>	existence, need, effects, importance	clearly, convincingly
<i>to identify</i>	causes, factors, issues, properties, needs, approach, origin	clearly, correctly, closely

#### 10. Prepositional phrases

**IN** conjunction, in comparison, in line with; in general, in particular, in addition to, in spite of, in terms of, in some ways, in turn, in most respects;  
**ON** the whole, on the one hand ... on the other hand; on the basis of, on behalf of with the exception of; as a result (of), at this point/stage; for the most part

#### 11. Verbs + prepositions

to draw, comment, concentrate, focus, rely/rest on  
to be exposed, attributed, traced, to amount, attend (deal with, give one's attention) to  
to associate, provide, couple, equip with  
to depart, benefit, exclude from  
to write, speak of (rather formal), convince, dispose of  
to account search, call argue for

#### 12. Nouns + prepositions

book, article, essay, lecture, project, assignment about, on  
research, investigation, insight, inquiry into  
analysis, examination, exploration, study, issue of  
problem, difficulty of, with  
reason, motivation, rationale for  
look, attempt at  
changes, differences, increase, decrease in  
influence, emphasis, effect on  
basis, idea, lack, means of  
reason, need, basis, case, preference for  
relation, approach, response, attention to  
attitude, tendency, move, progress towards  
principle, assumptions, rationale, logic behind  
relationship, difference, distinction between

#### 13. Referring to source materials

The... literature suggests that, the ... draws its data from/draws primarily on, several secondary sources were also consulted, ... proved a valuable resource, I also surveyed the literature on. I directly/indirectly cite those works which, an extensive body of literature exists on, as noted, is often attributed to, .... Is dealt with in, ... it treated separately from the main body of...

**! A void plagiarism, i.e., using other people's work while pretending it is your own, without clearly acknowledging the source of the information.**

#### 14. Degrees of certainty

##### Being tentative

There is some evidence that..., it can be argued that..., it may not be the case that... it would seem/appear that..., we can presume that..., there seems/appears to be some evidence that..., we can draw the tentative conclusion that...

##### It is true or almost true

It is undoubtedly true that..., it is, of course..., it is evident that..., the research will probably lead to..., there is a tendency for..., there is every likelihood that...

##### The writer is unsure

... has allegedly come to some... conclusions, ... is reportedly...

#### 15. Criticism of reference to an author

... asserts/claims/believes that, in his/her view, ... touches on, ... calls for,  
... underestimates/overestimates, ignores, ... is not persuasive, ... does not ring true, worse, the evidence is ... at best

#### 16. Organizing your writing

Working through a list of different things – firstly, secondly, thirdly, next, lastly/finally  
Changing topic/bringing in new points / we now/let us (now) turn to  
Referring forward – below, in the next section, later,  
Referring back – above, in the preceding section, earlier, as we have seen  
Referring to examples, diagrams, pages / as can be seen, see, for example

Source: McCarthy, Michael, O'Dell, Felicity. *Academic Vocabulary in Use*. Cambridge: Cambridge University Press, 2008



**WORDINESS: DANGER SIGNALS and Ways to React**

One of the most efficient ways to improve your writing is to edit it for conciseness. You may have been struggling to think ideas through as you wrote—and piled up alternative wordings. Or you may have fallen into the habit of using more words than necessary just to use up space. If you can let your original draft "cool down" a while, you will find it easier to recognize unnecessary words and edit them out. Your reader will thank you! Here are some common patterns of wordiness, with sensible things to do about them.

**Doubling of Words (INSTEAD, choose one):**

- e.g. mutual agreement (*agreement*)      future prospects (*prospects*)
- consensus of opinion (*consensus*)      reconsider again (*reconsider*)
- whether or not (*whether*)      inadvertent error (*error*)

**Intensifiers, Qualifiers (INSTEAD, omit or give specific details):**

- e.g. very      really
- extremely      definitely
- a considerable amount of      to a certain extent

**Formulaic Phrases (INSTEAD, use a one-word form or omit):**

- e.g. for the purpose of (*to*)      due to the fact that (*because*)
- at this point in time (*now*)      in the near future (*soon*)
- with regard to (*about*)      in view of the fact that (*because*)
- as the case may be (*—*)      Basically, . . . (*—*)

**Catch-all Terms (INSTEAD, omit wherever possible):**

e.g.	aspect	field	quality
	case	kind	situation
	fact	manner	sort
	factor	nature	thing
	feature	problem	type

**WEAK** A surprising aspect of most labour negotiations is their friendly-quality.

**IMPROVED** Most labour negotiations are surprisingly friendly.

**WEAK** The fact of the war had the effect of causing many changes.

**IMPROVED** The war caused many changes. Specifically . . .

**Padded Verbs (INSTEAD, use a one-word form):**

- e.g. to have an expectation, hope, wish, understanding, etc. (*to expect, hope, wish, understand, etc.*)
- to make an arrangement, plan, decision, inquiry, acquisition, etc. (*to arrange, plan, decide, inquire, acquire, etc.*)

**Unnecessary "to be" and "being" (INSTEAD, omit):**

**WEAK** The program is considered to be effective.

**IMPROVED** The book is considered effective OR The program is effective.

**WEAK** because of the terrain being rough

**IMPROVED** because of the rough terrain

**Passive Verbs (INSTEAD, use active voice, preferably with a personal subject):**

**WEAK** It is felt that an exercise program should be attempted by this patient before any surgery is performed.

**IMPROVED** The patient should attempt an exercise program before surgery.

**WEAK** I recommend that the patient attempt an exercise program before surgery.

**IMPROVED** Mr. Lee, please do these exercises every day for six weeks to strengthen your leg muscles before we try any more surgery.

**WEAK** The beveling jig is said by most users to be faulty.

**IMPROVED** Most users say the beveling jig is faulty.

**Overuse of Relative Structures ("Who," "Which," "That") (INSTEAD, omit):**

**WEAK** The novel, which is entitled *Ulysses*, takes place . . .

**IMPROVED** The novel *Ulysses* takes place . . .

**WEAK** It was Confucius who said . . .

**IMPROVED** Confucius said . . .

**WEAK** I think that X is the case. . .

**IMPROVED** X is the case, as this evidence shows. . .

**WEAK** There is a tendency among many writers who may be seen to display certain signs of lack of confidence that their sentences will be overloaded with relative clauses and other words which are generally useless in function.

**IMPROVED** Many hesitant writers overload their sentences with relative clauses and other useless words.

Prepared by Dr. Margaret Procter, University of Toronto Coordinator, Writing Support  
Over 30 other files giving advice on university writing are available at [www.writing.utoronto.ca](http://www.writing.utoronto.ca)

## THE LAB REPORT

The laboratory report is an important form of writing for scientists as it provides a record of experiments completed. Depending on the type of task or investigation you carry out, the sections of the written piece may vary, but a lab report or project report will usually have a title page, abstract, introduction and methods, results, discussion sections, a conclusion and references section.

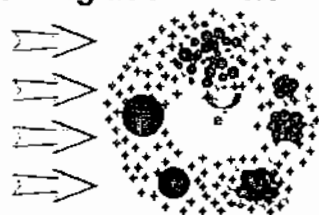
Section	Description
Title page + ID details	<ul style="list-style-type: none"> <li>• displays your name and student ID number</li> <li>• the title gives a precise description of what is in the report (this may be supplied by the lecturer).</li> </ul>
Abstract	<ul style="list-style-type: none"> <li>• placed at the beginning of the report</li> <li>• provides a summary of the entire paper (about 5% of the whole text) including:               <ul style="list-style-type: none"> <li>○ the problem and its importance</li> <li>○ what was done (the experiment)</li> <li>○ how it was done (the method)</li> <li>○ what resulted (the most important results)</li> <li>○ what this research contributes to the field (significance)</li> </ul> </li> </ul> <p>NB: The abstract does not include figures or tables.</p>
Introduction	<ul style="list-style-type: none"> <li>• gives the background or scope of study</li> <li>• includes background information so that the reader               <ol style="list-style-type: none"> <li>1. understands the question behind the research</li> <li>2. how it relates to other work in the field, and</li> <li>3. why it is worth investigating.</li> </ol> </li> </ul>
Methods	<ul style="list-style-type: none"> <li>• describes the methods and procedures used</li> <li>• clearly explains the methodology so that it could be replicated (repeated) by another researcher.</li> </ul>
Results	<ul style="list-style-type: none"> <li>• presents the results of the experiment</li> <li>• uses an equation editor with correct mathematical symbols if the results involve numbers and equations</li> <li>• includes clearly labelled figures, tables and graphs where appropriate.</li> </ul>
Discussion	<ul style="list-style-type: none"> <li>• analyses and interprets the results, showing how these relate to the scope of study</li> <li>• states conclusions about how the results confirm, verify, or support the hypothesis, or refute, negate, or contradict it.</li> </ul> <p>NB: The word "prove" is not used except in very specific contexts (eg in mathematics).</p>
Conclusion	<ul style="list-style-type: none"> <li>• summarises the conclusions of the study.</li> </ul>
References	<ul style="list-style-type: none"> <li>• lists all references cited in the text.</li> </ul>

Sample abstract from a mini-review in a Science journal.

- Underline the verbs and note the tenses used.
- Note the organizational flow. Identify key idea, additional information to clarify, situation [today], focus of the writing and the key areas that will be covered.
- Note limited use of 'we' and the use of passive voice.
- Note \*descriptive phrases defining the nouns\* & especially note their concise nature.

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## Self-healing at the nanoscale



Vincenzo Amendola and Moreno Meneghetti

The design of \*self-healing materials\* is a very important but challenging topic in nanotechnology. Self-healing strategies, also inspired by natural processes, allow the fabrication of \*auto-repairing systems\*, and in recent years, materials engineering at the nanoscale has allowed further advances in this \*emerging field\*. In this mini review, we recall some interesting self-healing systems found in natural processes and others created by man-made activity with special emphasis on the role played in this field by nanostructures. Finally, the self-healing of gold nanoparticles during laser irradiation is considered in more detail since it is a rare example of a functional nanomaterial with self-repairing properties.

### WRITING ORGANISATION

You may find it especially interesting to note the guidelines for 1.1.6 & 7

[www.rsc.org](http://www.rsc.org) Royal Soc. Of Chemistry Publication Guidelines

#### 1.0 Organization of material

The suggestions outlined here are for guidance only.

#### 1.1 Full articles

**1.1.1 Title.** A paper should have a short, straightforward title directed at the general reader. The use of non-standard abbreviations and symbols in a title is not encouraged. Brevity in a title, though desirable, should be balanced against its accuracy and usefulness.

**1.1.2 Author names.** Full names for all the authors of an article should be given; initials should not be used.

**1.1.3 Graphical contents entry.** Graphics are included in the contents list. In view of the space available graphics should be as clear as possible. Simple schematic diagrams or reaction schemes are preferred to ORTEP-style crystal structure depictions and complicated graphs, for example. Authors should bear in mind

the final size of any lettering on the graphic. For examples of graphical contents entries check the online version of the appropriate journal.

**1.1.4 Summary.** Every paper must be accompanied by a summary (50-250 words) setting out briefly and clearly the main objects and results of the work; it should give the reader a clear idea of what has been achieved. The summary should be essentially independent of the main text; however, names, partial names or linear formulae of compounds may be accompanied by the numbers referring to the corresponding displayed formulae in the body of the text.

**1.1.5 Introduction.** This should give clearly and briefly, with relevant references, both the nature of the problem under investigation and its background.

**1.1.6 Results and discussion.** It is usual for the results to be presented first, followed by a discussion of their significance. Only strictly relevant results should be presented and figures, tables, and equations should be used for purposes of clarity and brevity. The use of flow diagrams and reaction schemes is encouraged. Data must not be reproduced in more than one form, e.g. in both figures and tables, without good reason.

**1.1.7 Experimental.** Descriptions of experiments should be given in detail sufficient to enable experienced experimental workers to repeat them; the degree of purity of materials should be given, as should the relative quantities used. Descriptions of established procedures are unnecessary. Standard techniques and methods used throughout the work should be stated at the beginning of the section. Apparatus should be described only if it is non-standard; commercially available instruments are referred to by their stock numbers (e.g. Perkin-Elmer 457 or Varian HA-100 spectrometers). The accuracy of primary measurements should be stated. Unexpected hazards encountered during the experimental work should be noted. In general there is no need to report unsuccessful experiments.

**1.1.8 Conclusion.** This is for interpretation and to highlight the novelty and significance of the work. The conclusions should *not* summarise information already present in the text or abstract.

**1.1.9 Acknowledgements.** Contributors other than co-authors may be acknowledged in a separate paragraph at the end of the paper; acknowledgements should be as brief as possible.

**1.1.11 Bibliography, references and notes.** These should be listed at the end of the manuscript in numerical order.

*The style and organization of your academic writing should follow guidelines from your faculty; it is useful to become familiar with the guidelines used by the major journals as this can **make your reading more efficient** and helps you to recognize the reasons behind format limitations. Journal article guidelines tend to be very similar to those required by the teaching staff of post graduate students.*